MEMO

State of Idaho
Department of Water Resources
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Date: May 18, 2023

To: Shelley Keen, Water Allocation Bureau Chief

Cc: Sean Vincent, P.G., Hydrology Section Manager

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

Subject: Cumulative review of ESPA transfers between 2012 and 2022

The Idaho Department of Water Resources (IDWR) previously analyzed and documented the cumulative effect of water right transfers involving pumping from the Eastern Snake Plain aquifer (ESPA). The most recent analysis included water right transfers approved between January 1, 2012 and September 30, 2021 (Sukow, 2022)[1]. This memorandum presents the results of an updated cumulative review including water right transfers processed between January 1, 2012 and September 30, 2022.

Water Allocation Bureau staff identified 45 transfers approved between October 1, 2021 and September 30, 2022 involving PODs located within the Eastern Snake Plain Aquifer Model Version 2.2 (ESPAM2.2) boundary. For each transfer, Water Allocation Bureau staff assigned "TO" and "FROM" well locations to a model row and column. For transfers involving a well location outside of the active model boundary, the well location was assigned the model row and column of the nearest active model cell. Water Allocation Bureau staff also provided an annual pumping volume for each well. Figure 1 shows the locations of model cells with TO and FROM wells representing the 45 recently approved transfers. Figure 2 shows the cumulative change in annual pumping volume by model cell for the recently approved transfers.

[1] Sukow, J., 2022. *Cumulative review of ESPA transfers between 2012 and 2021*, Idaho Department of Water Resources, memorandum to Shelley Keen dated March 28, 2022, 12 p., https://idwr.idaho.gov/wp-content/uploads/sites/2/forms/waterrightsforms/ESPAXferMemo2021final.pdf.

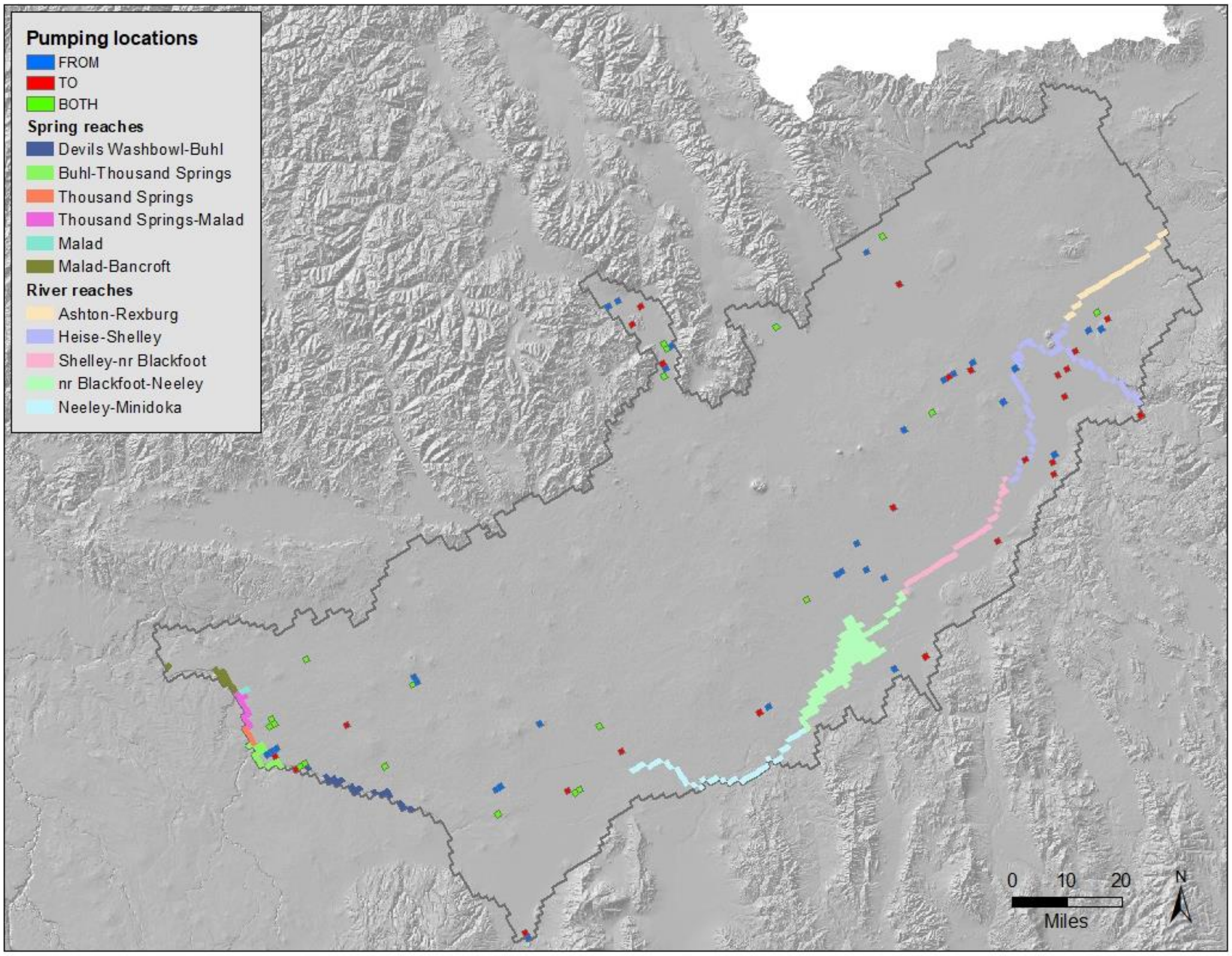

Figure 1. Locations of TO and FROM wells for transfers approved between October 1, 2021 and September 30, 2022

