MEMO

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Date: November 15, 2022

To: Swan Falls Implementation Group

From: Swan Falls Technical Working Group

Subject: Analysis of impacts of trust water rights on Snake River flow below Milner Dam (Questions 2-4)

Question 2. Analyze impacts of ESPA groundwater trust rights on Snake River flow below Milner Dam

Groundwater trust rights in the ESPA and tributary basins

Groundwater trust rights with points of diversion (PODs) located in the ESPA model area and in basins tributary to the ESPA were identified from a list compiled from IDWR's water right database by Cody Parker, Water Rights Supervisor, in March 2022. Water rights with irrigation, commercial, municipal, and industrial uses were included in the impact analysis. Other water uses were assumed to have minimal consumptive use and were excluded from the analysis. Table 1 summarizes the aggregate diversion rate limits of trust groundwater rights included in the analysis. Figure 1 shows the POD locations of trust groundwater rights included in the analysis.

Table 1. Trust groundwater right aggregate diversion rate limits for irrigation and CMI uses.

AREA	IRRIGATION (cfs)	COMMERCIAL (cfs)	MUNICIPAL (cfs)	INDUSTRIAL (cfs)
ESPA	980	27	58	6
ESPA tributaries	216	1	19	0

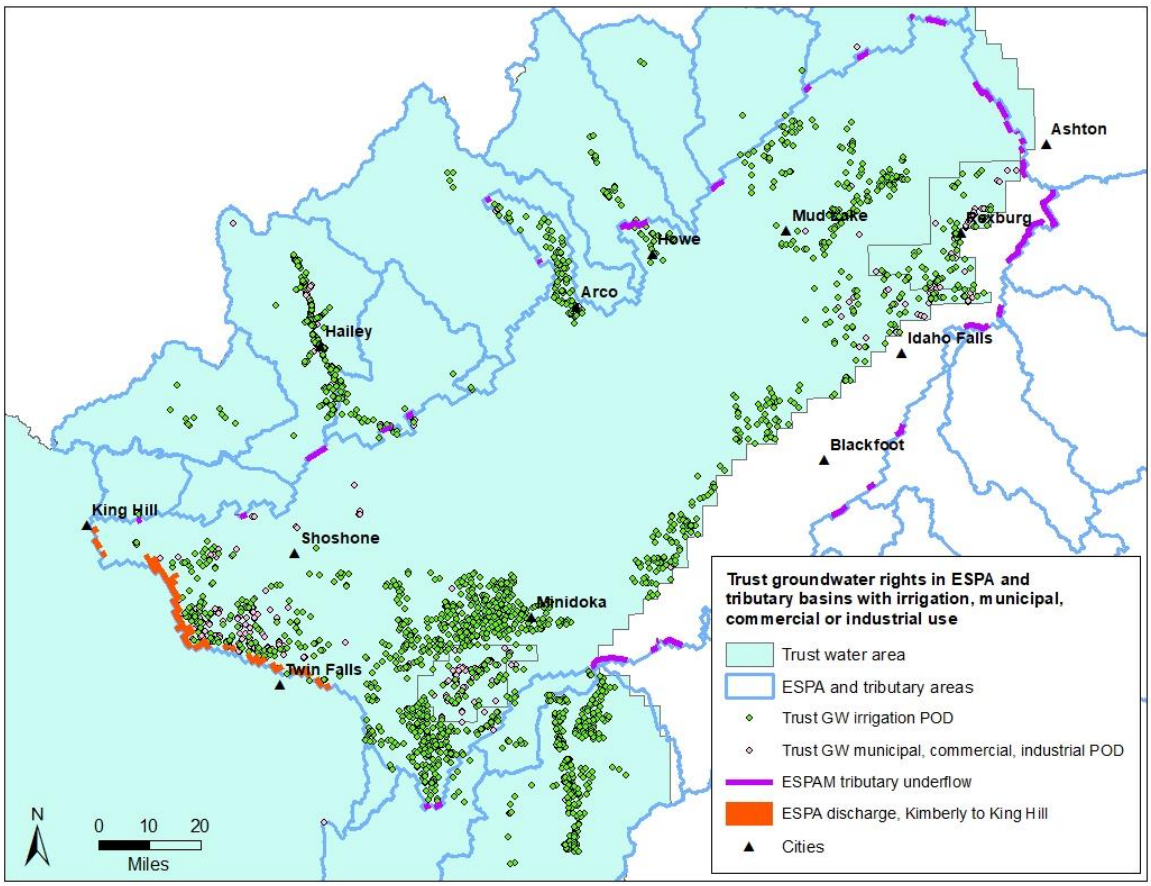

Figure 1. Trust groundwater rights diverted from the ESPA and tributary basins.

Consumptive water use estimates for groundwater trust rights in the ESPA and tributary basins

The consumptive water use associated with irrigation water rights is expected to be less than the water right diversion limit and will vary both seasonally and annually with crop irrigation demand. For trust groundwater rights located within the Eastern Snake Plain Aquifer Model Version 2.2 (ESPAM2.2)[1,2] boundary, consumptive use was calculated by multiplying the 10-year average monthly crop irrigation demand for water years 2009 through 2018[3] by the acres irrigated. The number of acres irrigated with each water right was estimated by dividing the water right diversion rate limit by 0.02 cfs. For water rights with PODs located both inside and outside the trust area,

[1] Sukow, J., 2021, *Model Calibration Report Eastern Snake Plain Aquifer Model Version 2.2*, Idaho Department of Water Resources, 181 p., https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM22_Reports/ModelCalibrationRpt/ModelCalibration22_Final.pdf.

[2] Sukow, J., 2021, *Comparison of Eastern Snake Plain Aquifer Model Version 2.2 with Version 2.1 via the Curtailment Scenario*, Idaho Department of Water Resources, 19 p., https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM22_Reports/Scenarios/CurtScen22_FinalwApp.pdf.

