MEMO

State of Idaho
Department of Water Resources
322 E Front Street, P.O. Box 83720, Boise, Idaho 83720-0098
Phone: (208) 287-4800 Fax: (208) 287-6700

Date: February 25, 2015

To: Tim Luke, Water Compliance Bureau Chief

From: Jennifer Sukow, P.E., P.G., Hydrology Section

Subject: Post audit of 2014 aquifer enhancement activities

This memorandum describes model simulations of aquifer enhancement activities performed by the Idaho Ground Water Appropriators, Inc. (IGWA), Southwest Irrigation District (SWID), and A & B Irrigation District (ABID). The purpose of the model simulations was to evaluate the impacts of aquifer enhancement activities on discharge from Curren Tunnel and flow in the Snake River between Kimberly and King Hill. The Enhanced Snake Plain Aquifer Model Version 2.1 (ESPAM2.1) was used to simulate aquifer enhancement projects and predict impacts to aquifer discharge.

Methods used to simulate the impacts of aquifer enhancement activities are described in this memorandum. Detailed results are presented in Attachment A. Tables 1 and 2 summarize results relevant to mitigation plans for the Rangen water delivery call and the Magic Springs water right transfer. Table 1 summarizes the predicted steady state impact by organization. Table 2 summarizes the total predicted impact of aquifer enhancement activities performed by IGWA and SWID[1].

[1] SWID is a participant in IGWA's mitigation plan for the Rangen delivery call. ABID has a separate mitigation plan for the Rangen delivery call.

Entity	Volume of 2014 aquifer enhancement projects	Predicted increase in Curren Tunnel discharge	Predicted contribution to flow in the Snake River between Kimberly and King Hill
IGWA	42,334 AF	0.9 cfs	> 9.4 cfs
SWID	51,609 AF	0.9 cfs	> 10.2 cfs
ABID	3,956 AF	0.07 cfs	not applicable[2]
Total	97,899 AF	1.9 cfs	> 19.6 cfs

Table 1. Predicted steady state impacts by organization.

Time period	Predicted increase in Curren Tunnel discharge	Predicted contribution to flow in the Snake River between Kimberly and King Hill
4/2014 – 3/2015[3]	1.2 cfs	> 13.8 cfs
4/2015 – 3/2016[3]	1.1 cfs	> 12.6 cfs
Steady state[4]	1.8 cfs	> 19.6 cfs

Table 2. Summary of predicted impacts of IGWA and SWID aquifer enhancement project on aquifer discharge at selected locations.

ESPAM2.1 simulations

The impact of aquifer enhancement activities on discharge in the Rangen model cell and other model cells tributary to the Snake River between Kimberly and King Hill was simulated using ESPAM2.1. Impacts to discharge from Curren Tunnel are calculated as 63% of the predicted impact to the Rangen model cell. Impacts to flow in the Snake River between Kimberly and King Hill are predicted to exceed the sum of the impacts to baseflow[5] and impacts to spring discharge in Devil's Washbowl model cell, Devil's Corral model cell, and Box Canyon reach[6].

Aquifer enhancement activities were simulated using both steady state and transient analyses. The steady state analyses simulate the long term effect aquifer enhancement projects performed

[2] ABID is not a participant in IGWA's mitigation plan and was not an applicant on the water right transfer for the Magic Springs pipeline.
[3] Predicted impact of documented past aquifer enhancement projects from 2005 through 2014, assuming no projects performed in 2015.
[4] Predicted impact of 2014 aquifer enhancement activities at steady state, assuming 2014 activities continue into future years.
[5] Baseflow is subsurface discharge to the Snake River and is unavailable to surface water users. The baseflow between Kimberly and King Hill is represented in ESPAM2.1 using general head boundaries.
[6] The Devil's Washbowl, Devil's Corral, and Box Canyon reaches do not contain springs diverted for irrigation use. Spring discharge is represented in ESPAM2.1 using drains.

in 2014 would have on spring discharge if the projects are continued at the same locations and rates in future years. The transient analyses simulated the effect of documented and approved aquifer enhancement activities that occurred between 2005 and 2014. For each year, the volume of aquifer enhancement activities was input into ESPAM2.1 at a constant rate distributed over a one-year stress period beginning on April 1. Model inputs for 2005 through 2013 were obtained from previous analyses of aquifer enhancement projects located within the Great Rift trim line[7]. The transient analyses do not consider potential impacts of aquifer enhancement activities that may occur in 2015 or future years, or impacts of aquifer enhancement projects located east of the Great Rift. To my knowledge, the groundwater users' only ongoing aquifer enhancement projects east of the Great Rift are Conservation Reserve Enhancement Program (CREP) projects. A steady state analysis of the CREP projects east of the Great Rift is discussed in this memorandum.

Simulation of Conservation Reserve Enhancement Program

The CREP reduces withdrawals from the Eastern Snake Plain Aquifer (ESPA) by removing groundwater irrigated land from production. The volume of benefit to the aquifer was calculated using ESPAM2.1 data for the average annual crop irrigation requirement from November 1998 through October 2008 (Figure 1). If a parcel is irrigated to establish a cover crop, 1/3 foot per acre is deducted from the average annual crop irrigation requirement during the year irrigated. For 2014, IGWA CREP lands were obtained from the shapefile crep.shp, dated January 30, 2015, and reviewed by Sandra Thiel, Idaho Department of Water Resources (IDWR). CREP data are submitted to IDWR by Chuck Penzer, Idaho Soil and Water Conversion Commission. Mr. Penzer stated no fields were watered to establish cover crops in 2014 to his knowledge.

For 2014, a shapefile of IGWA CREP lands was created by removing from crep.shp lands outside of the area of common groundwater supply, lands within SWID or Goose Creek Irrigation District (GCID), and lands enrolled by ABID as identified in Exhibit C to *A&B Irrigation District's Rule 43 Mitigation Plan* dated March 7, 2014. In 2014, there were 13,830 acres of IGWA CREP located within the area of common groundwater supply and 4,819 acres of IGWA CREP located within the Great Rift trim line (Figure 2). The simulated reduction of consumptive use was 32,106 AF/year within the area of common groundwater supply and 11,853 AF/yr within the Great Rift trim line.

[7] http://idwr.idaho.gov/browse/legal/rangen/Data_Accmp_4_11_14_Order/

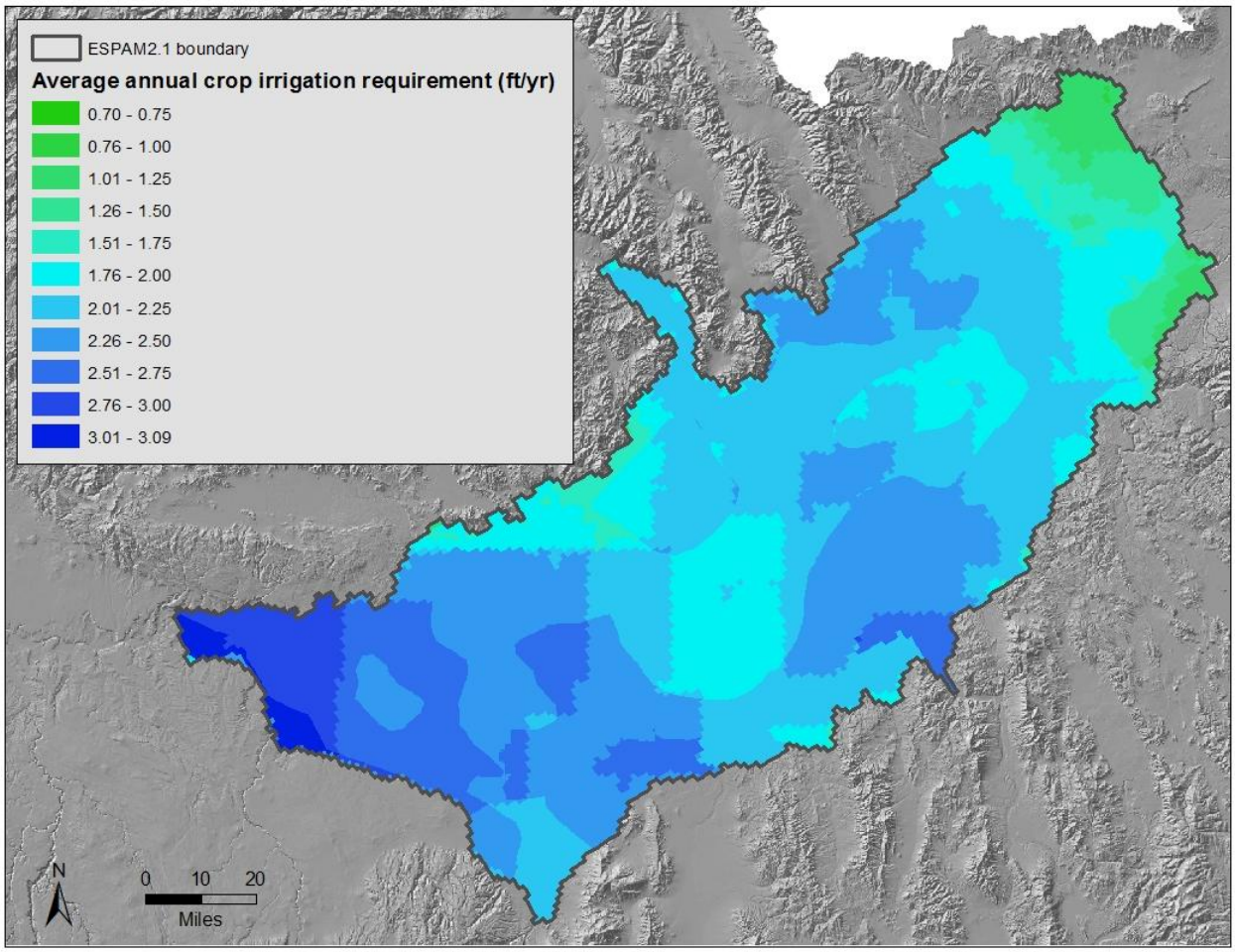


Figure 1. Average annual crop irrigation requirement from November 1998 through October 2008.

In 2014, there were 720 acres of CREP lands located within both the the area of common groundwater supply and SWID or GCID (Figure 2). All of the SWID/GCID CREP lands were located within the Great Rift trim line. The simulated reduction in consumptive use was 1,588 AF/year.

In 2014, there were 98 acres of CREP lands enrolled by ABID (Figure 2) as identified in Exhibit C to *A&B Irrigation District's Rule 43 Mitigation Plan* dated March 7, 2014. The simulated reduction in consumptive use was 242 AF/year.