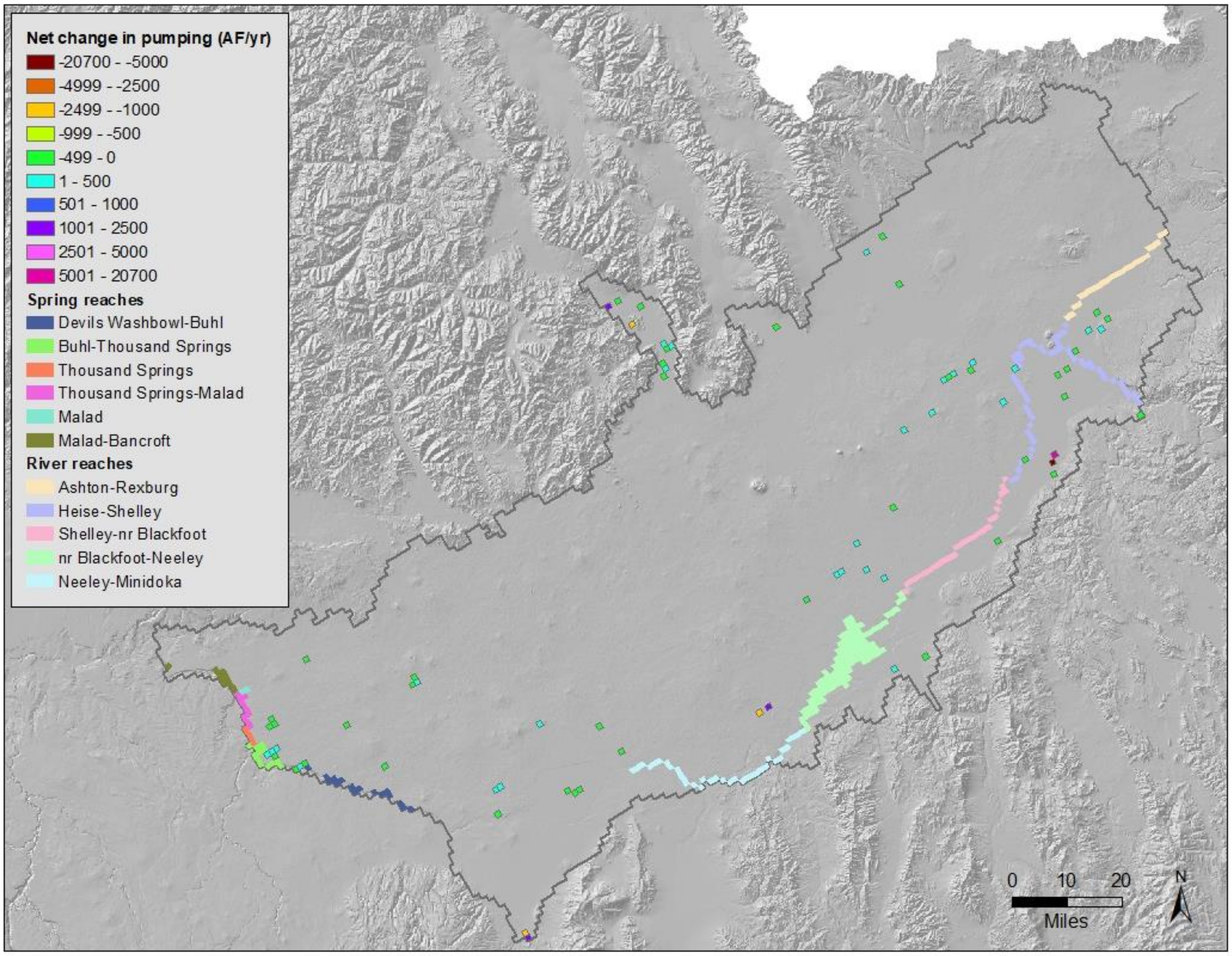

Figure 2. Net change in pumping resulting from transfers approved between October 1, 2021 and September 30, 2022

For the cumulative review, changes in pumping resulting from the recently approved transfers were added to changes in pumping resulting from the 622 transfers analyzed previously in Sukow (2022). The updated analysis includes a total of 667 transfers. Figure 3 shows the locations of model cells with TO and FROM wells representing the transfers approved between January 1, 2012 and September 30, 2022. Figure 4 shows the cumulative change in annual pumping volume by model cell for these transfers.