[3] Shapefile ESPAM22_CIR_GWadj.shp is available at https://research.idwr.idaho.gov/files/projects/espam/browse/model_files/Version_22/ESPAM22_CREP_tools/.

the diversion rate and number of acres irrigated by trust water was apportioned based on the fraction of the PODs located inside the trust area.

The average annual consumptive use estimated for trust groundwater irrigation rights with PODs located in the ESPAM2.2 model domain is 120,000 AF/yr (166 cfs) for approximately 49,000 acres. The average peak month consumptive use occurs in July and is estimated to be 35,000 AF/mo (568 cfs).

For trust groundwater rights located in areas tributary to the ESPA but outside the ESPAM2.2 boundary, the monthly consumptive use was calculated by multiplying the ET_{Idaho}[4] 30-year average monthly precipitation deficit for peak alfalfa (no cutting effects) by the acres irrigated. An ET_{Idaho} station was assigned to each POD outside the ESPAM boundary using a shapefile of the station locations (ETIdahoStations_Poly.shp). The number of acres irrigated with each water right was estimated by dividing the water right diversion rate limit by 0.02 cfs.

The average annual consumptive use estimated for trust groundwater irrigation rights with PODs located in basins tributary to the ESPA is 34,000 AF/yr (47 cfs) for approximately 11,000 acres. The average peak month consumptive use occurring in July is estimated to be 8,300 AF/month (135 cfs).

Consumptive use associated with commercial, municipal, and industrial uses may vary significantly with the specific nature of use and wastewater treatment methods. For this analysis, water right diversion limits (diversion rate or annual volume) were used to represent the maximum consumptive use that might occur and were applied at a constant rate year-round. Actual consumptive use is expected to be less than the water right rate diversion limits, but cannot be estimated without considerable research into individual water user operations and water right portfolios.

The maximum annual consumptive use for trust commercial, municipal, and industrial rights is 46,000 AF/yr (64 cfs) for water rights with PODs located in the ESPAM2.2 model domain and 11,000 AF/yr (15 cfs) for water rights with PODs located in basins tributary to the ESPA. These values are less than the aggregate maximum diversion rates in Table 1, because some water rights have more restrictive annual diversion volume limits.

Impact of groundwater trust rights in ESPA and tributary basins on Snake River flow below Milner Dam

The impact of groundwater trust rights diverted from the ESPA and tributary basins was simulated using the superposition version of ESPAM2.2[5]. Documentation for the ESPAM2.2 model, including a model calibration report, a report describing the superposition version, and a predictive uncertainty analysis report are available at https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM22_Reports/.

[4] http://data.kimberly.uidaho.edu/ETIdaho/

[5] The ESPAM2.2 model simulation files are available in 20220607-Swan-Falls-SFIG-Assignment.zip at https://idwr.idaho.gov/legal-actions/settlements/swan-falls/twg/.

The average monthly consumptive use was modeled as a recurring stress at the location of each water right POD located within the ESPAM2.2 model boundary. For water right PODs located in tributary basins, the average monthly consumptive use was modeled as a recurring stress at the location of tributary underflow to the ESPA. ESPAM2.2 was used to calculate the volume and timing of impact on the Kimberly to King Hill reach of the Snake River. The Kimberly to King Hill reach of ESPAM2.2 represents all ESPA discharge to the Snake River below Milner Dam. The timing of propagation of impacts within each tributary basin was assumed to be negligible relative to the timing of propagation of impact from the locations of tributary underflow to the Kimberly to King Hill reach.

Figure 2 shows the model-predicted impact of the trust groundwater irrigation use on aquifer discharge from the ESPA to the Snake River below Milner Dam. The lack of seasonality in the response to irrigation use in the tributaries supports the assumption that the timing of propagation of impacts within each tributary basin can be neglected in this analysis.

Figure 3 shows the model-predicted maximum impact of the trust groundwater commercial, municipal, and industrial use on aquifer discharge from the ESPA to the Snake River below Milner Dam. Actual impact is expected to be less than the maximum impact predicted based on water right diversion limits.

Model results indicate that approximately 80% of the impacts of trust water use are realized within 25 years and approximately 88% of the impacts are realized within 35 years.