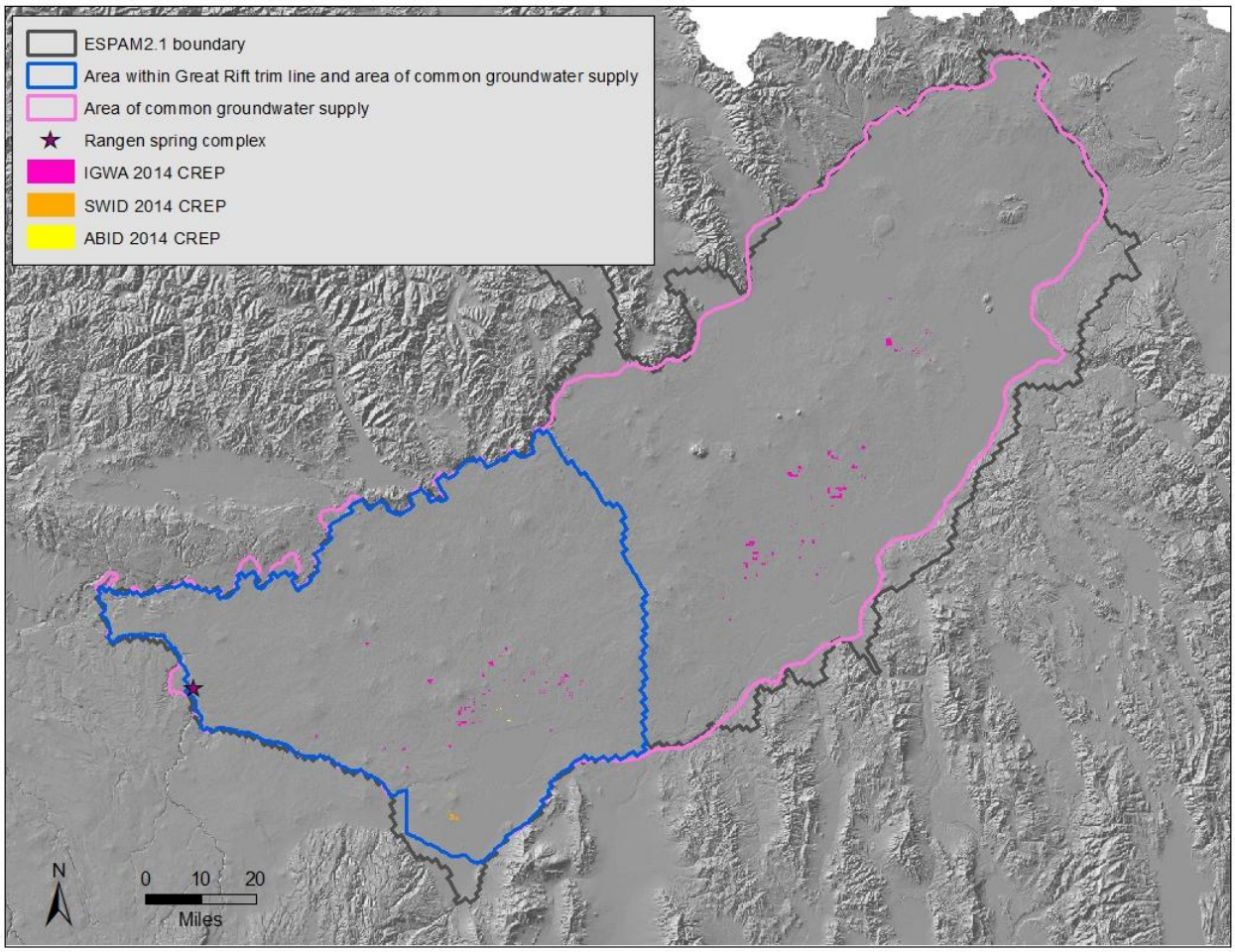


Figure 2. CREP lands in 2014.

Simulation of conversion projects

Conversion projects deliver surface water for irrigation of lands historically irrigated by groundwater. The volume of benefit to the aquifer includes the volume of water delivered to conversion project sites and canal seepage associated with conveyance of the water delivered to conversion project sites.

The volume of water delivered to IGWA conversion sites is compiled and reviewed by Cindy Yenter, Watermaster, Water District 130. Delivery volumes are reported to the Watermaster by canal companies. The volume of water delivered is simulated at the location of the conversion project, unless excess water is delivered (Figure 3). If excess water is delivered, the volume of excess water is distributed evenly across model cells with centroids intersected by irrigated lands within the canal company service area (Figure 4). Canal seepage ratios assessed by North Side Canal Company (NSCC) and American Falls Reservoir District No. 2 (AFRD2) were used to

calculate the total volume of canal seepage associated with conversion projects in each canal system. The volume of canal seepage in each system was distributed evenly across model cells intersected by the delivery system (Figure 3). In 2014, 25,698 AF of surface water was delivered to IGWA conversion projects, including 494 AF of excess delivery to a site within the NSCC system. Canal seepage associated with conveyance of the additional surface water was calculated to be 4,230 AF (3,327 AF in NSCC canals and 903 AF in AFRD2 canals).

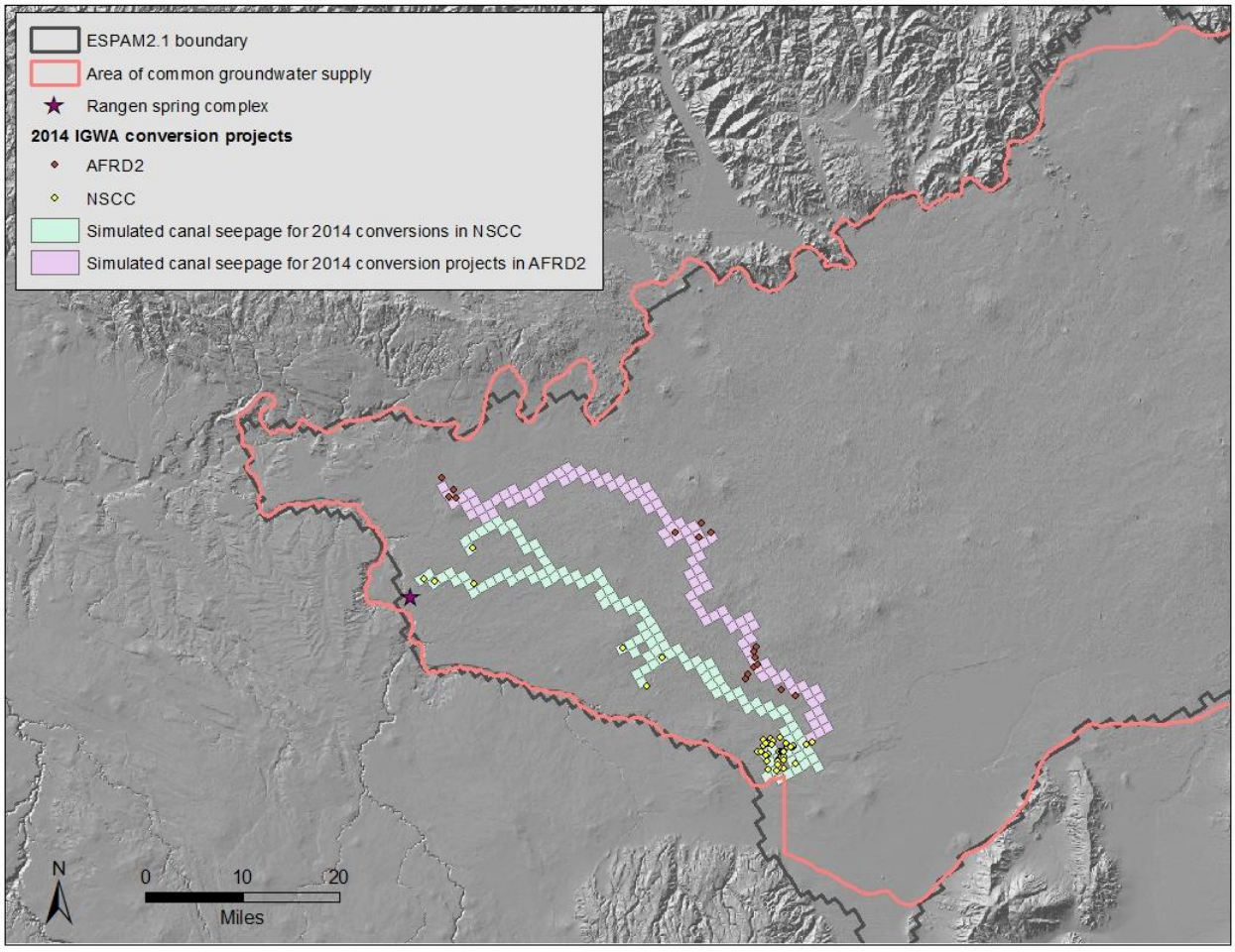


Figure 3. Locations of 2014 IGWA conversion projects and modeled distribution of canal seepage.

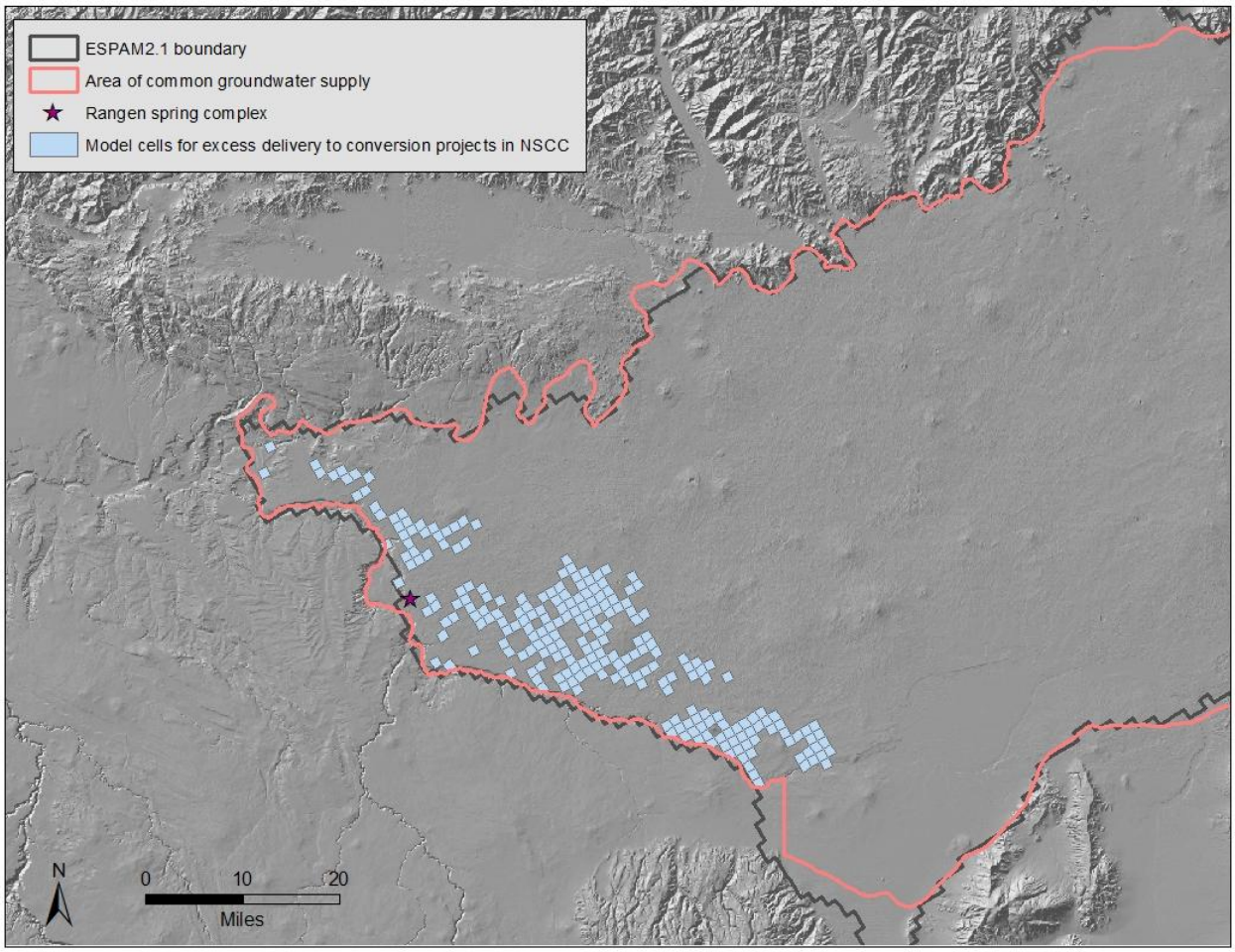


Figure 4. Modeled distribution of excess water delivered to IGWA conversion projects within NSCC.

IGWA conversion projects also include voluntary idle projects. Water users participating in these projects irrigated with both surface water and groundwater prior to participating in the conversion project. The water users agree not to divert groundwater and irrigate using only surface water, but do not purchase additional surface water. The volume of mitigation provided to the aquifer is calculated as 30% of the annual diversion volume authorized by groundwater rights. The Watermaster only approves mitigation credit if the wells are idled the entire year. The location of voluntary idle projects completed in 2014 is shown in Figure 5. Because additional surface water is not delivered to voluntary idle projects, canal seepage is not included in the analysis. In 2014, the volume of benefit to the aquifer from IGWA voluntary idle projects was 552 AF.