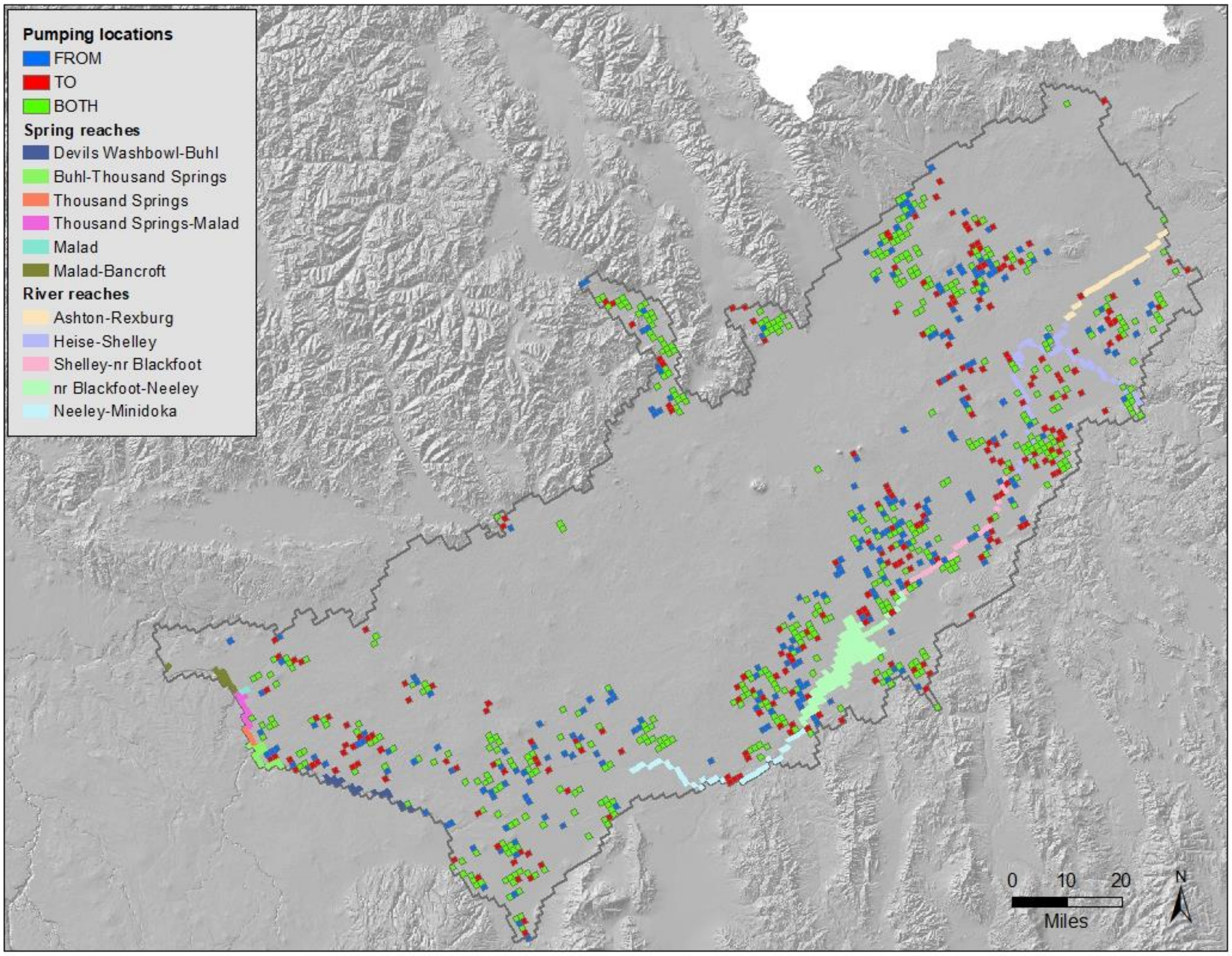

Figure 3. Location of TO and FROM wells for transfers approved between January 1, 2012 and September 30, 2022