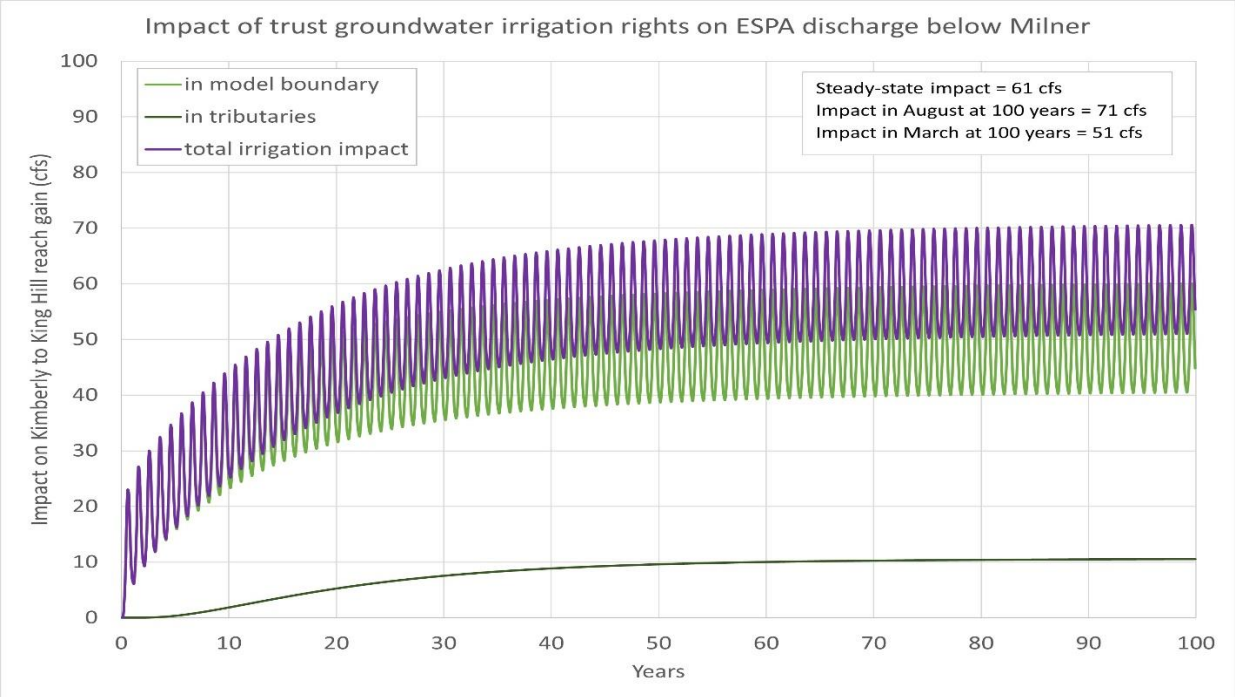

Figure 2. Estimated impact of trust groundwater irrigation water rights diverted from the ESPA and tributary basins

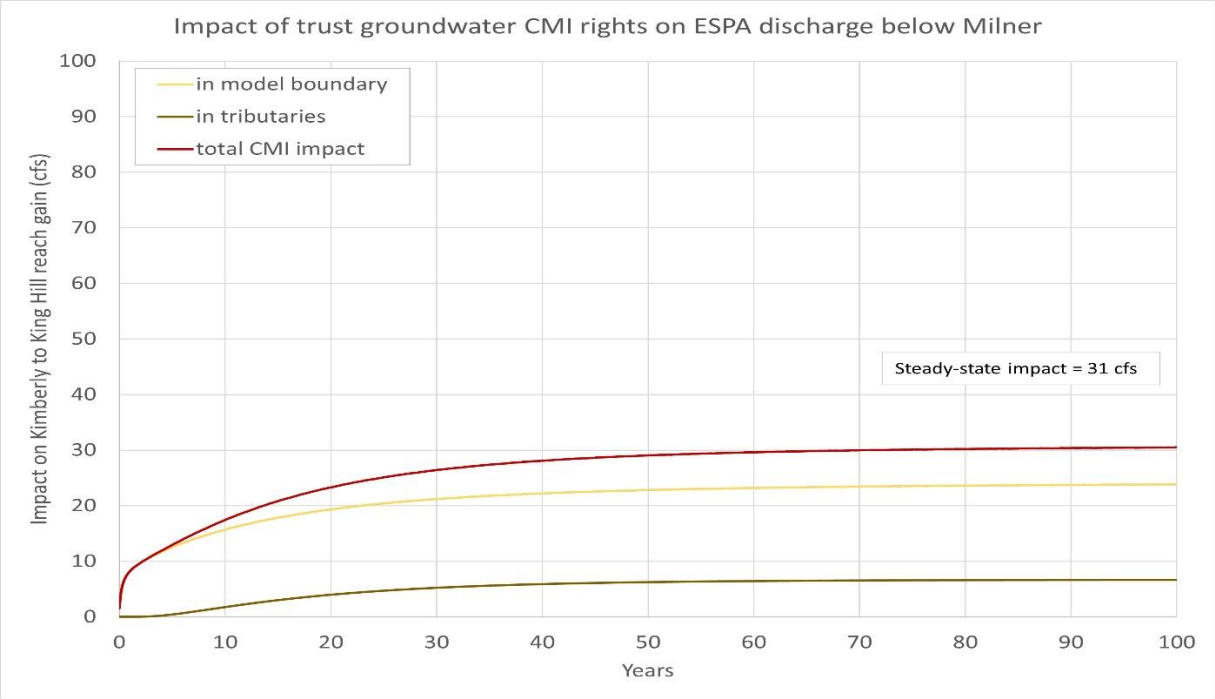

Figure 3. Maximum impact of trust groundwater commercial, municipal, and industrial water rights diverted from the ESPA and tributary basins

Predictive uncertainty in ESPAM2.2 model predictions

The uncertainty of ESPAM2.2 predictions of long-term responses to aquifer stresses was evaluated following completion of the model calibration[6]. The predictive uncertainty analysis included evaluations of the uncertainty of predictions of the response at the Kimberly to King Hill reach to aquifer stresses applied in each of seven regions within the model boundary. Based on an aggregation of the results for the seven predictions, the estimated predictive uncertainty for a model prediction of the long-term response in the Snake River below Milner Dam to aquifer stresses distributed throughout the model domain is +/-3.6% (Table 2).

[6] Sukow, J., 2021, *Predictive Uncertainty Analysis, Eastern Snake Plain Aquifer Model Version 2.2*, Idaho Department of Water Resources, 44 p., https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM22_Reports/UncertaintyRpt/E22PredUnc_Final.pdf.

Table 2. ESPAM2.2 predictive uncertainty analyses for the Kimberly to King Hill reach

District	Applied Stress (cubic feet per day (cfd))	Calibrated Impact (cfd)	Post-calibration standard deviation (cfd)	Post-calibration 95% confidence interval (cfd)
WD33	5,534,425	144,059	8,469	16,599
WD34	5,382,210	1,586,725	112,678	220,849
WD100	14,669,608	24,897	3,466	6,794
WD110	46,659,571	602,703	45,151	88,496
WD120	123,918,862	5,201,317	131,761	258,251
WD130	93,942,633	50,947,644	714,431	1,400,284
WD140	34,852,549	16,208,780	366,955	719,232
Sum	324,959,857	74,716,125	1,382,911	2,710,506

Aggregate predictive uncertainty = 2,710,506/74,716,125 = 3.6%

As noted in the predictive uncertainty report, predictive uncertainty analyses only consider the uncertainty associated with adjustable model parameters and do not account for potential predictive error resulting from other sources such as the conceptual model, model discretization, or the values of fixed model parameters. The total uncertainty in model predictions of impact to Snake River flow below Milner Dam will be somewhat greater than +/- 3.6%.