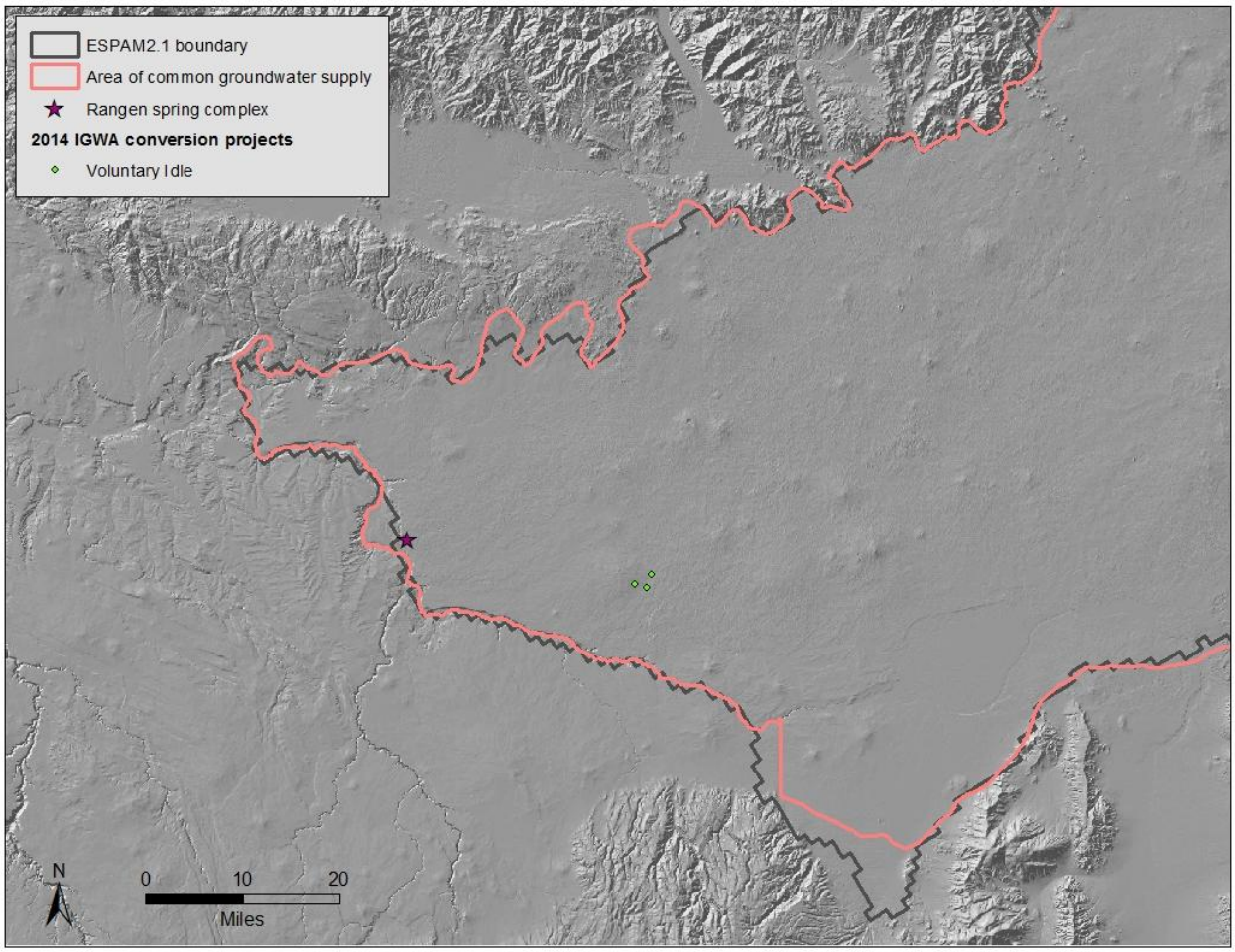


Figure 5. IGWA voluntary idle projects completed in 2014.

The volume of surface water delivered to SWID conversion projects was compiled by Brian Higgs, Watermaster, Water District 140 and reviewed by Tim Luke, IDWR. The volume of water delivered is simulated at the location of the conversion project (Figure 6). For SWID conversion projects delivered via the J Canal, canal seepage was calculated at a rate of 38% of diversions. For SWID conversions delivered via the West Cassia Pipeline, conveyance loss is assumed to be negligible. The volume of canal seepage was distributed evenly across model cells intersected by the delivery system (Figure 6). In 2014, 10,793 AF of water was delivered to West Cassia Pipeline conversion projects and 21,594 AF of water was delivered to J Canal conversion projects. Canal seepage in the J Canal was calculated to be 13,235 AF.

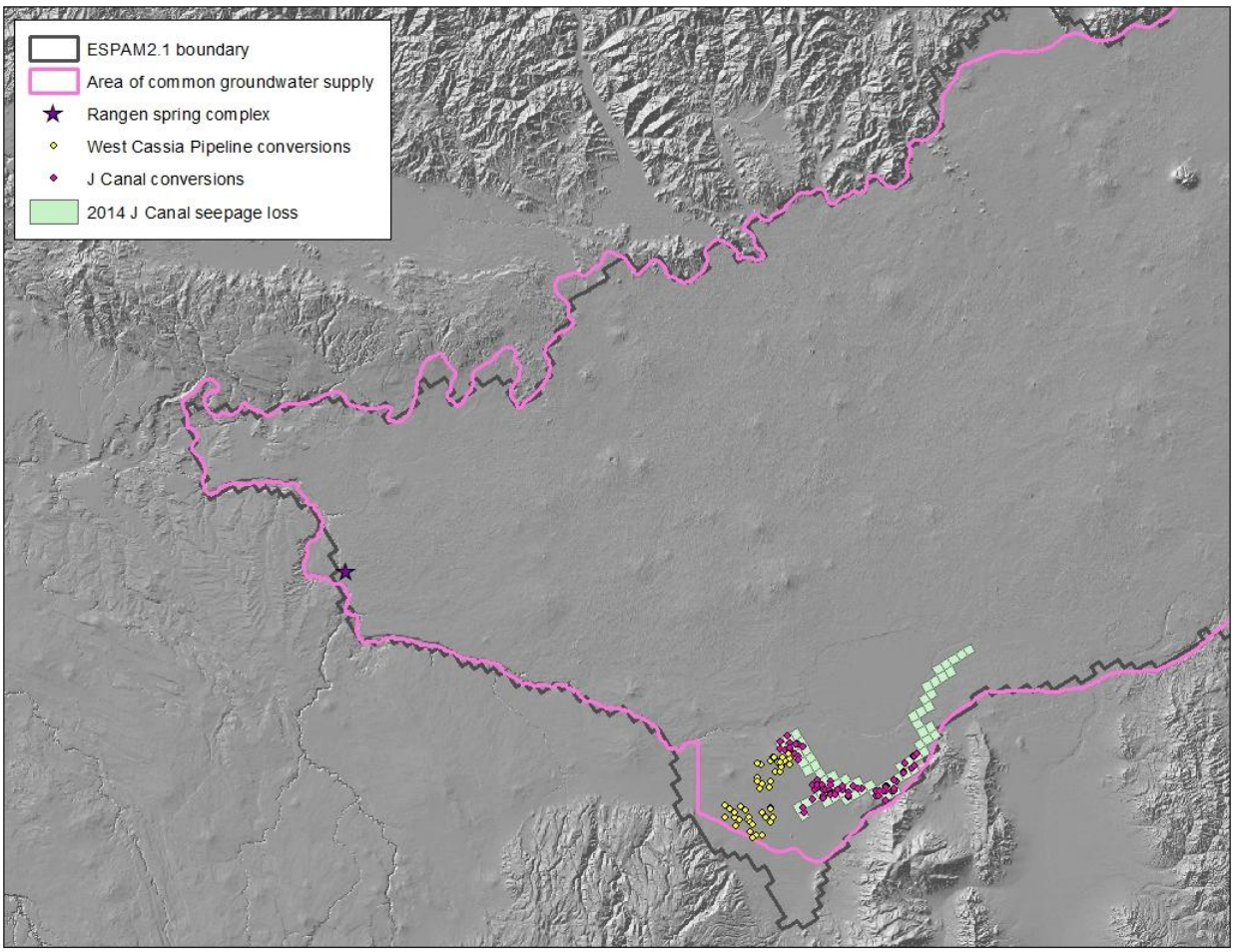


Figure 6. SWID conversion projects in 2014.

The volume of water delivered to ABID conversion projects was compiled by ABID and reviewed by Cindy Yenter, Watermaster, Water District 130. The volume of water delivered is simulated at the location of the conversion project (Figure 7). For ABID conversion projects, canal seepage was calculated at a rate of 15% of diversions. The volume of canal seepage was distributed evenly across model cells intersected by the delivery system (Figure 7). In 2014, 3,157 AF of water was delivered to ABID conversion projects. Canal seepage was calculated to be 557 AF.

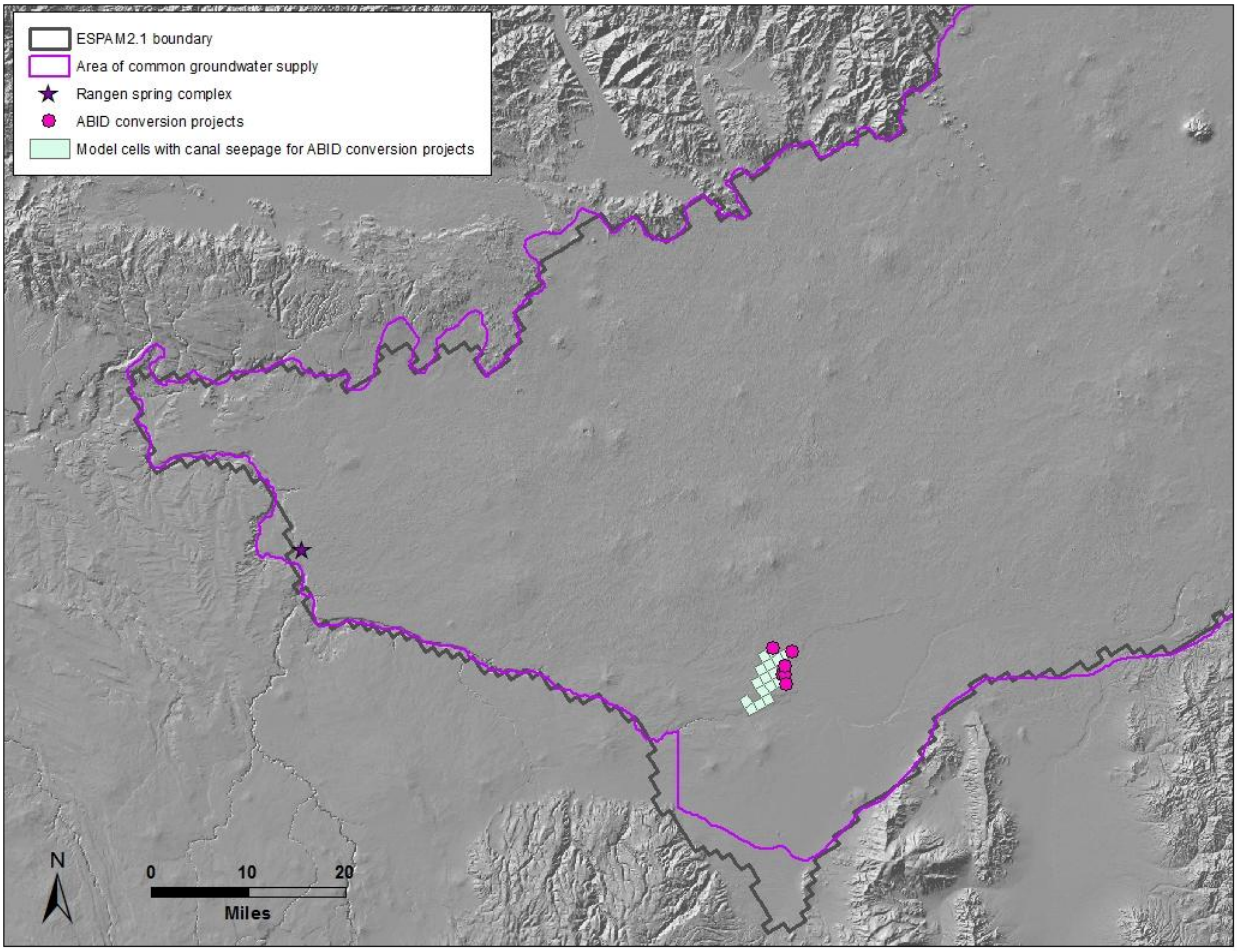


Figure 7. ABID conversion projects in 2014.

Simulation of voluntary curtailment

Voluntary curtailment projects reduce withdrawals from the ESPA by removing groundwater irrigated land from production. SWID is the only entity with voluntary curtailment projects. The locations of SWID voluntary curtailment projects were compiled by Brian Higgs, Watermaster, Water District 140 and reviewed by Tim Luke, IDWR (Figure 8). The volume of benefit to the aquifer was calculated using ESPAM2.1 data for the average annual crop irrigation requirement from November 1998 through October 2008 (Figure 1). If a parcel was historically irrigated by groundwater supplemental to surface water, the area and volume of benefit are multiplied by 0.88[8]. In 2014, SWID voluntary curtailment projects included 1,811 acres. After adjusting for projects with supplemental groundwater, the volume of benefit was calculated for 1,749 acres. The simulated reduction in consumptive use was 3,946 AF.