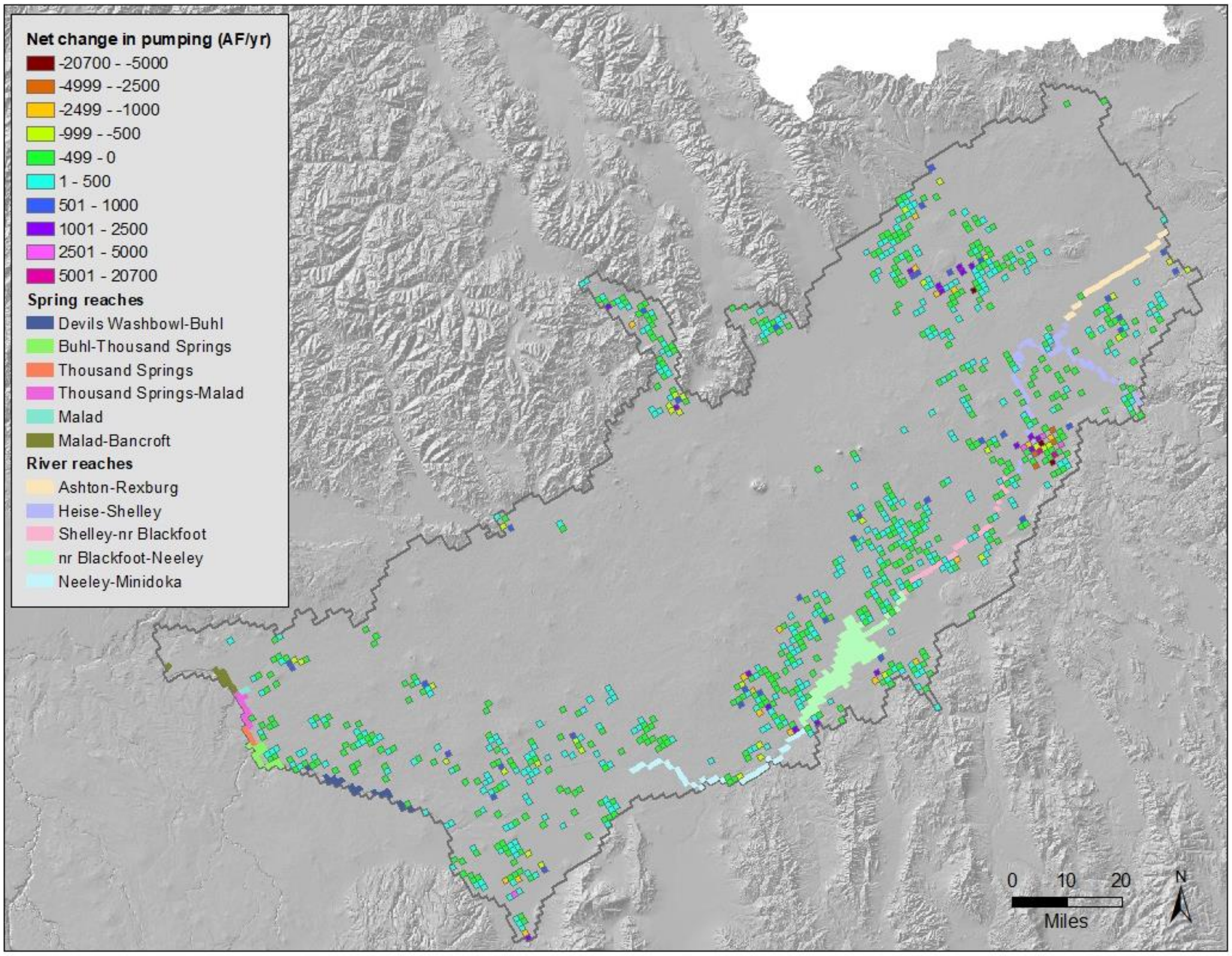

Figure 4. Net change in pumping resulting from transfers approved between January 1, 2012 and September 30, 2022

Most transfers involve relatively small amounts of water (Figure 5) or move points of diversion a relatively short distance (Figure 6). Figure 7 shows the cumulative volume of water transferred by the average distance between TO and FROM wells.