Conclusions

The estimated long-term average annual impact of trust groundwater rights on ESPA discharge to the Snake River below Milner Dam is between 61 cfs and 92 cfs. The estimated long-term seasonal impact in March is between 51 cfs and 82 cfs. The estimated long-term seasonal impact in August is between 71 cfs and 102 cfs. The ranges reflect a lack of information on the consumptive use associated with the commercial, municipal, and industrial water rights. The model predictive uncertainty of +/- 3.6% is +/- 2 cfs to +/- 4 cfs for the estimates listed above.

Model results indicate that approximately 80% of the long-term impact rate is realized in the Kimberly to King Hill reach within the 25 years and approximately 88% of the long-term impact rate is realized in the Kimberly to King Hill reach within 35 years. Recent river flows reflect the majority, but not all, of the long-term impacts of trust water rights on aquifer discharge to the Kimberly to King Hill reach.

Question 3. Analyze impacts of groundwater trust rights outside of the ESPA on Snake River flow below Milner Dam

Groundwater trust rights in the Twin Falls area and Western Snake Plain

Groundwater trust rights with points of diversion (PODs) located outside of the ESPA and its tributary basins were identified from a list compiled from IDWR's water right database by Cody Parker, Water Rights Supervisor, in March 2022. These water rights PODs are generally located in the Twin Falls area south of the Snake River, and in the Western Snake Plain (WSP). Water rights with irrigation, commercial, municipal, and industrial uses were included in the impact analysis. Other water uses were assumed to have minimal consumptive use and were excluded from the analysis. Table 3 summarizes the aggregate diversion rate limits of trust groundwater rights included in the analysis. Figure 4 shows the POD locations of trust groundwater rights included in the analysis.

Table 3. Trust groundwater right aggregate diversion rate limits for irrigation and CMI uses.

AREA	IRRIGATION (cfs)	COMMERCIAL (cfs)	MUNICIPAL (cfs)	INDUSTRIAL (cfs)
Twin Falls and WSP	134	6	33	2

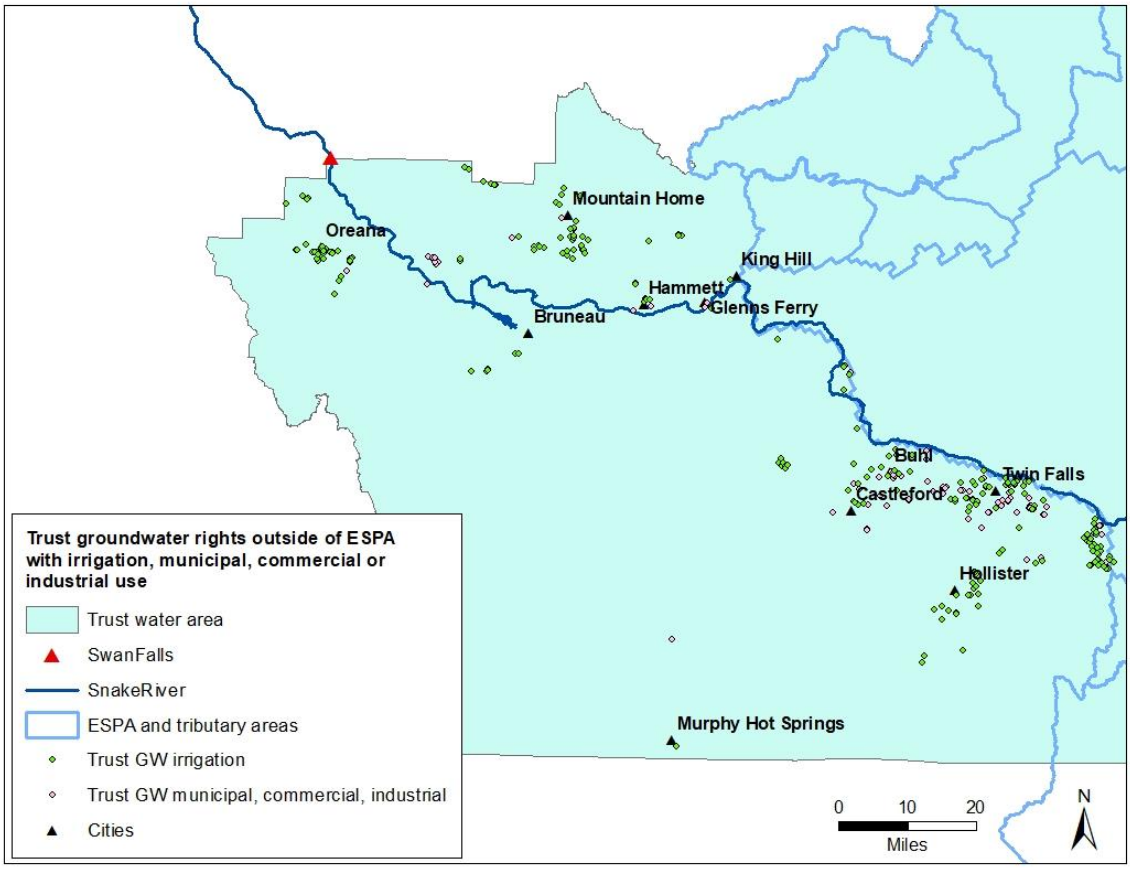

Figure 4. Trust groundwater rights diverted outside of the ESPA and tributary basins

Consumptive water use estimates for groundwater trust rights in the Twin Falls area and Western Snake Plain

The consumptive water use associated with irrigation water rights is expected to be less than the water right diversion limit and will vary both seasonally and annually with crop irrigation demand. Monthly consumptive use was calculated by multiplying the ET_{Idaho} 30-year average monthly precipitation deficit for peak alfalfa (no cutting effects) by the acres irrigated. An ET_{Idaho} station was assigned to each POD outside the ESPAM boundary using a shapefile of the station locations (ETIdahoStations_Poly.shp). The number of acres irrigated with each water right was estimated by dividing the water right diversion rate limit by 0.02 cfs.