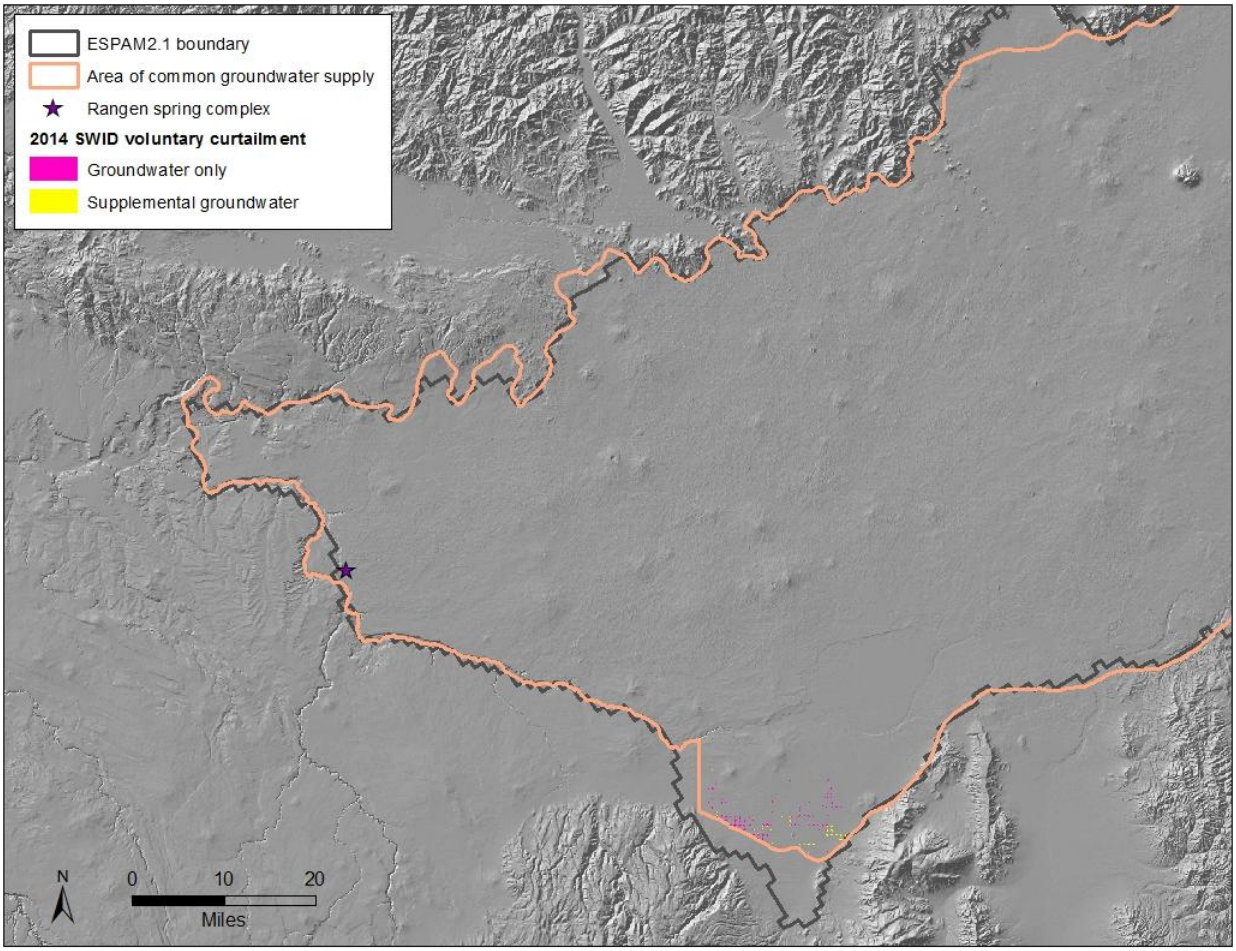


Figure 8. SWID voluntary curtailment projects in 2014.

[8] The average groundwater source fraction for SWID/GCID in ESPAM2.1 is 0.88.

Simulation of managed recharge

Managed recharge not sponsored by the Idaho Water Resource Board (IWRB) is included in IGWA and SWID mitigation plans. To my knowledge, IGWA did not perform non-IWRB sponsored recharge in 2014. Brian Higgs, Watermaster, Water District 140, submitted information to Tim Luke, IDWR regarding non-IWRB recharge performed by SWID. In 2014, SWID recharged 453 AF in two injection wells (Figure 9) located within the area of common groundwater supply. Recharge was simulated at the locations of the injection wells.

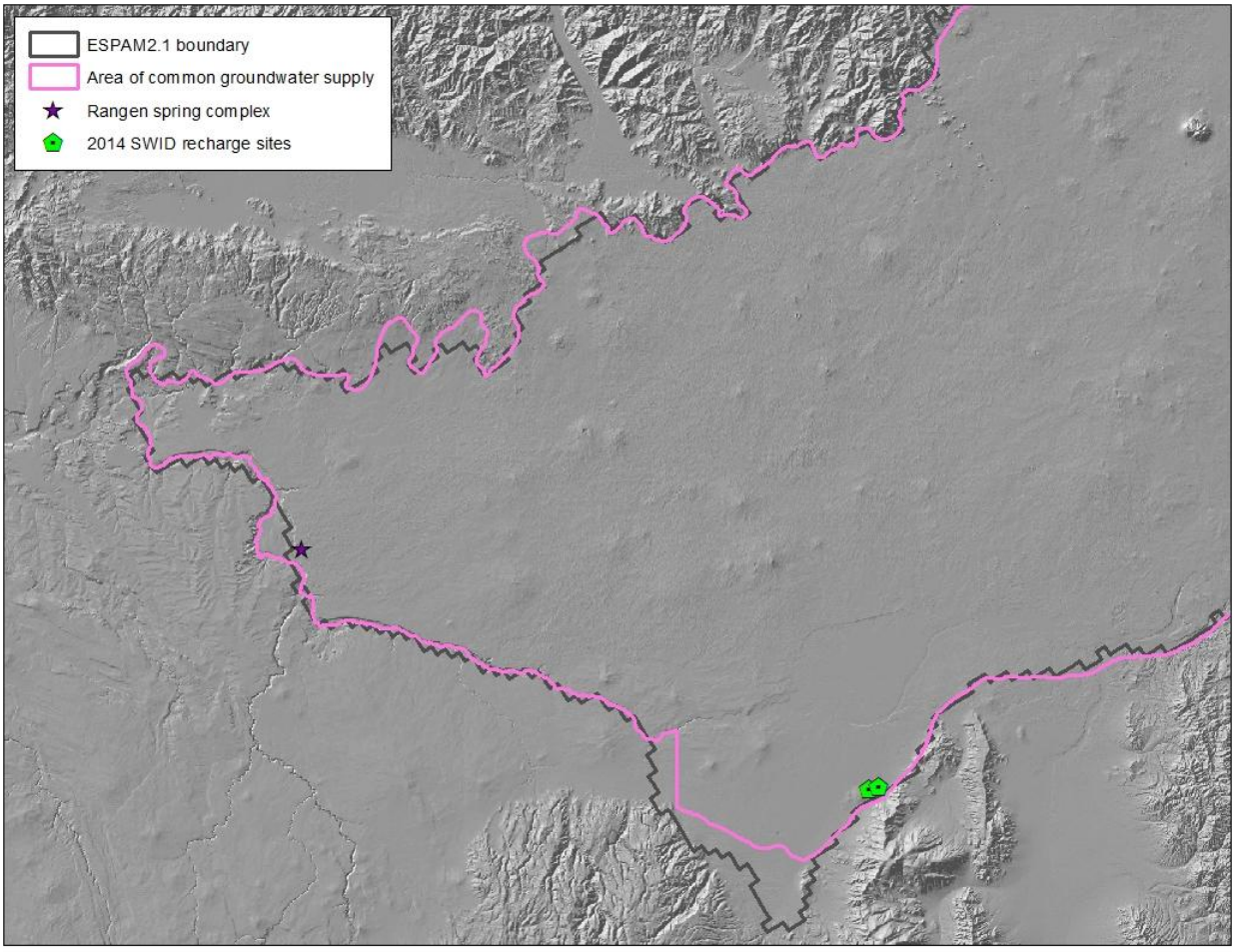


Figure 9. SWID injection wells with non-IWRB managed recharge in 2014.

Modeling results

ESPAM2.1 simulation results are provided in Attachment A. Model files are available in the zip folder, 2014AqEnhPostAudit.zip.

ATTACHMENT A.
ESPAM2.1 SIMULATION RESULTS

A-1. Predicted impact of 2005 through 2014 aquifer enchancement projects on discharge from Curren Tunnel.

Mitigation project	Volume (AF/yr) [8]											Predicted average benefit to Curren Tunnel (cfs) [10]					
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Future years [9]	Year 1 (4/2014-3/2015)	Year 2 (4/2015-3/2016)	Year 3 (4/2016-3/2017)	Year 4 (4/2017-3/2018)	Year 5 (4/2018-3/2019)	Impact of 2014 projects at steady state
IGWA Conversions [1]	29,161	35,250	36,915	35,967	13,562	17,210	23,307	30,144	24,335	30,480	0	0.54	0.38	0.22	0.15	0.11	0.74
SWID Conversions [2]	0	0	0	0	0	47,138	47,189	58,909	47,350	45,622	0	0.44	0.50	0.47	0.39	0.32	0.77
ABID Conversions [3]	4,553	4,553	4,553	4,553	3,884	3,240	3,271	4,772	3,930	3,715	0	0.06	0.06	0.05	0.04	0.03	0.06
SWID Voluntary Curtailment [4]	0	0	0	0	0	4,211	4,015	4,015	3,946	3,946	0	0.04	0.04	0.04	0.03	0.03	0.07
IGWA CREP [5]	0	0	11,624	16,443	19,787	14,258	14,258	12,266	12,376	11,853	0	0.17	0.15	0.12	0.09	0.07	0.18
SWID CREP [5]	0	0	0	0	0	1,588	1,588	1,588	1,588	1,588	0	0.01	0.02	0.02	0.01	0.01	0.03
ABID CREP [5]	0	0	0	0	0	0	0	0	0	242	0	0.0002	0.0007	0.0006	0.0004	0.0003	0.003
IGWA Recharge [6]	0	0	27,360	0	13,687	0	0	0	0	0	0	0.02	0.02	0.01	0.01	0.01	0
SWID Recharge [7]	0	0	0	0	0	0	0	1,195	1,169	453	0	0.005	0.007	0.006	0.005	0.004	0.008
IGWA	29,161	35,250	75,899	52,410	47,036	31,468	37,565	42,410	36,711	42,334	0	0.73	0.55	0.35	0.25	0.19	0.92
SWID/GCID	0	0	0	0	0	52,936	52,792	65,706	54,053	51,609	0	0.49	0.56	0.53	0.44	0.36	0.87
ABID	4,553	4,553	4,553	4,553	3,884	3,240	3,271	4,772	3,930	3,956	0	0.06	0.06	0.05	0.04	0.03	0.07
Total	33,714	39,803	80,452	56,963	50,920	87,644	93,628	112,888	94,694	97,899	0	**1.28**	**1.17**	**0.93**	**0.74**	**0.58**	**1.86**

Notes:

1. IGWA conversion volume includes water delivered to conversion projects, excess water delivered to conversion projects, canal seepage within NSCC and AFRD2 delivery systems, and voluntary idle projects. For 2005-2014, canal seepage was assumed to be 30% of diversions for NSCC and 42% of diversions for AFRD2. Beginning in 2014, canal loss ratios reported to the watermaster by the canal companies were used to calculate canal seepage within the NSCC and AFRD2 delivery systems.
2. SWID conversion volume includes water delivered to conversion projects and canal seepage of 38% within the J Canal delivery system.
3. ABID conversion volume includes water delivered to conversion projects and canal seepage of 15% within the delivery system.
4. SWID voluntary curtailments on mixed source lands where groundwater irrigation is supplemental to surface water irrigation were assigned a groundwater fraction of 0.88 for calculation of idled acres and volume of benefit to the aquifer.
5. 2007-2009 IGWA CREP may include land located within SWID/GCID. Beginning in 2010, CREP land located within SWID/GCID is simulated separately. 2007-2013 IGWA CREP may include lands enrolled by ABID. Beginning in 2014, CREP lands enrolled by A&B Irrigation Distict are simulated separately. IGWA CREP lands outside of the Great Rift trim line were excluded from this analysis. The predicted impact of 2014 IGWA CREP east of the Great Rift on discharge at Curren Tunnel is 0.04 cfs at steady state.
6. IGWA recharge does not include recharge sponsored by IWRB or recharge outside of the Great Rift trim line.
7. SWID recharge is not intended to include recharge sponsored by IWRB. Unable to verify whether or not SWID recharge claimed for 2012 and 2013 was sponsored by IWRB.
8. Mitigation volumes were modeled at an average constant rate distributed over a one-year period beginning April 1.
9. Predicted average benefit does not consider potential benefits of aquifer enhancement activities that may occur in future years.
10. Predicted benefits to the Rangen spring model cell were calculated using transient and steady state, superposition versions of ESPAM2.1. Predicted benefits to Curren tunnel were calculated as 63% of the benefits to the Rangen spring model cell using a linear regression model adopted by the Director in the Rangen proceeding.