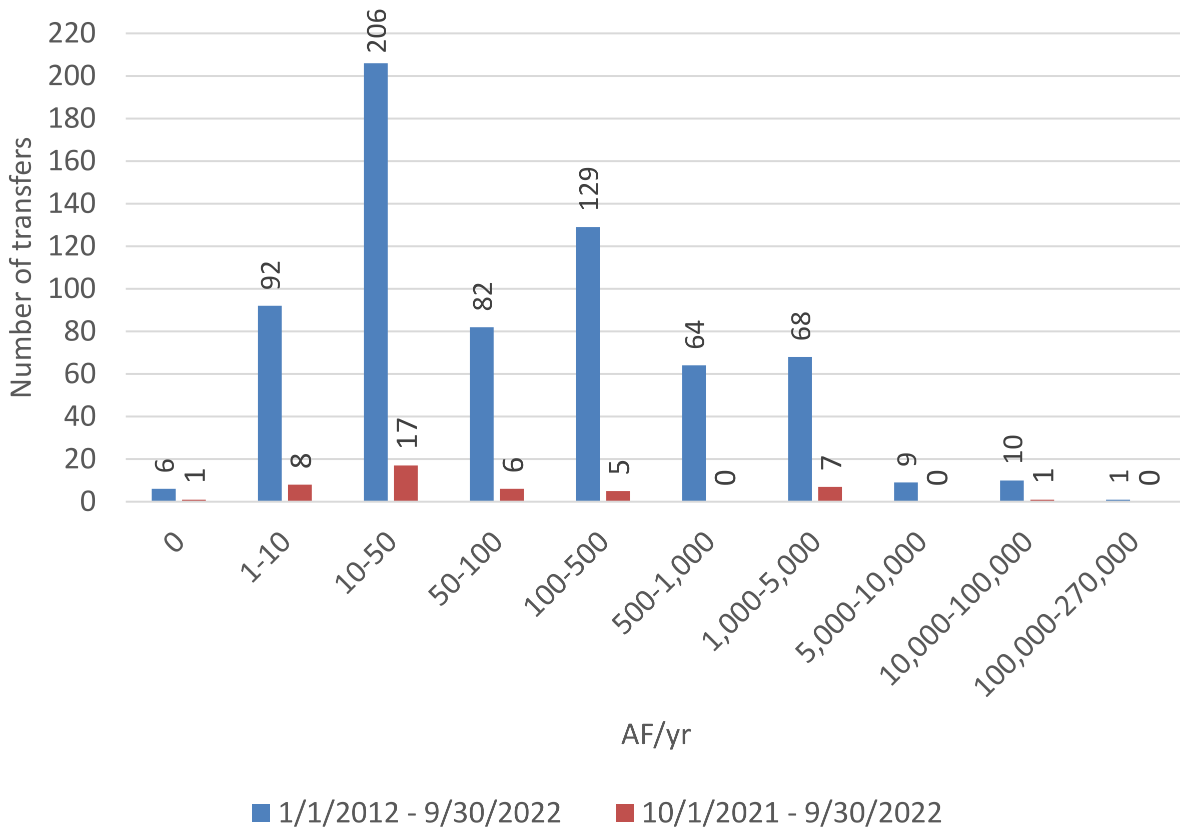

Figure 5. Transfer pumping volume

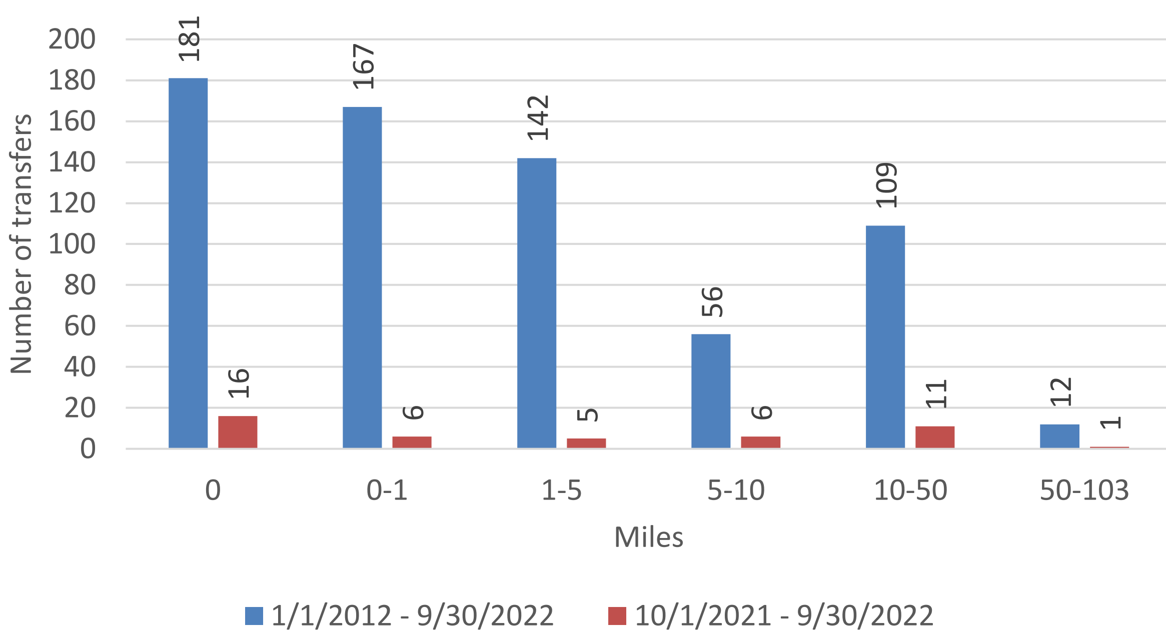

Figure 6. Average distance between TO and FROM wells

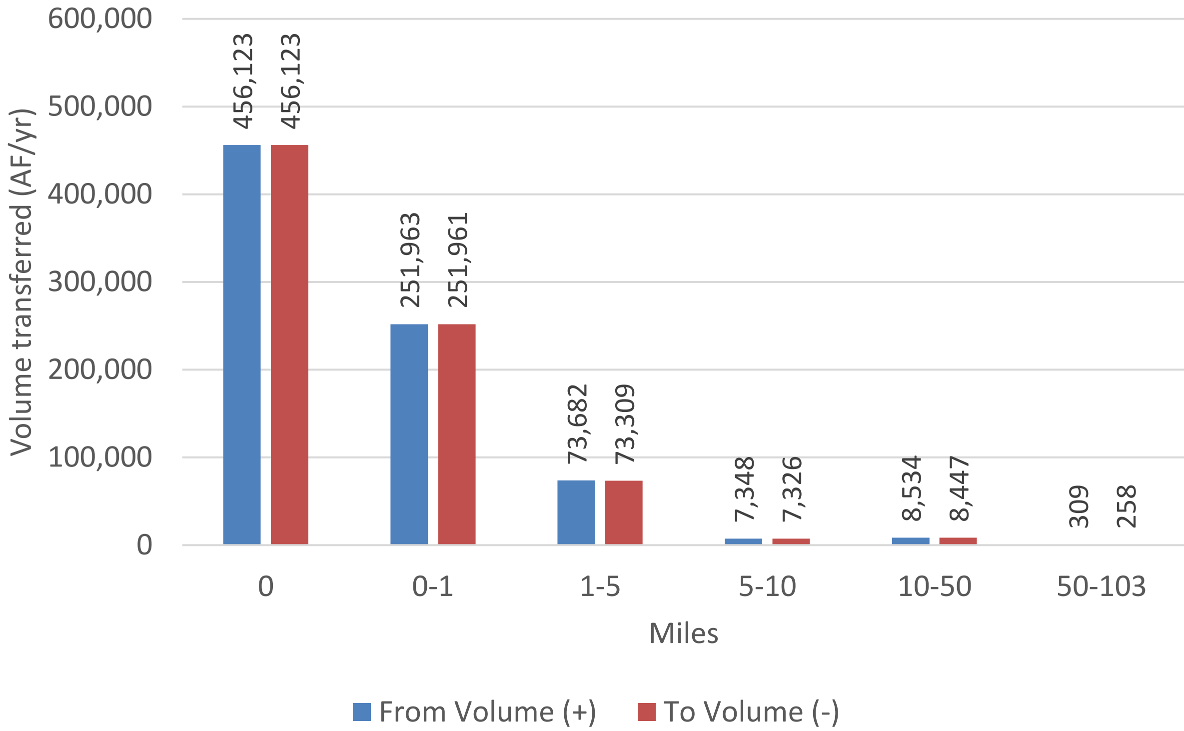

Figure 7. Cumulative volume transferred by distance transferred (1/1/2012 – 9/30/2022)

The Eastern Snake Plain Aquifer Model version 2.2 (ESPAM2.2)[2] was used to simulate the cumulative effects of the transfers on steady-state reach gains equivalent to the reaches represented in the ESPA Model Transfer Spreadsheet (ETRAN), which is commonly used as a tool by transfer applicants and Water Allocation Bureau staff to analyze the hydrologic impacts of individual transfers. ETRAN simulates the effects of changes in pumping location using the ESPAM2.2 groundwater flow model, but the ETRAN user interface only supports the simulation of a limited number of points of diversion. Because the cumulative analysis requires simulation of a large number of points of diversion, ESPAM2.2 was used with other pre- and post-processing tools to perform the analyses.

Transfer data provided by Water Allocation Bureau staff were reformatted to create MODFLOW input files. FROM wells were represented as a positive stress to simulate a decrease in pumping at these locations. TO wells were represented as a negative stress to simulate an increase in pumping at these locations. The superposition version of ESPAM2.2[3] was used to simulate the effects of the changes in pumping at steady state.