The average annual consumptive use estimated for trust groundwater irrigation rights with PODs located in the Twin Falls area and western Snake Plain is 27,000 AF/yr (37 cfs) for approximately 7,000 acres. The average peak month consumptive use occurs in July and is estimated to be 5,500 AF/month (90 cfs).

Consumptive use associated with commercial, municipal, and industrial uses may vary significantly with the specific nature of use and wastewater treatment methods. For this analysis, water right diversion limits (diversion rate or annual volume) were used to represent the maximum consumptive use that might occur and were applied at a constant rate year-round. Actual consumptive use is expected to be less than the maximum diversion limit, but cannot be estimated without considerable research into individual water user operations and water right portfolios.
The maximum annual consumptive use for trust commercial, municipal, and industrial rights is 25,000 AF/yr (35 cfs) for water rights with PODs located in the Twin Falls area and Western Snake Plain. These values are less than the aggregate maximum diversion rates in Table 3, because some water rights have more restrictive annual diversion volume limits.

Impact of groundwater trust rights in Twin Falls area and western Snake Plain on Snake River flow below Milner Dam

The long-term impact of trust groundwater use in the Twin Falls area and Western Snake Plain on Snake River flow below Milner Dam is assumed to be equal to the volume of consumptive use (Figure 5). The timing of impacts has not been evaluated for this analysis.

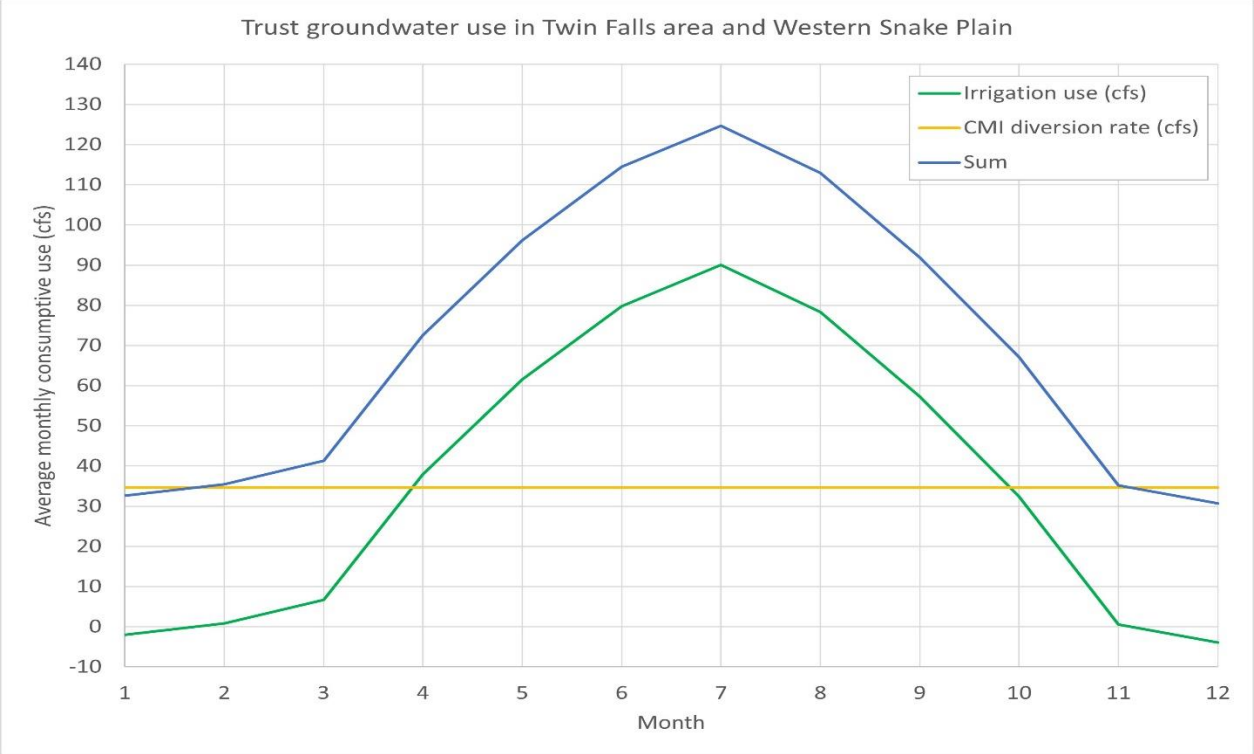

Figure 5. Estimated consumptive use of trust water in Twin Falls area and Western Snake Plain

Conclusions

The estimated long-term average annual impact of trust groundwater rights in the Twin Falls area and Western Snake Plain on the Snake River below Milner Dam is between 37 cfs and 72 cfs. The range reflects a lack of information on the consumptive use associated with the commercial, municipal, and industrial water rights. The long-term seasonal impact in March will be less than the annual average. The long-term peak summer impact will be higher than the annual average. The long-term peak summer impact may be as high 90 to 125 cfs, but will be attenuated by response time and can be expected to be between the annual average and maximum values.

Question 4. Analyze impacts of surface water trust water right diversions on Snake River flow below Milner Dam

Surface water trust rights

Surface water trust rights were identified from a list compiled from IDWR's water right database by Cody Parker, Water Rights Supervisor, in March 2022. Water rights with irrigation, commercial, municipal, and industrial uses were included in the impact analysis. Other water uses were assumed to have minimal consumptive use and were excluded from the analysis. Table 4 summarizes the aggregate maximum diversion rates of trust surface water rights included in the analysis. Figure 6 shows the POD locations of trust groundwater rights included in the analysis.

