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DEPARTMENT OF
WATER RESOURCES

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BEFORE THE DEPARTMENT OF WATER RESOURCES

OF THE STATE OF IDAHO

IN THE MATTER OF DISTRIBUTION OF WATER TO VARIOUS WATER RIGHTS HELD BY OR FOR THE BENEFIT OF A&B IRRIGATION DISTRICT, AMERICAN FALLS RESERVOIR DISTRICT #2, BURLEY IRRIGATION DISTRICT, MILNER IRRIGATION DISTRICT, MINIDOKA IRRIGATION DISTRICT, NORTH SIDE CANAL COMPANY, AND TWIN FALLS CANAL COMPANY

Docket No. CM-DC-2010-001

CITY OF IDAHO FALLS, CITY OF POCATELLO, AND COALITION OF CITIES' SECOND AMENDED JOINT DISCLOSURE OF PROPOSED EXHIBITS FOR HEARING

The City of Idaho Falls, the City of Pocatello, and the Coalition of Cities[1] (collectively, "Cities") submit this *Second Amended Joint Disclosure of Proposed Exhibits for Hearing* ("Second Amended Joint Exhibit Disclosure") in compliance with the Director of the Idaho Department of Water Resources Department's May 2, 2023 *Scheduling Order and Order Authorizing Remote Appearance at Hearing* (p. 3). This Second Amended Joint Exhibit Disclosure deletes Exhibit 347 and replaces it with Exhibit 347A, Expert Report of Gregory

[1] The Coalition of Cities includes the Cities of Bliss, Burley, Carey, Declo, Dietrich, Gooding, Hazelton, Heyburn, Jerome, Paul, Richfield, Rupert, Shoshone, and Wendell

K. Sullivan, P.E. (rev. 6-4-2023) on Behalf of the Cities of Pocatello, Idaho Falls, and the Coalition of Cities.

DATED this 5th day of June, 2023.

SOMACH SIMMONS & DUNN

By____________________________
Sarah A. Klahn, ISB # 7928

Attorneys for City of Pocatello

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By___/s/ Robert L. Harris____________
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Attorneys for City of Idaho Falls

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that on this 5th day of June, 2023, I caused to be filed a true and correct copy of the foregoing document to be filed and served via electronic mail to the following:

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EXHIBIT 347A
(Rev. 6-4-2023)

Expert Report

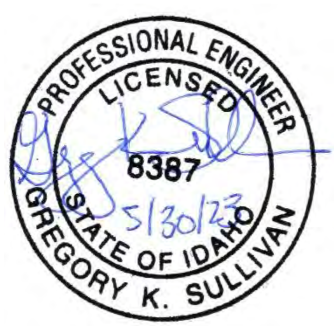
Surface Water Coalition Methodology Order

Prepared for:

City of Idaho Falls
City of Pocatello
Coalition of Cities

Prepared by:

Gregory K. Sullivan, P.E.



May 30, 2023

SWE EST.1984 Spronk Water Engineers, Inc.

Errata

Expert Report
Surface Water Coalition
Methodology Order

Gregory K. Sullivan, P.E.

<u>Report Text</u>

Section 1.0

P. 1, Paragraph 1, Line 6: Deleted text "The Fifth Methodology Order amends and replaces the Fourth Methodology Order that was issued in 2016."

P. 1, Paragraph 2, Line 1: Added text "The SWC members divert from the Snake River between Lake Walcott and Milner Dam under mostly senior natural flow water rights. They also have storage contracts in various upstream Bureau of Reclamation reservoirs. The following are the SWC members:

- A&B Irrigation District ("A&B")
- American Falls Reservoir District #2 ("AFRD2")
- Burley Irrigation District ("BID")
- Milner Irrigation District ("Milner")
- Minidoka Irrigation District ("Minidoka")
- North Side Canal Company ("NSCC")
- Twin Falls Canal Company ("TFCC")"

P. 1, Paragraph 3, Line 1: Added text "A more detailed summary of the SWC natural flow water rights and storage contracts is contained in SWE's 2007 expert report prepared for the 2008 hearing for the SWC delivery call (SWE 2007a)."