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[2] Sukow, J., 2021. *Model Calibration Report, Eastern Snake Plain Aquifer Model Version 2.2*, Idaho Department of Water Resources, May 2021, 226 p., https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM22_Reports/ModelCalibrationRpt/.

[3] Sukow, J., 2021, *Comparison of Superposition Model with Fully-populated Model for Eastern Snake Plain Aquifer Model Version 2.2*, Idaho Department of Water Resources, March 2021, 14 p.,

The cumulative effect of changes in pumping on reach gains in each of the eleven reaches of the Snake River was extracted from the model output. Results are summarized in Table 1. Changes in reach gains resulting from the transfers are very small compared to average reach gains (less than +/- 1.5%). The largest changes are an increase of 1,692 AF/yr (2.3 cfs) in the near Blackfoot to Neeley reach and a decrease of 894 AF/yr (-1.2 cfs) in the Neeley to Minidoka reach. The cumulative effect on the near Blackfoot to Minidoka reach is an increase of 799 AF/yr (1.1 cfs).

Table 1. Cumulative effect of transfers approved between January 1, 2012 and September 30, 2022 on reach gains in the Snake River

Reach	Transfer Impact		Average Reach Gain[4]		% change in reach gain
	(AF/yr)	(cfs)	(AF/yr)	(cfs)	
Ashton-Rexburg	252	0.35	-19,756	-27	1.28%
Heise-Shelley	-133	-0.18	-214,459	-296	-0.06%
Shelley-Near Blackfoot	-454	-0.63	-400,694	-553	-0.11%
Subtotal above nr Blackfoot	-335	-0.46	-634,908	-876	-0.05%
Near Blackfoot-Neeley	1,692	2.34	1,720,822	2,375	0.10%
Neeley-Minidoka	-894	-1.23	71,706	99	-1.25%
Subtotal nr Blackfoot-Minidoka	799	1.10	1,792,528	2,474	0.04%
Devil's Washbowl -Buhl	-10	-0.01	787,690	1,087	0.00%
Buhl-Thousand Springs	-3	0.00			
Thousand Springs	14	0.02			
Thousand Springs-Malad	18	0.02			
Malad	45	0.06			
Malad-Bancroft	9	0.01			
Subtotal Kimberly-King Hill	72	0.10	4,248,456	5,864	0.00%
Total	536	0.74	5,406,075	7,462	0.01%

https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM22_Reports/Scenarios/Super_FullyPop_Final.pdf.

[4] Average reach gains were calculated from data compiled for development of ESPAM2.2 for water years 1981 through 2018.

Figure 8 shows the trend in the cumulative effect of transfers approved on or after January 1, 2012 on reaches of the Snake River above Minidoka. For reaches of the Snake River above the near Blackfoot gage, there is not an apparent trend in the cumulative effect of the transfers. For these reaches, the cumulative effect of transfers approved during a given year resulted in increases in reach gains for some years and decreases in reach gains for other years. For the near Blackfoot to Neeley reach, the cumulative effect of the transfers approved during a given year has resulted in a very small increase in reach gains for most years. For the Neeley to Minidoka reach, the cumulative effect of the transfers approved during a given year has resulted in a very small decrease in reach gains for most years. The cumulative effect on the combined near Blackfoot to Minidoka reach has been a very small increase in reach gains for most years.