Table 4. Trust surface water right aggregate maximum diversion rates for irrigation and CMI uses.

AREA	IRRIGATION (cfs)	COMMERCIAL (cfs)	MUNICIPAL (cfs)	INDUSTRIAL (cfs)
Tributary to Snake River below Milner Dam (see Figure 6)	101	<1	4	0

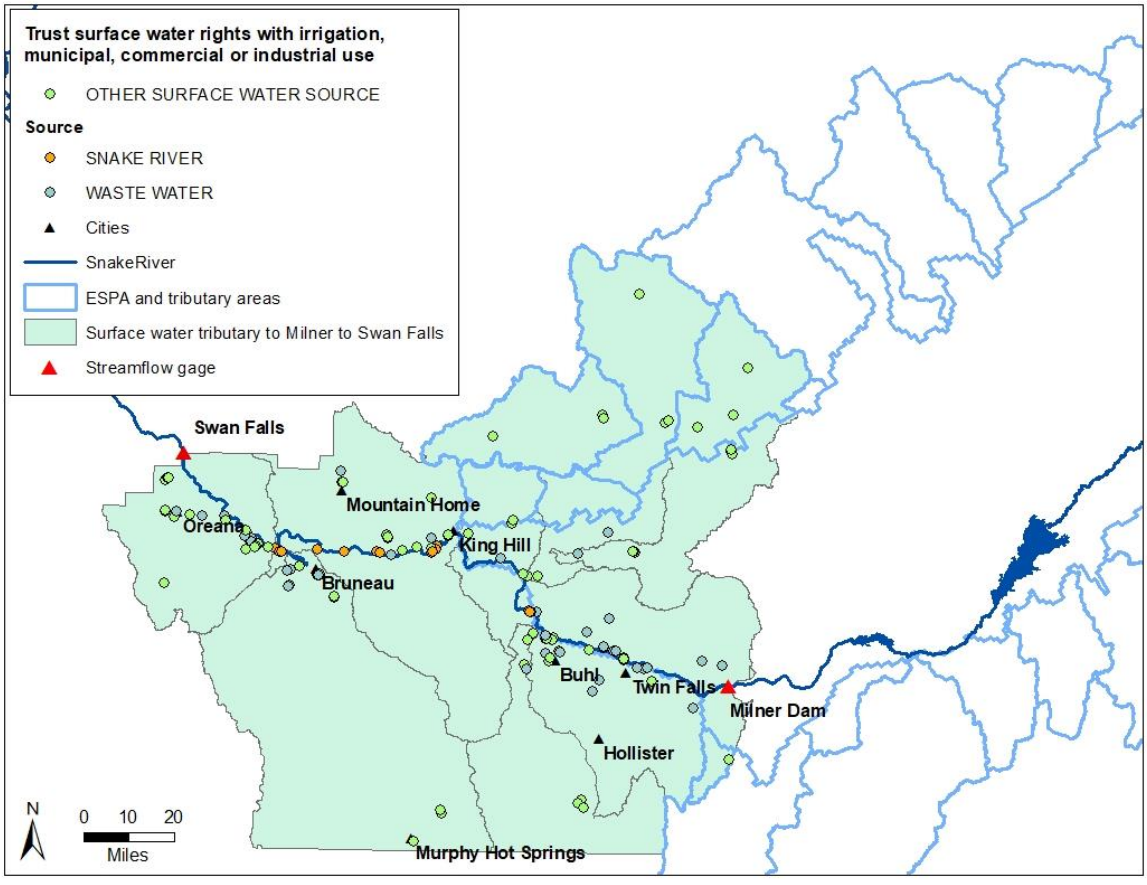

Figure 6. Trust surface water rights with irrigation, commercial, municipal, or industrial use

Consumptive water use estimates for trust surface water rights

The consumptive water use associated with irrigation water rights is expected to be less than the water right diversion limit and will vary both seasonally and annually with crop irrigation demand. Potential monthly consumptive use was calculated by multiplying the ET_{Idaho} 30-year average monthly precipitation deficit for peak alfalfa (no cutting effects) by the acres irrigated. An ET_{Idaho} station was assigned to each POD outside the ESPAM boundary using a shapefile of the station locations (ETIdahoStations_Poly.shp). The number of acres irrigated with each water right was estimated by dividing the water right diversion rate limit by 0.02 cfs.

Because trust surface water rights have relatively late priority dates, irrigation consumptive use may also be limited by surface water availability, depending on the water source. The trust surface water rights are diverted from 40 different water sources (Figure 7). Approximately 55% of the trust surface water rights are regulated by 20 different water districts. The other 45% are either not regulated by a water district or have not been associated with a water district in the database (Figure 8). Determining historic water availability for each individual trust surface water right would require considerable research and records may not be available for many of the water rights. Water availability was not evaluated for this analysis.

The average annual potential consumptive use estimated for trust surface water irrigation rights is 20,000 AF/yr (28 cfs) for approximately 5,000 acres. The average potential consumptive use during March is estimated to be 400 AF/month (7 cfs). The average potential peak month consumptive use occurring in July is estimated to be 4,200 AF/month (68 cfs). Average irrigation consumptive use is likely lower than these values because of limited water availability to fill some of the surface water rights.

Consumptive use associated with commercial, municipal, and industrial uses may vary significantly with the specific nature of use and wastewater treatment methods. For this analysis, water right diversion limits (diversion rate or annual volume) were used to represent the maximum consumptive use that might occur and were applied at a constant rate year-round. Actual consumptive use is expected to be less than the maximum diversion limit, but cannot be estimated without considerable research into individual water user operations and water right portfolios.
The maximum annual consumptive use for trust surface water rights with commercial, municipal, and industrial use is 3,200 AF/yr (4 cfs).