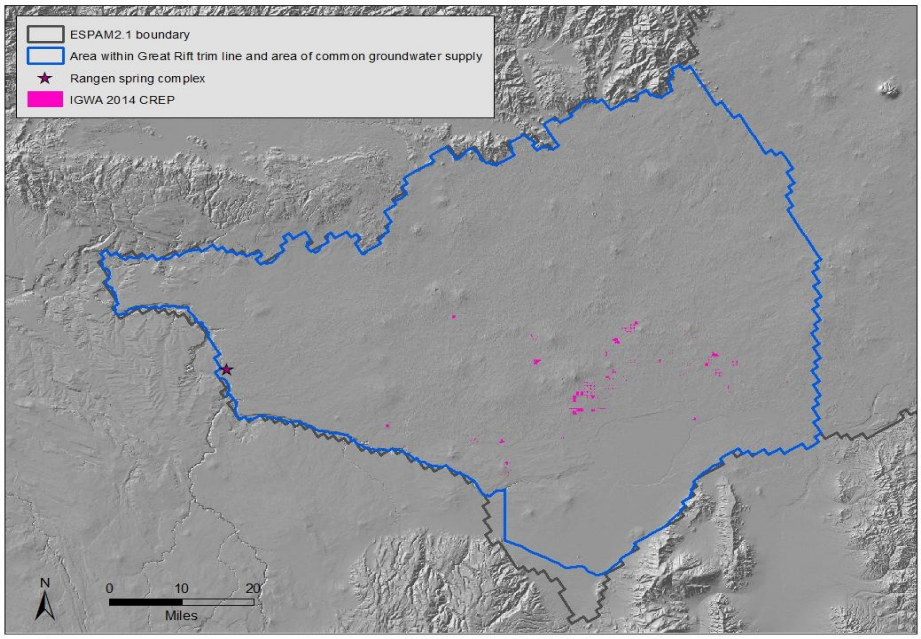
A-2. Predicted impact of 2005 through 2014 aquifer enhancement projects on baseflow and spring discharge tributary to the Snake River between Kimberly and King Hill.

Mitigation project	Volume (AF/yr) [8]											Predicted average benefit to baseflow & spring cells with no irrigation use (cfs) [10]						Predicted average benefit to Kimberly to King Hill reach [11]					
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Future years [9]	Year 1 (4/2014-3/2015)	Year 2 (4/2015-3/2016)	Year 3 (4/2016-3/2017)	Year 4 (4/2017-3/2018)	Year 5 (4/2018-3/2019)	Impact of 2014 projects at steady state	Year 1 (4/2014-3/2015)	Year 2 (4/2015-3/2016)	Year 3 (4/2016-3/2017)	Year 4 (4/2017-3/2018)	Year 5 (4/2018-3/2019)	Impact of 2014 projects at steady state
IGWA Conversions [1]	29,161	35,250	36,915	35,967	13,562	17,210	23,307	30,144	24,335	30,480	0	5.39	3.92	2.18	1.54	1.16	7.59	19.98	14.87	8.42	5.92	4.46	28.21
SWID Conversions [2]	0	0	0	0	0	47,138	47,189	58,909	47,350	45,622	0	5.67	6.10	5.34	4.28	3.35	8.96	19.20	21.27	19.41	15.91	12.62	32.08
SWID Voluntary Curtailment [4]	0	0	0	0	0	4,211	4,015	4,015	3,946	3,946	0	0.48	0.52	0.45	0.36	0.28	0.80	1.62	1.79	1.62	1.32	1.04	2.86
IGWA CREP [5]	0	0	11,624	16,443	19,787	14,258	14,258	12,266	12,376	11,853	0	1.71	1.54	1.15	0.87	0.67	1.84	6.66	6.02	4.50	3.39	2.63	7.14
SWID CREP [5]	0	0	0	0	0	1,588	1,588	1,588	1,588	1,588	0	0.19	0.21	0.18	0.14	0.11	0.33	0.65	0.72	0.64	0.52	0.41	1.16
IGWA Recharge [6]	0	0	27,360	0	13,687	0	0	0	0	0	0	0.24	0.19	0.15	0.12	0.09	0	0.94	0.73	0.57	0.45	0.36	0
SWID Recharge [7]	0	0	0	0	0	0	0	1,195	1,169	453	0	0.08	0.08	0.07	0.06	0.04	0.09	0.26	0.29	0.26	0.21	0.17	0.32
IGWA	29,161	35,250	75,899	52,410	47,036	31,468	37,565	42,410	36,711	42,334	0	7.35	5.65	3.48	2.52	1.92	9.43	27.59	21.62	13.49	9.76	7.46	35.35
SWID/GCID	0	0	0	0	0	52,936	52,792	65,706	54,053	51,609	0	6.43	6.91	6.04	4.84	3.78	10.18	21.73	24.08	21.93	17.96	14.24	36.42
Total	29,161	35,250	75,899	52,410	47,036	84,405	90,357	108,116	90,764	93,943	0	**13.78**	**12.56**	**9.52**	**7.36**	**5.71**	**19.61**	**49.32**	**45.70**	**35.42**	**27.72**	**21.70**	**71.77**

Notes:

1. IGWA conversion volume includes water delivered to conversion projects, excess water delivered to conversion projects, canal seepage within NSCC and AFRD2 delivery systems, and voluntary idle projects. For 2005-2014, canal seepage was assumed to be 30% of diversions for NSCC and 42% of diversions for AFRD2. Beginning in 2014, canal loss ratios reported to the watermaster by the canal companies were used to calculate canal seepage within the NSCC and AFRD2 delivery systems.
2. SWID conversion volume includes water delivered to conversion projects and canal seepage of 38% within the J Canal delivery system.
3. ABID conversion volume includes water delivered to conversion projects and canal seepage of 15% within the delivery system.
4. SWID voluntary curtailments on mixed source lands where groundwater irrigation is supplemental to surface water irrigation were assigned a groundwater fraction of 0.88 for calculation of idled acres and volume of benefit to the aquifer.
5. 2007-2009 IGWA CREP may include land located within SWID/GCID. Beginning in 2010, CREP land located within SWID/GCID is simulated separately. 2007-2013 IGWA CREP may include lands enrolled by ABID. Beginning in 2014, CREP lands enrolled by A&B Irrigation Distict are simulated separately. IGWA CREP lands outside of the Great Rift trim line were excluded from this analysis.
6. IGWA recharge does not include recharge sponsored by IWRB or recharge outside of the Great Rift trim line.
7. SWID recharge is not intended to include recharge sponsored by IWRB. Unable to verify whether or not SWID recharge claimed for 2012 and 2013 was sponsored by IWRB. It may not be appropriate to provide mitigation credit for recharge modeled in 2012 or 2013.
8. Mitigation volumes were modeled at an average constant rate distributed over a one-year period beginning April 1.
9. Predicted average benefit does not consider potential benefits of aquifer enhancement activities that may occur in future years.
10. Predicted benefit to baseflow between Kimberly and King Hill and spring discharge in the Devil's Washbowl cell, Devil's Corral cell, and Box Canyon reach.
11. Predicted benefit to baseflow and springs tributary to the Snake River between Kimberly and King Hill. Some of the predicted increases in spring discharge may be diverted for consumptive use, therefore the increase in flow in the Snake River between Kimberly and King Hill is expected to be less than the increase in aquifer discharge.

A-3. Simulated steady state impact of 2014 CREP for lands enrolled by IGWA



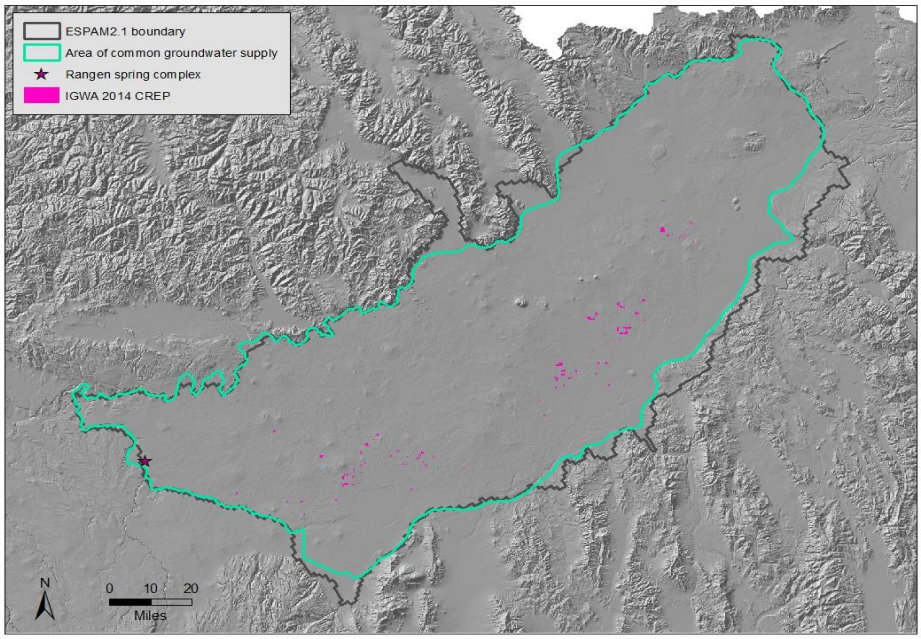
Simulated volume:

4,819	acres
11,853	AF/yr
16.36	cfs
2.46	AF/ac

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.22	159
Heise to Shelley	0.64	466
Shelley to Near Blackfoot	1.92	1,395
Near Blackfoot to Minidoka	6.44	4,665
Kimberly to Buhl	2.44	1,765
Buhl to Lower Salmon Falls	4.03	2,922
Lower Salmon Falls to King Hill	0.67	483
Total	16.36	11,853
Group A&B Spring Reaches		
Devil's Washbowl	0.13	95
Devil's Corral	0.17	125
Blue Lakes	0.51	366
Crystal	0.82	596
Niagara	0.55	402
Clear Lake	0.72	518
Briggs	0.02	14
Box Canyon	1.18	853
Sand	0.31	227
Thousand	0.81	589
National Fish Hatchery	0.18	132
Rangen	0.29	206
Three	0.21	150
Malad	0.58	422
Curren Tunnel	0.18	130
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.13	
Devil's Corral	0.17	
Box Canyon	1.18	
Baseflow , Kimberly to King Hill	0.36	
Total	1.84	
Kimberly to King Hill total	7.14	

A-4. Simulated steady state impact of 2014 CREP for lands enrolled by IGWA



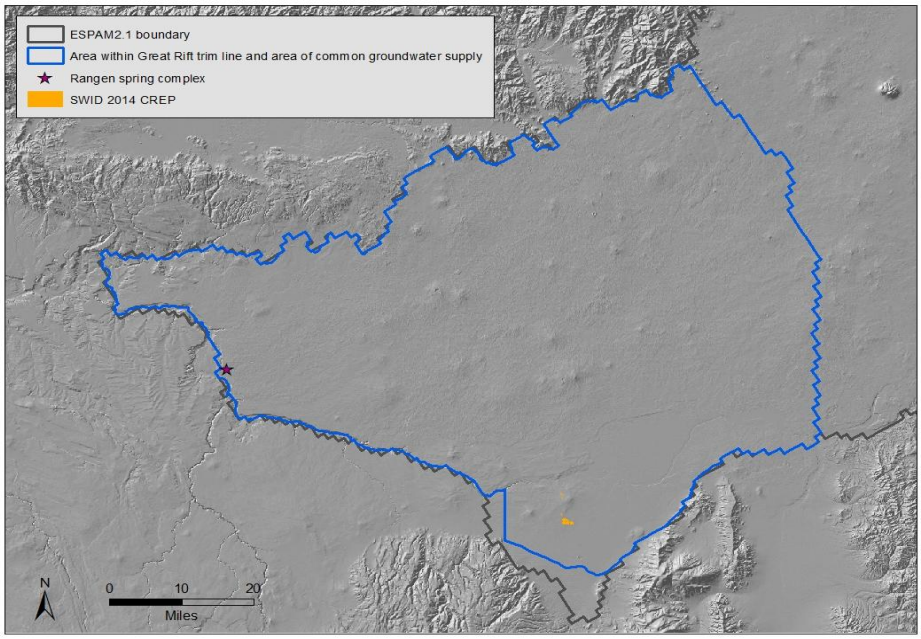
Simulated volume:

13,830	acres
32,106	AF/yr
44.32	cfs
2.32	AF/ac

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	1.09	789
Heise to Shelley	3.00	2,171
Shelley to Near Blackfoot	7.69	5,570
Near Blackfoot to Minidoka	24.04	17,420
Kimberly to Buhl	2.87	2,077
Buhl to Lower Salmon Falls	4.83	3,501
Lower Salmon Falls to King Hill	0.80	579
Total	44.32	32,106
Group A&B Spring Reaches		
Devil's Washbowl	0.15	109
Devil's Corral	0.20	144
Blue Lakes	0.58	420
Crystal	0.98	713
Niagara	0.66	481
Clear Lake	0.86	621
Briggs	0.02	17
Box Canyon	1.41	1,022
Sand	0.38	272
Thousand	0.97	706
National Fish Hatchery	0.22	158
Rangen	0.34	247
Three	0.25	179
Malad	0.70	506
Curren Tunnel	0.22	156
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.15	
Devil's Corral	0.20	
Box Canyon	1.41	
Baseflow , Kimberly to King Hill	0.42	
Total	2.18	
Kimberly to King Hill total	8.50	

A-5. Simulated steady state impact of 2014 CREP for lands enrolled by Southwest Irrigation District



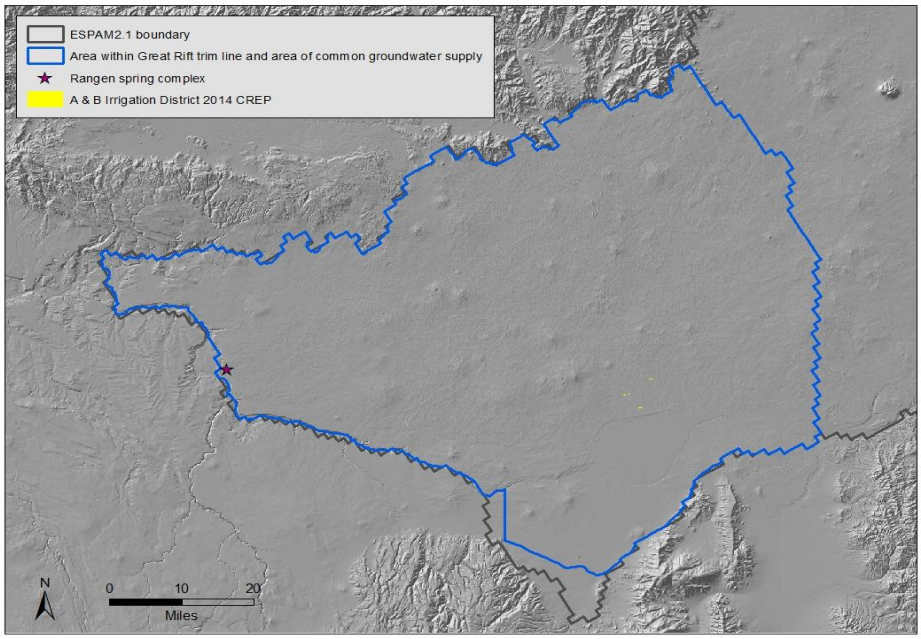
Simulated volume:

720	acres
1,588	AF/yr
2.19	cfs
2.20	AF/ac

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.02	18
Heise to Shelley	0.07	52
Shelley to Near Blackfoot	0.22	156
Near Blackfoot to Minidoka	0.72	524
Kimberly to Buhl	0.44	316
Buhl to Lower Salmon Falls	0.62	449
Lower Salmon Falls to King Hill	0.10	74
Total	2.19	1,588
Group A&B Spring Reaches		
Devil's Washbowl	0.03	24
Devil's Corral	0.04	31
Blue Lakes	0.09	66
Crystal	0.13	93
Niagara	0.09	62
Clear Lake	0.11	80
Briggs	0.00	2
Box Canyon	0.18	131
Sand	0.05	35
Thousand	0.12	90
National Fish Hatchery	0.03	20
Rangen	0.04	32
Three	0.03	23
Malad	0.09	64
Curren Tunnel	0.03	20
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.03	
Devil's Corral	0.04	
Box Canyon	0.18	
Baseflow , Kimberly to King Hill	0.07	
Total	0.33	
Kimberly to King Hill total	1.16	

A-6. Simulated steady state impact of 2014 CREP for lands enrolled by A & B Irrigation District



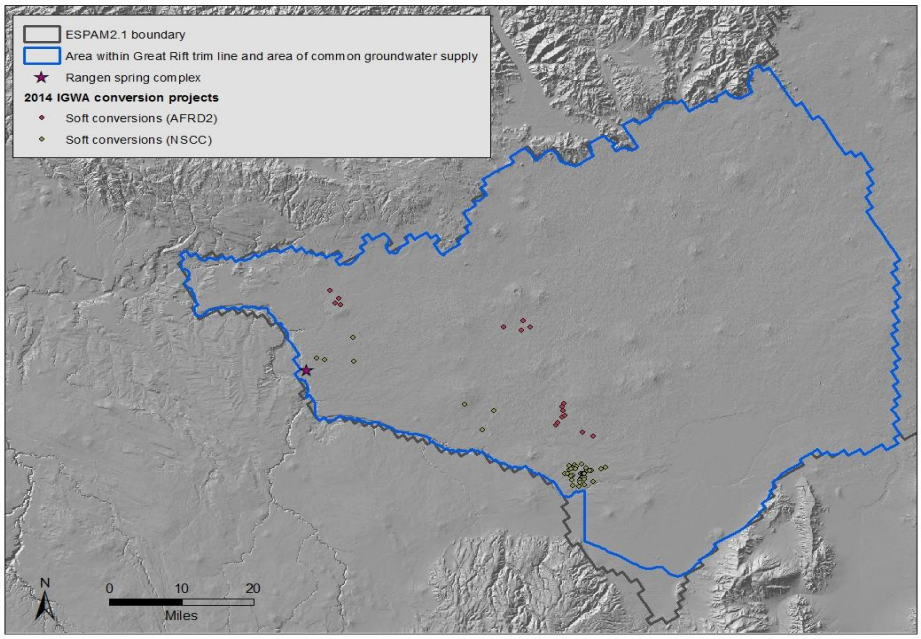
Simulated volume:

98	acres
242	AF/yr
0.333	cfs
2.46	AF/ac

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.005	4
Heise to Shelley	0.014	10
Shelley to Near Blackfoot	0.043	31
Near Blackfoot to Minidoka	0.143	103
Kimberly to Buhl	0.041	30
Buhl to Lower Salmon Falls	0.075	55
Lower Salmon Falls to King Hill	0.013	9
Total	0.333	242
Group A&B Spring Reaches		
Devil's Washbowl	0.002	1
Devil's Corral	0.002	2
Blue Lakes	0.007	5
Crystal	0.015	11
Niagara	0.010	8
Clear Lake	0.013	10
Briggs	0.000	0
Box Canyon	0.022	16
Sand	0.006	4
Thousand	0.015	11
National Fish Hatchery	0.003	2
Rangen	0.005	4
Three	0.004	3
Malad	0.011	8
Curren Tunnel	0.003	2
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.002	
Devil's Corral	0.002	
Box Canyon	0.022	
Baseflow , Kimberly to King Hill	0.006	
Total	0.032	
Kimberly to King Hill total	0.129	

A-7. Simulated steady state impact of water delivered to IGWA soft conversion projects in 2014



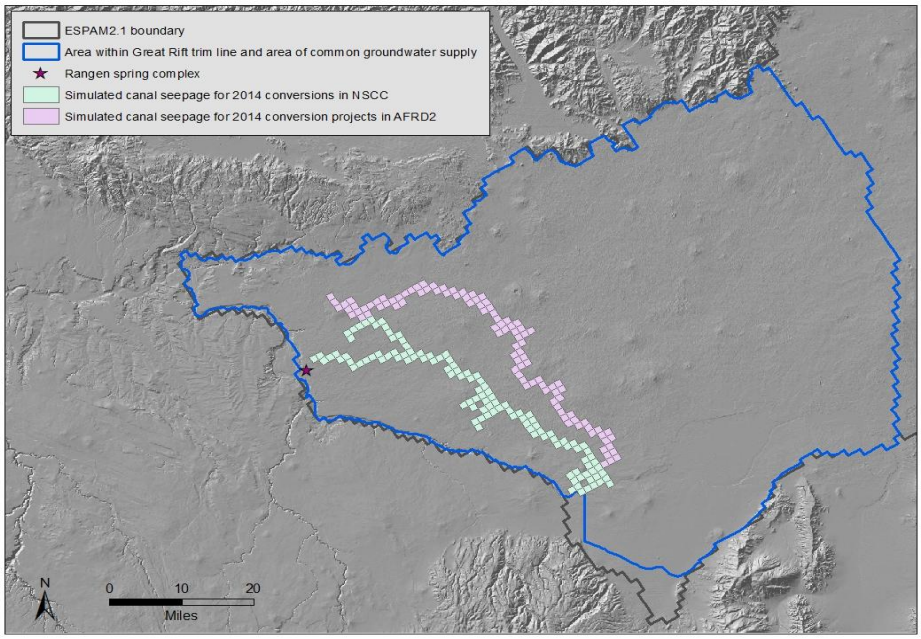
Simulated volume:

25,205 AF/yr
34.79 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.28	205
Heise to Shelley	0.83	601
Shelley to Near Blackfoot	2.49	1,801
Near Blackfoot to Minidoka	8.32	6,031
Kimberly to Buhl	8.20	5,940
Buhl to Lower Salmon Falls	12.36	8,953
Lower Salmon Falls to King Hill	2.31	1,674
Total	34.79	25,205
Group A&B Spring Reaches		
Devil's Washbowl	0.62	451
Devil's Corral	0.81	584
Blue Lakes	1.75	1,267
Crystal	2.35	1,700
Niagara	1.61	1,165
Clear Lake	2.09	1,513
Briggs	0.06	41
Box Canyon	3.46	2,510
Sand	0.93	674
Thousand	2.56	1,854
National Fish Hatchery	0.59	430
Rangen	0.94	683
Three	0.69	499
Malad	2.02	1,460
Curren Tunnel	0.59	430
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.62	
Devil's Corral	0.81	
Box Canyon	3.46	
Baseflow , Kimberly to King Hill	1.40	
Total	6.29	
Kimberly to King Hill total	22.87	

A-8. Simulated steady state impact of canal seepage for 2014 IGWA conversion projects



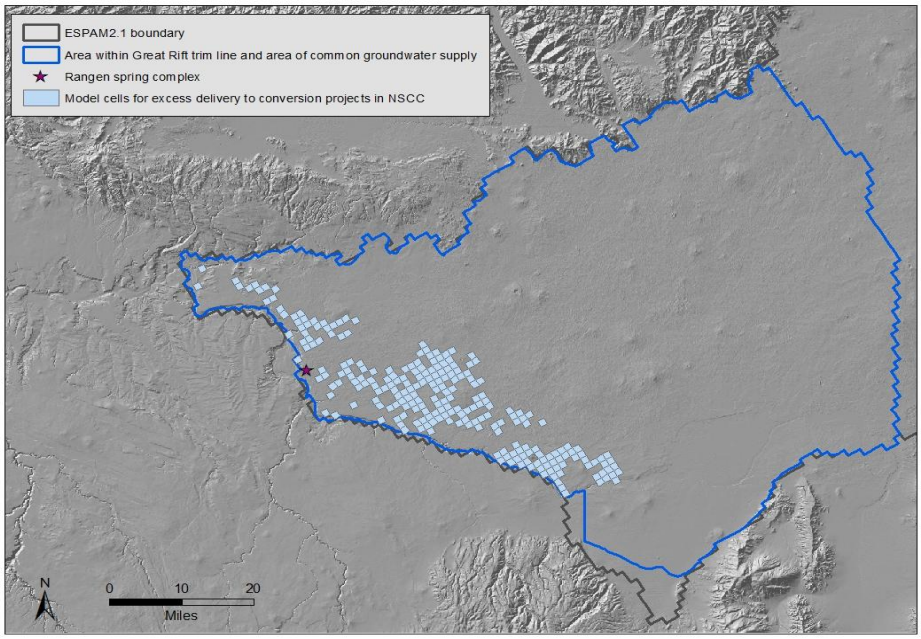
Simulated volume:

4,230 AF/yr
5.84 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.04	27
Heise to Shelley	0.11	81
Shelley to Near Blackfoot	0.33	241
Near Blackfoot to Minidoka	1.11	807
Kimberly to Buhl	1.27	916
Buhl to Lower Salmon Falls	2.52	1,824
Lower Salmon Falls to King Hill	0.46	334
Total	5.84	4,230
Group A&B Spring Reaches		
Devil's Washbowl	0.06	46
Devil's Corral	0.08	60
Blue Lakes	0.22	162
Crystal	0.45	325
Niagara	0.33	236
Clear Lake	0.43	309
Briggs	0.01	8
Box Canyon	0.71	513
Sand	0.19	138
Thousand	0.52	377
National Fish Hatchery	0.12	87
Rangen	0.19	138
Three	0.14	101
Malad	0.40	292
Curren Tunnel	0.12	87
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.06	
Devil's Corral	0.08	
Box Canyon	0.71	
Baseflow , Kimberly to King Hill	0.20	
Total	1.05	
Kimberly to King Hill total	4.24	

A-9. Simulated steady state impact of 2014 excess delivery to IGWA conversion projects



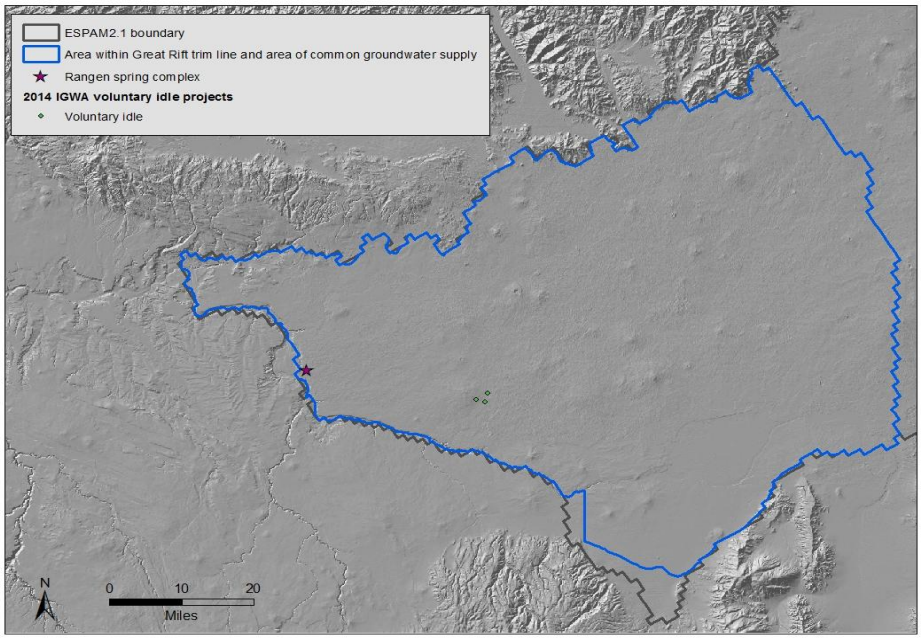
Simulated volume:

494 AF/yr
0.68 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.00	2
Heise to Shelley	0.01	7
Shelley to Near Blackfoot	0.03	21
Near Blackfoot to Minidoka	0.10	71
Kimberly to Buhl	0.16	113
Buhl to Lower Salmon Falls	0.30	217
Lower Salmon Falls to King Hill	0.08	61
Total	0.68	493
Group A&B Spring Reaches		
Devil's Washbowl	0.01	4
Devil's Corral	0.01	6
Blue Lakes	0.03	21
Crystal	0.06	46
Niagara	0.04	27
Clear Lake	0.05	37
Briggs	0.00	1
Box Canyon	0.08	59
Sand	0.02	16
Thousand	0.06	45
National Fish Hatchery	0.01	11
Rangen	0.02	17
Three	0.02	12
Malad	0.07	51
Curren Tunnel	0.01	11
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.01	
Devil's Corral	0.01	
Box Canyon	0.08	
Baseflow , Kimberly to King Hill	0.03	
Total	0.12	
Kimberly to King Hill total	0.54	

A10. Simulated steady state impact of IGWA 2014 voluntary idle projects



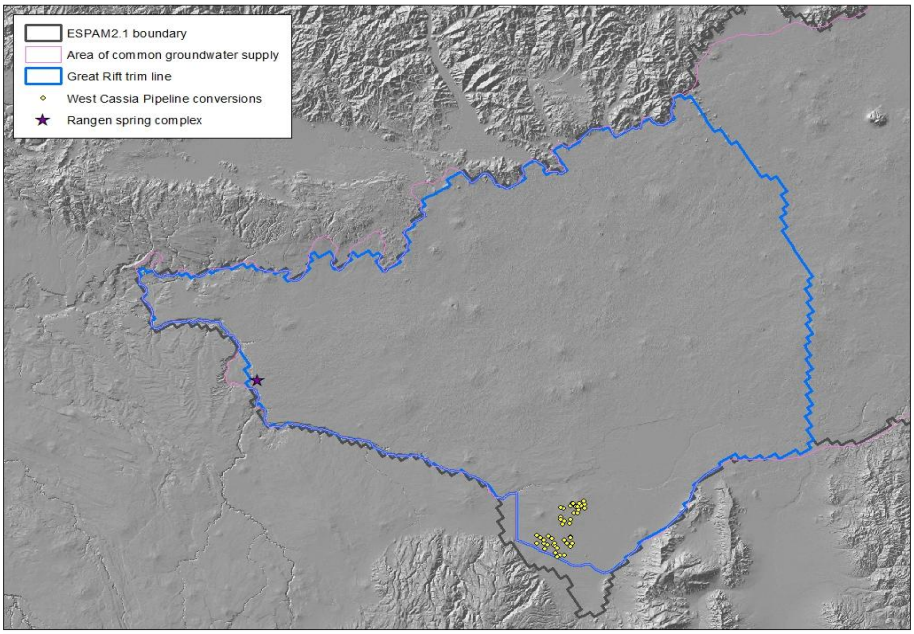
Simulated volume:

552 AF/yr
0.76 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.00	4
Heise to Shelley	0.01	10
Shelley to Near Blackfoot	0.04	31
Near Blackfoot to Minidoka	0.14	104
Kimberly to Buhl	0.17	125
Buhl to Lower Salmon Falls	0.33	239
Lower Salmon Falls to King Hill	0.05	39
Total	0.76	552
Group A&B Spring Reaches		
Devil's Washbowl	0.01	4
Devil's Corral	0.01	6
Blue Lakes	0.03	22
Crystal	0.07	51
Niagara	0.05	33
Clear Lake	0.06	43
Briggs	0.00	1
Box Canyon	0.10	70
Sand	0.03	19
Thousand	0.07	48
National Fish Hatchery	0.01	11
Rangen	0.02	17
Three	0.02	12
Malad	0.05	34
Curren Tunnel	0.01	11
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.01	
Devil's Corral	0.01	
Box Canyon	0.10	
Baseflow , Kimberly to King Hill	0.02	
Total	0.13	
Kimberly to King Hill total	0.56	

A11. Simulated steady state impact of water delivered to West Cassia Pipeline conversion field headgates in 2014



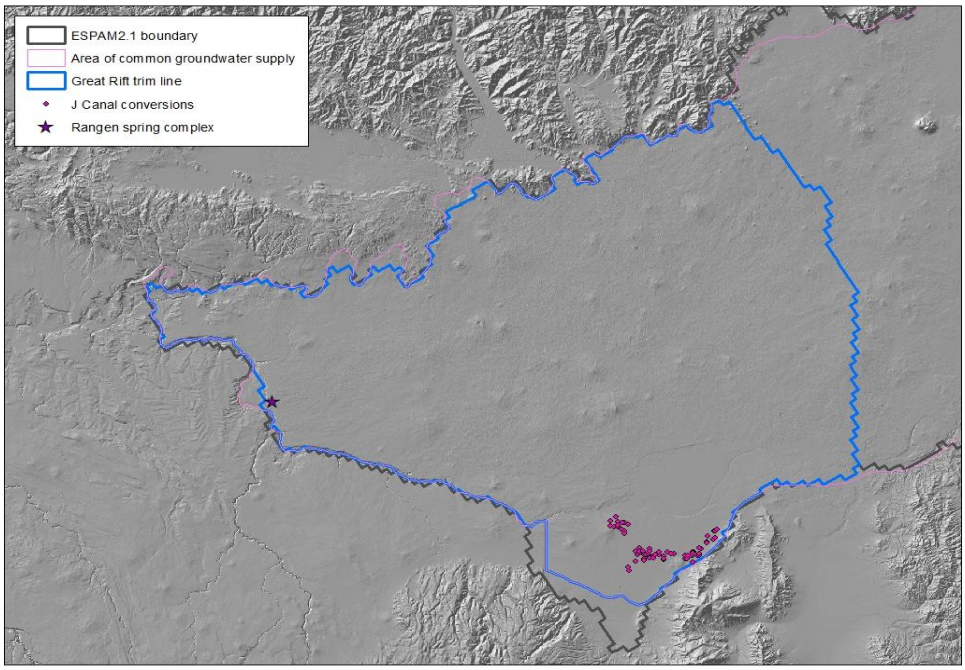
Simulated volume:

10,793 AF/yr
14.90 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.17	121
Heise to Shelley	0.49	355
Shelley to Near Blackfoot	1.47	1,063
Near Blackfoot to Minidoka	4.93	3,571
Kimberly to Buhl	2.95	2,140
Buhl to Lower Salmon Falls	4.20	3,043
Lower Salmon Falls to King Hill	0.69	499
Total	14.90	10,793
Group A&B Spring Reaches		
Devil's Washbowl	0.22	161
Devil's Corral	0.28	206
Blue Lakes	0.62	448
Crystal	0.87	630
Niagara	0.58	419
Clear Lake	0.75	540
Briggs	0.02	15
Box Canyon	1.23	890
Sand	0.33	237
Thousand	0.85	613
National Fish Hatchery	0.19	137
Rangen	0.30	215
Three	0.21	155
Malad	0.60	437
Curren Tunnel	0.19	135
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.22	
Devil's Corral	0.28	
Box Canyon	1.23	
Baseflow , Kimberly to King Hill	0.48	
Total	2.21	
Kimberly to King Hill total	7.84	

A12. Simulated steady state impact of water delivered to J Canal conversion field headgates in 2014



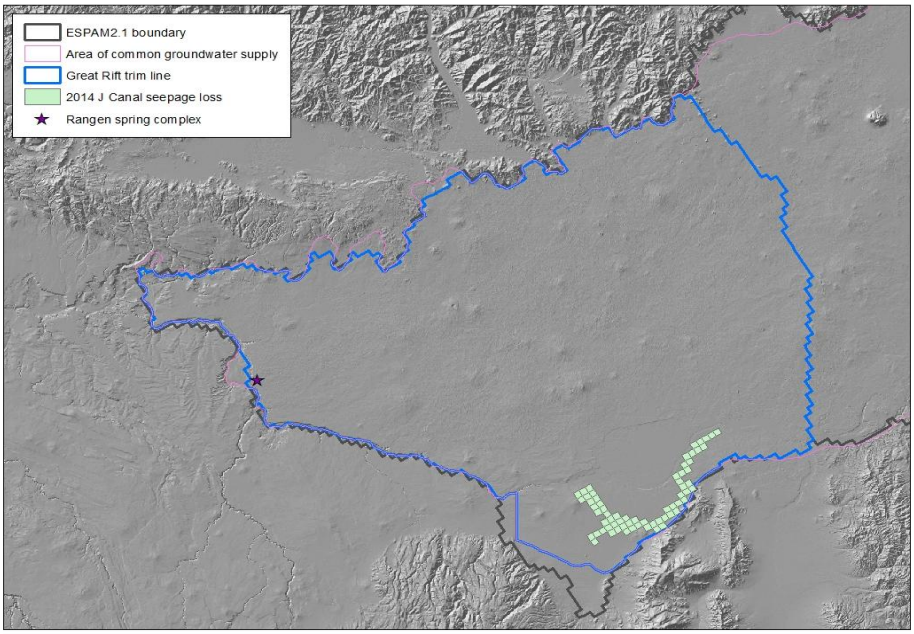
Simulated volume:

21,594 AF/yr
29.81 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.34	247
Heise to Shelley	1.00	725
Shelley to Near Blackfoot	3.00	2,170
Near Blackfoot to Minidoka	10.07	7,292
Kimberly to Buhl	5.75	4,169
Buhl to Lower Salmon Falls	8.29	6,005
Lower Salmon Falls to King Hill	1.36	986
Total	29.81	21,594
Group A&B Spring Reaches		
Devil's Washbowl	0.43	308
Devil's Corral	0.55	396
Blue Lakes	1.20	866
Crystal	1.71	1,241
Niagara	1.14	827
Clear Lake	1.47	1,066
Briggs	0.04	29
Box Canyon	2.42	1,755
Sand	0.64	467
Thousand	1.67	1,209
National Fish Hatchery	0.37	270
Rangen	0.58	424
Three	0.42	307
Malad	1.19	863
Curren Tunnel	0.37	267
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.43	
Devil's Corral	0.55	
Box Canyon	2.42	
Baseflow , Kimberly to King Hill	0.93	
Total	4.32	
Kimberly to King Hill total	15.40	

A-13. Simulated steady state impact of conveyance losses for J Canal conversions in 2014, assuming 38% seepage loss



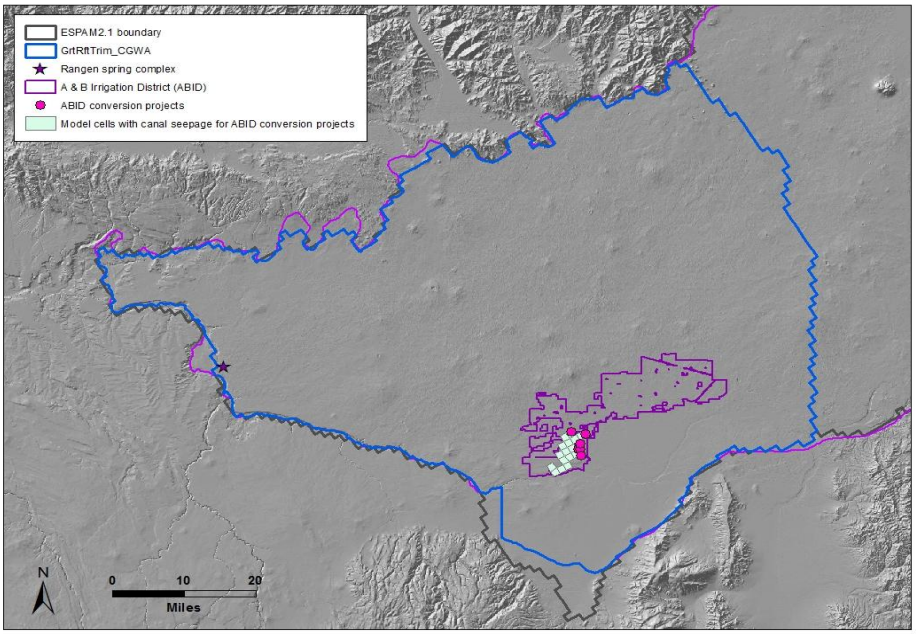
Simulated volume:

13,235.1 AF/yr
18.27 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.22	161
Heise to Shelley	0.65	471
Shelley to Near Blackfoot	1.95	1,409
Near Blackfoot to Minidoka	6.62	4,794
Kimberly to Buhl	3.21	2,327
Buhl to Lower Salmon Falls	4.83	3,498
Lower Salmon Falls to King Hill	0.79	575
Total	18.27	13,235
Group A&B Spring Reaches		
Devil's Washbowl	0.22	162
Devil's Corral	0.29	209
Blue Lakes	0.65	472
Crystal	0.99	720
Niagara	0.66	481
Clear Lake	0.86	621
Briggs	0.02	17
Box Canyon	1.41	1,022
Sand	0.38	272
Thousand	0.97	705
National Fish Hatchery	0.22	157
Rangen	0.34	247
Three	0.25	179
Malad	0.70	504
Curren Tunnel	0.21	156
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.22	
Devil's Corral	0.29	
Box Canyon	1.41	
Baseflow , Kimberly to King Hill	0.51	
Total	2.43	
Kimberly to King Hill total	8.84	

A-14. Simulated steady state impact of 2014 A & B Irrigation District conversion projects, including conveyance loss of 15%



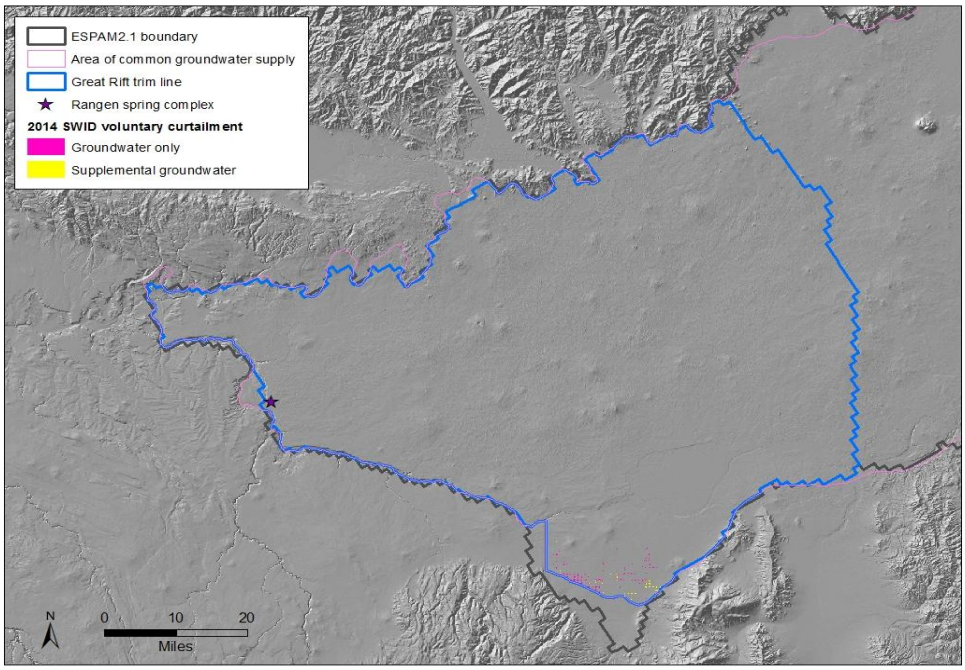
Simulated volume:

3,715 AF/yr
5.13 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.06	44
Heise to Shelley	0.18	128
Shelley to Near Blackfoot	0.53	382
Near Blackfoot to Minidoka	1.77	1,281
Kimberly to Buhl	0.96	693
Buhl to Lower Salmon Falls	1.41	1,019
Lower Salmon Falls to King Hill	0.23	167
Total	5.13	3,715
Group A&B Spring Reaches		
Devil's Washbowl	0.07	50
Devil's Corral	0.09	64
Blue Lakes	0.20	142
Crystal	0.29	210
Niagara	0.19	140
Clear Lake	0.25	181
Briggs	0.01	5
Box Canyon	0.41	298
Sand	0.11	79
Thousand	0.28	205
National Fish Hatchery	0.06	46
Rangen	0.10	72
Three	0.07	52
Malad	0.20	147
Curren Tunnel	0.06	45
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.07	
Devil's Corral	0.09	
Box Canyon	0.41	
Baseflow , Kimberly to King Hill	0.15	
Total	0.72	
Kimberly to King Hill total	2.60	

A-15. Simulated steady state impact of SWID voluntary curtailment in 2014



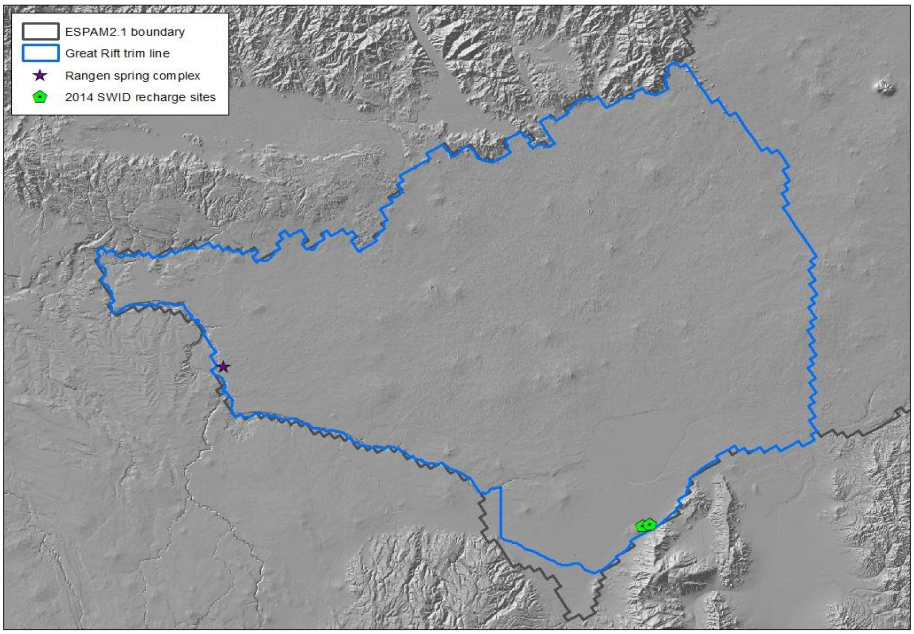
Simulated volume:

1,749	acres
3,946	AF/yr
5.45	cfs
2.26	AF/ac

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.06	45
Heise to Shelley	0.18	130
Shelley to Near Blackfoot	0.54	391
Near Blackfoot to Minidoka	1.81	1,312
Kimberly to Buhl	1.07	778
Buhl to Lower Salmon Falls	1.53	1,109
Lower Salmon Falls to King Hill	0.25	182
Total	5.45	3,946
Group A&B Spring Reaches		
Devil's Washbowl	0.08	58
Devil's Corral	0.10	75
Blue Lakes	0.22	162
Crystal	0.32	229
Niagara	0.21	153
Clear Lake	0.27	197
Briggs	0.01	5
Box Canyon	0.45	324
Sand	0.12	86
Thousand	0.31	223
National Fish Hatchery	0.07	50
Rangen	0.11	78
Three	0.08	57
Malad	0.22	159
Curren Tunnel	0.07	49
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.08	
Devil's Corral	0.10	
Box Canyon	0.45	
Baseflow , Kimberly to King Hill	0.17	
Total	0.80	
Kimberly to King Hill total	2.86	

A-16. Simulated steady state impact of 2014 SWID recharge



Simulated volume:

453 AF/yr
0.63 cfs

Predicted response:

Reach	Response (cfs)	Response (AF/yr)
Ashton to Rexburg	0.01	5
Heise to Shelley	0.02	15
Shelley to Near Blackfoot	0.06	45
Near Blackfoot to Minidoka	0.21	152
Kimberly to Buhl	0.12	88
Buhl to Lower Salmon Falls	0.17	126
Lower Salmon Falls to King Hill	0.03	21
Total	0.63	453
Group A&B Spring Reaches		
Devil's Washbowl	0.01	7
Devil's Corral	0.01	8
Blue Lakes	0.03	18
Crystal	0.04	26
Niagara	0.02	17
Clear Lake	0.03	22
Briggs	0.00	1
Box Canyon	0.05	37
Sand	0.01	10
Thousand	0.04	25
National Fish Hatchery	0.01	6
Rangen	0.01	9
Three	0.01	6
Malad	0.03	18
Curren Tunnel	0.01	6
Baseflow and selected spring cells without irrigation use		
Devil's Washbowl	0.01	
Devil's Corral	0.01	
Box Canyon	0.05	
Baseflow , Kimberly to King Hill	0.02	
Total	0.09	
Kimberly to King Hill total	0.32	