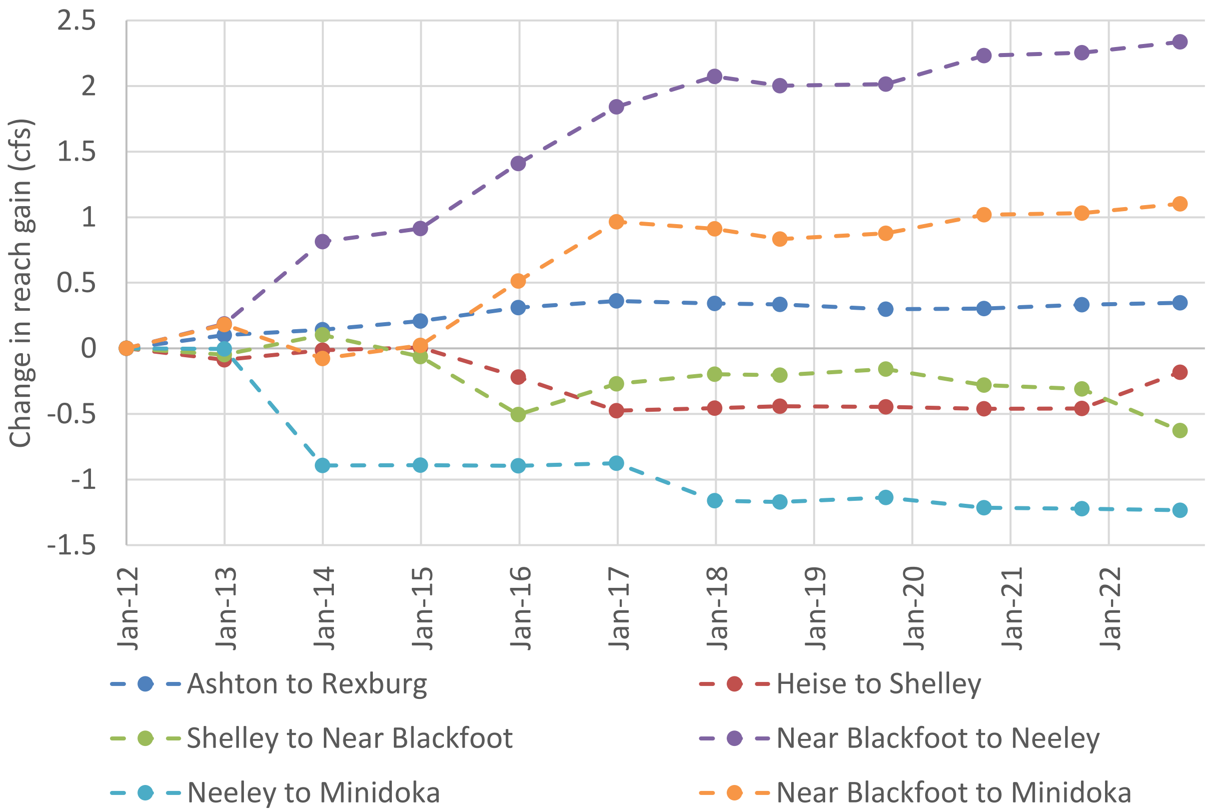

Figure 8. Trend in cumulative effect of transfers approved on or after January 1, 2012 on reaches of the Snake River above Minidoka

Figure 9 shows the trend in the cumulative effect of transfers approved on or after January 1, 2012 on reaches of the Snake River between Kimberly and King Hill. For reaches between Kimberly and King Hill, the cumulative effect of transfers approved during a given year resulted in increases in reach gains for some years and decreases in reach gains for other years. The effect on the Devil's Washbowl to Buhl reach has been a very small decrease in reach gains for five of the eleven years. The effect on the Buhl to Thousand Springs reach has been a very small decrease in reach gains for seven of the eleven years. The total effect on the Kimberly to King Hill reach has been a very small decrease in reach gains for six of the eleven years and a very small increase for five of the eleven years.

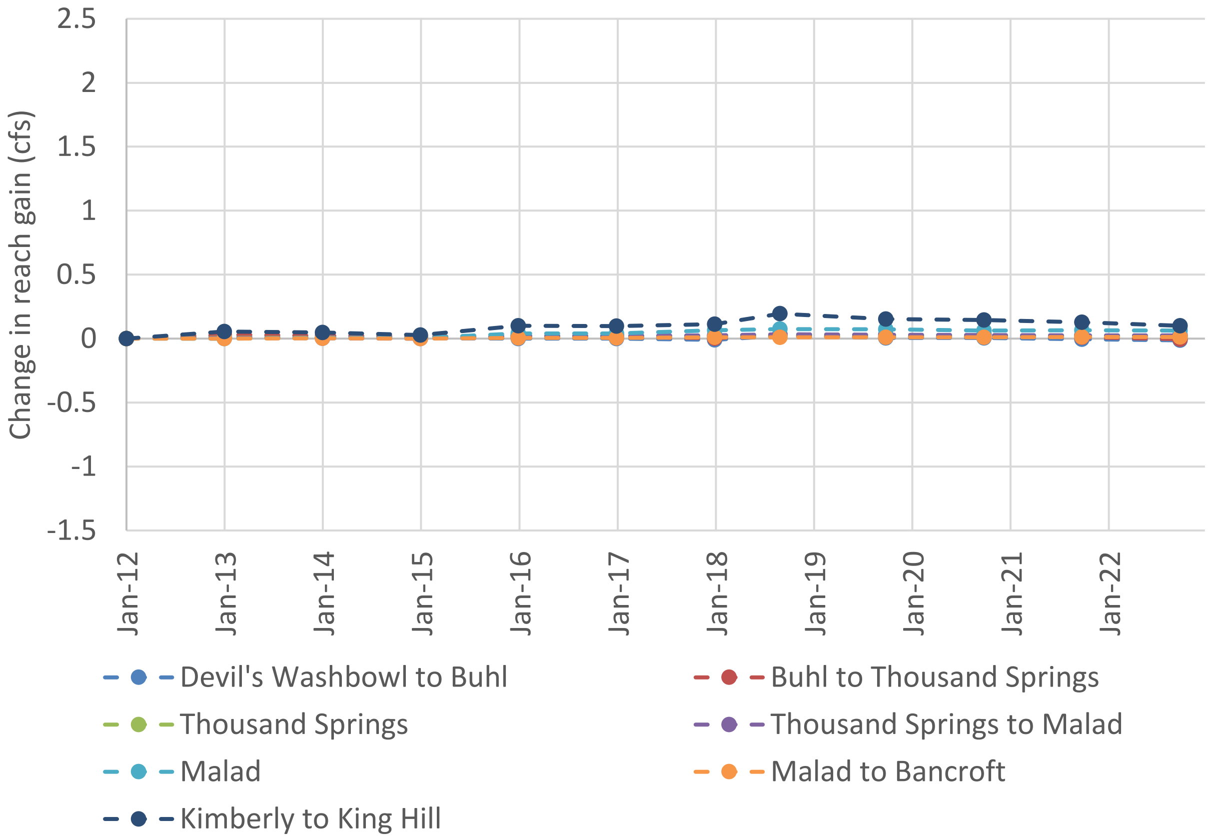

Figure 9. Trend in cumulative effect of transfers approved on or after January 1, 2012 on reaches of the Snake River between Kimberly and King Hill

Of the 667 transfers included in the cumulative analysis, 319 transfers had an average distance of greater than 1.0 mile between the TO and FROM model cell locations (Figure 10). The cumulative effects of these 319 transfers were simulated using the superposition version of ESPAM2.2. Results of the simulation are summarized in Table 2. The results are similar to the results of the simulation that included all of the transfers. Changes in reach gains resulting from the transfers are very small compared to average reach gains (less than +/- 1.5%). The largest changes are an increase of 1,114 AF/yr (1.5 cfs) in the near Blackfoot to Neeley reach and a decrease of 729 AF/yr (-1.0 cfs) in the Neeley to Minidoka reach. The cumulative effect on the near Blackfoot to Minidoka reach is an increase of 386 AF/yr (0.5 cfs).