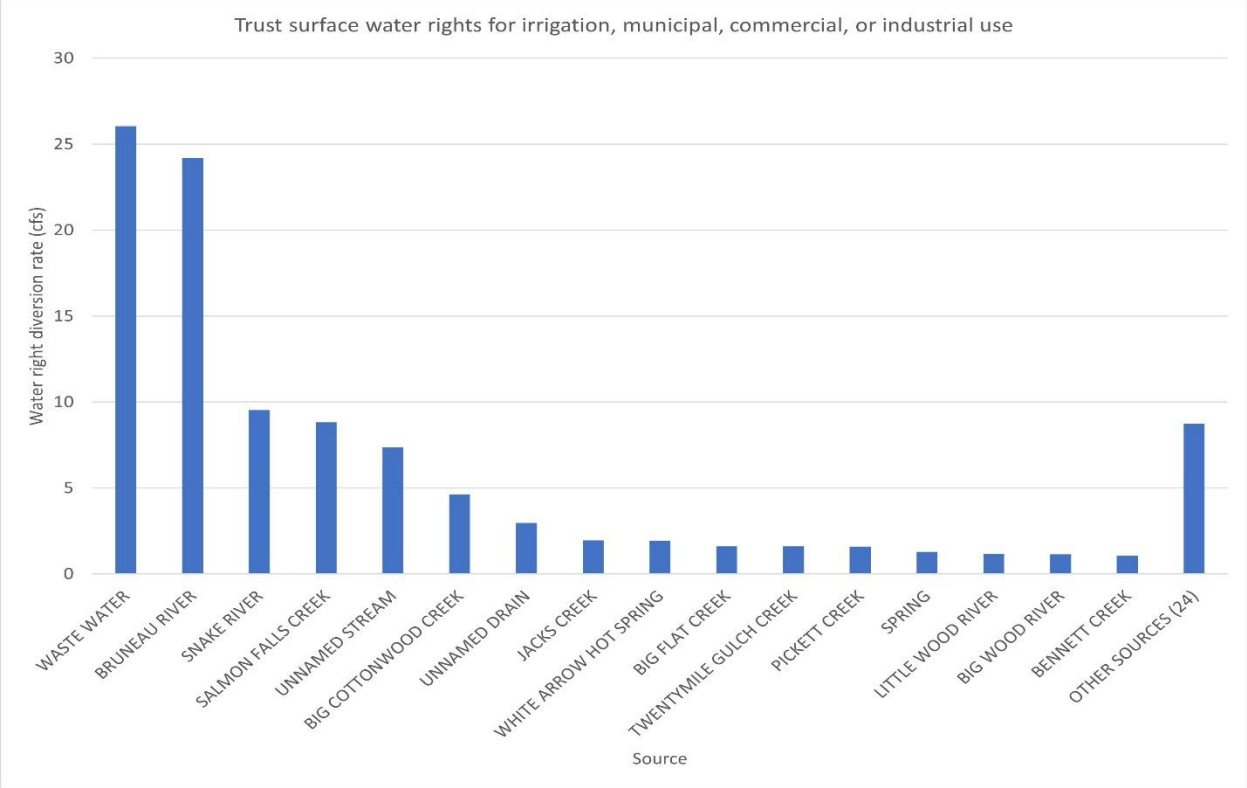

Figure 7. Trust surface water rights for irrigation or CMI uses by water source

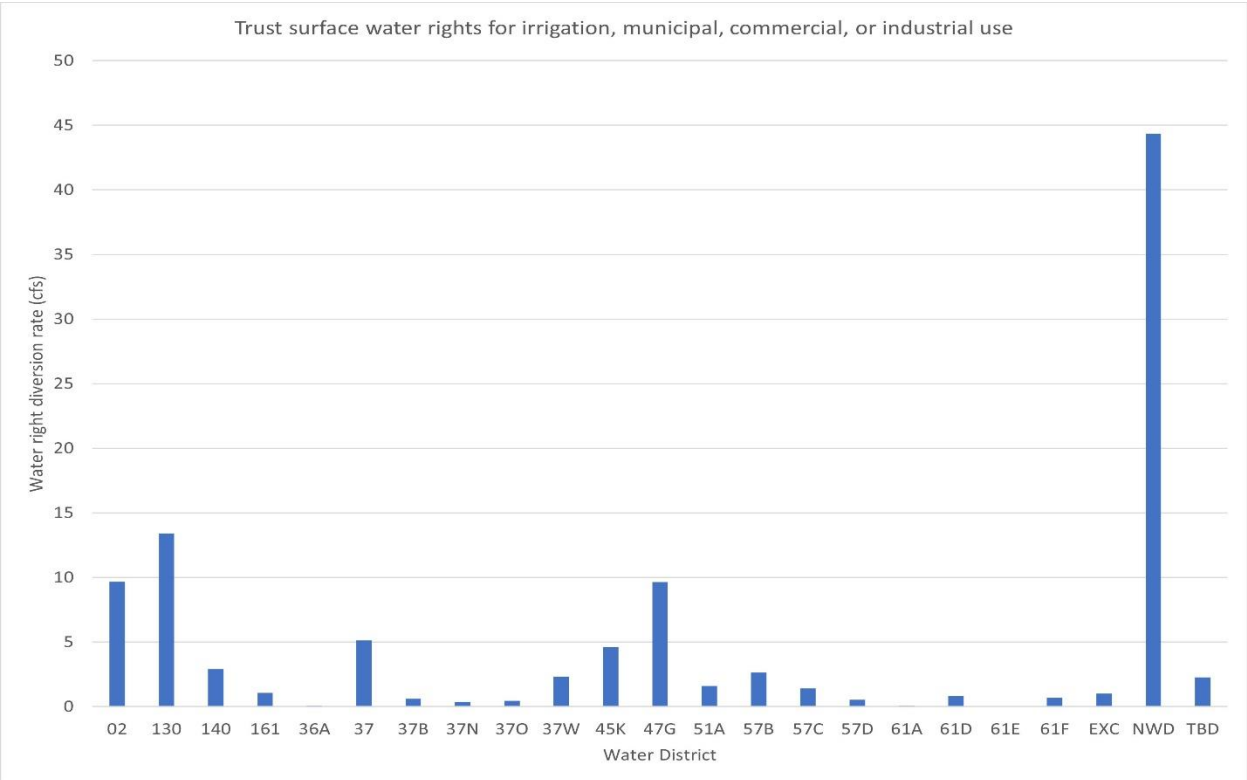

Figure 8. Trust surface water rights for irrigation or CMI uses by water district

Impact of surface water trust rights on Snake River flow below Milner Dam

The impact of trust surface water use on Snake River flow below Milner Dam is assumed to be equal to the volume of consumptive use. Because surface water availability may be limited for some of the trust water rights, the actual consumptive use and impact on Snake River flow are expected to be less than the potential consumptive use shown in Figure 9.

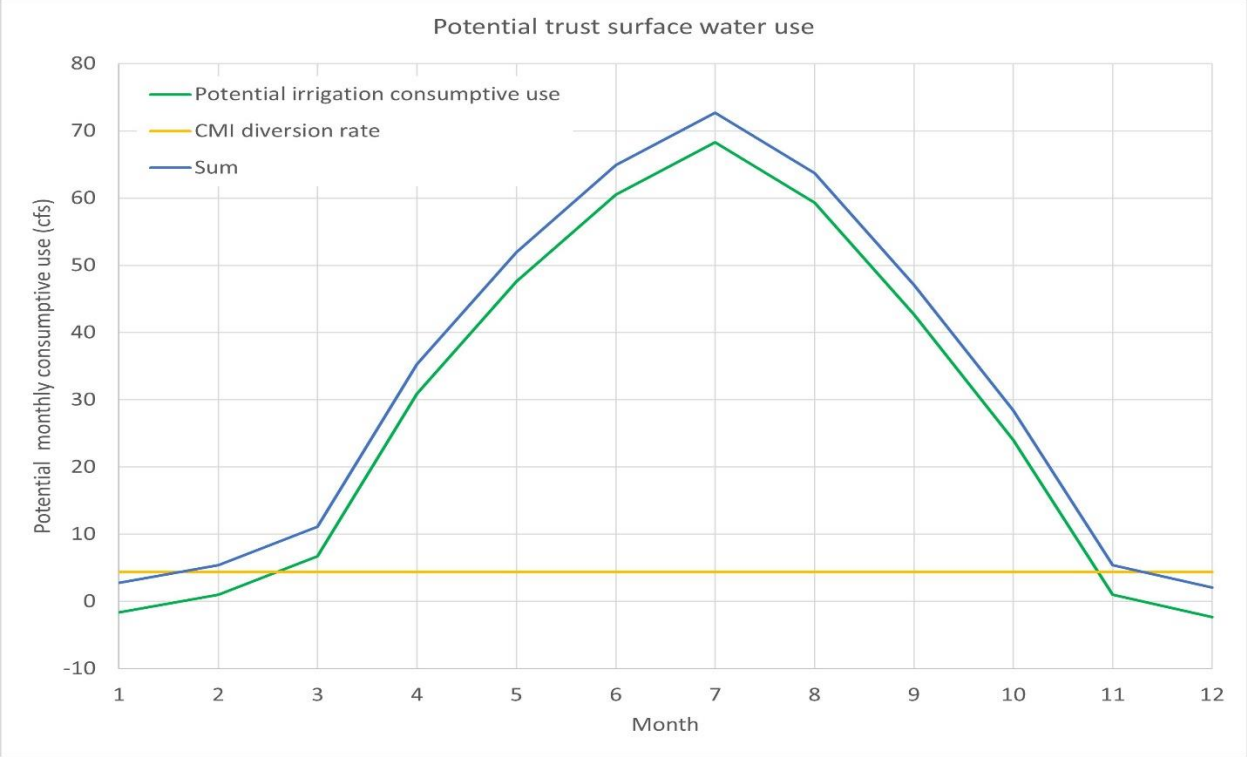

Figure 9. Potential consumptive use of trust surface water

Conclusions

The potential annual average impact of trust surface water rights for irrigation, commercial, municipal, and industrial uses on Snake River flow below Milner Dam is estimated to be 33 cfs. The estimated monthly potential impact is 11 cfs in March and 73 cfs in July. Actual impact is expected to be less than the potential because of limited surface water availability in some areas.

Summary of conclusions for Questions 2-4

Table 5 summarizes the estimated long-term impacts of trust water use on Snake River flow below Milner Dam. The estimated long-term annual average impact of trust water use is between 98 cfs and 197 cfs. The estimated long-term impact in March is between 58 cfs and 165 cfs. The estimated long-term peak summer impact is between 108 cfs and 300 cfs.

The ranges reflect a lack of information on the consumptive use associated with the commercial, municipal, and industrial water rights, uncertainty in the timing of impacts from irrigation use in the Twin Falls area and Western Snake Plain, and uncertainty on surface water available to fill surface water trust rights. There is also uncertainty in the estimates of consumptive use associated with irrigation water rights and with the ESPA groundwater flow model predictions used to answer Question 2, but these uncertainties are smaller and are expected to be within the ranges presented. Because the high end of the ranges reflects several conservative assumptions, actual impacts are expected to be in the lower half of the ranges.

Table 5. Summary of estimated long-term impacts of trust water use on Snake River reach gain between Milner Dam and Swan Falls

Time period	ESPA and tributary groundwater trust rights	Twin Falls area and Western Snake Plain groundwater trust rights	Surface water trust rights	Sum
Average annual impact (cfs)	61-92	37-72	<33	98-197
March impact (cfs)	51-82	7-72	<11	58-165
Peak summer impact (cfs)	71-102	37-125	<73	108-300