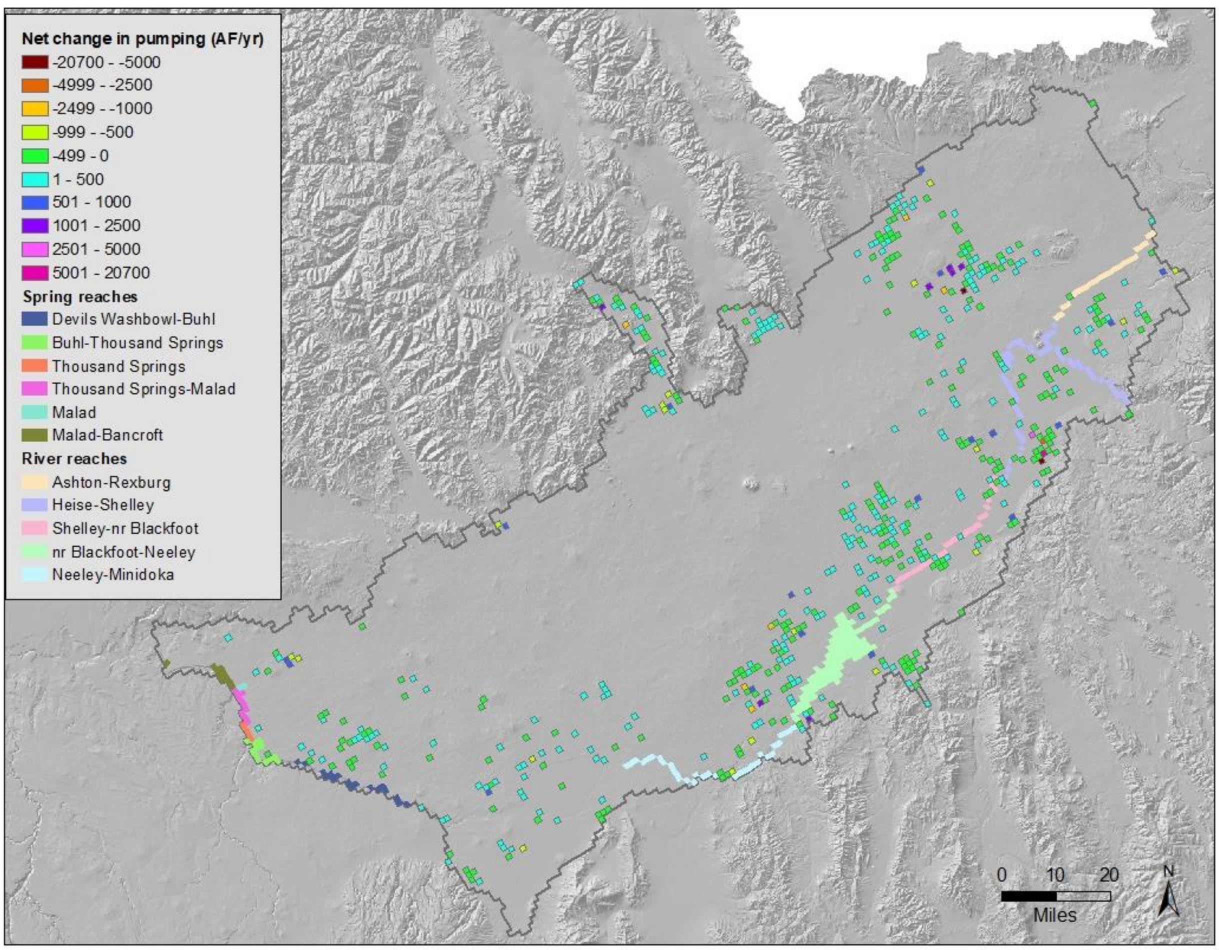

Figure 10. Net change in pumping resulting from transfers with an average distance of greater than one mile (approved between January 1, 2012 and September 30, 2022)

Table 2. Cumulative effects of transfers with an average distance greater than one mile on reach gains in the Snake River (for transfers approved between January 1, 2012 and September 30, 2022)

Reach	Transfer Impact		Average Reach Gain		% change in reach gain
	(AF/yr)	(cfs)	(AF/yr)	(cfs)	
Ashton-Rexburg	135	0.19	-19,756	-27	0.69%
Heise-Shelley	173	0.24	-214,459	-296	0.08%
Shelley-Near Blackfoot	-198	-0.27	-400,694	-553	-0.05%
Subtotal above nr Blackfoot	111	0.15	-634,908	-876	0.02%
Near Blackfoot-Neeley	1,114	1.54	1,720,822	2,375	0.06%
Neeley-Minidoka	-729	-1.01	71,706	99	-1.02%
Subtotal nr Blackfoot-Minidoka	386	0.53	1,792,528	2,474	0.02%
Devil's Washbowl -Buhl	-18	-0.03	787,690	1,087	0.00%
Buhl-Thousand Springs	-3	0.00			
Thousand Springs	6	0.01			
Thousand Springs-Malad	12	0.02			
Malad	34	0.05			
Malad-Bancroft	7	0.01			
Subtotal Kimberly-King Hill	38	0.05	4,248,456	5,864	0.00%
Total	534	0.74	5,406,075	7,462	0.01%