P. 2, Paragraph 1, Line 1: "The Fifth Methodology Order made" should read "The Fifth Methodology Order amends and replaces the Fourth Methodology Order that was issued in 2016, and makes"

P. 2, Bullet 3, Line 2: "Aquifer Groundwater Model" should read "Aquifer Model"

P. 2, Paragraph 2, Line 1: "Hearing Officer Schroeder's ruling" should read "April 29, 2008, Order from Hearing Officer Schroeder (former Chief Justice of the Idaho Supreme Court)"

P. 3, Paragraph 4, Line 3: "April-As Applied" should read "April As-Applied"

P. 3, Paragraph 2, Line 5: "technical working groups" should read "technical working groups ("TWG")"

P. 3, Paragraph 2, Line 7: "Technical Working Group ("TWG")" should read "TWG"

P. 4, Bullet 1, Line 5: "A&B Irrigation District, American Falls Reservoir District #2, Burley Irrigation District, Milner Irrigation District, Minidoka Irrigation District,

	North Side Canal Company, and Twin Falls Canal Company [“SWC”]” should read “the SWC”
P. 4, Bullet 6, Line 2:	“Idaho Department of Resources” should read “Idaho Department of Water Resources”

Section 2.0

P. 6, Paragraph 2, Line 1:	“The IDWR supports the average combined SWC diversions during 2000-2021 of 3,200,389 AF described in paragraph 27 and the reported backup file is the diversion data” should read “The IDWR support for the average combined SWC diversions during 2000-2021 of 3,200,389 AF in paragraph 27 is provided in a backup file of diversion data”
P. 6, Paragraph 3, Line 2:	“Fourth Methodology” should read “Fourth Methodology Order”
P. 6, Paragraph 3, Line 3:	“show” should read “shows”
P. 6, Paragraph 5, Line 1:	Deleted text “difference between”
P. 7, Paragraph 4, Line 6:	Added text “(Idaho 1903)”

Section 3.0

P. 8, Paragraph 1, Line 9:	“IDWRIDWR” should read “IDWR”
P. 10, Paragraph 1, Line 1:	“systems.” should read “systems (blue line).”
P. 10, Paragraph 4, Line 6:	“2008” should read “2008,”
P. 12, Paragraph 1, Line 4:	Deleted text “also”
P. 12, Paragraph 1, Line 7:	“It is not expected that the SWC members would at times operate at lower efficiencies than the reasonable values” should read “The SWC members may at times operate at lower efficiencies than the reasonable values when water supplies are plentiful”
P. 12, Paragraph 1, Line 10:	“than” should read “that"
P. 13, Section Header, Line 1:	“Fifth Methodology” should read “Fifth Methodology Order”
P. 13, Paragraph 1, Line 4:	“Firth” should read “Fifth”
P. 16, Paragraph 1, Line 5:	“shortfall” should read "shortfalls”

Section 4.0

P. 17, Paragraph 1, Line 1:	“April 29, 2008,” should read “2008”
P. 17, Paragraph 1, Line 1:	Deleted text “(former Chief Justice of the Idaho Supreme Court)”
P. 17, Paragraph 2, Line 2:	“IGW A” should read “IGWA”
P. 17, Paragraph 2, Line 4:	“of75,152” should read “of 75,212”

P. 18, Inset Table:	Added highlights to methodology acres column for Burley, Minidoka, and TFCC
P. 18, Paragraph 3, Line 1:	Added text "for Burley, Minidoka, and TFCC"
P. 18, Paragraph 3, Line 2:	"proposed to be used" should read "used"

Section 6.0

P. 22, Paragraph 3, Line 1:	"right" should read "rights"
P. 22, Paragraph 4, Line 1:	"The Fifth Methodology asserts that it must now update" should read "IDWR now asserts in the Fifth Methodology Order that it must"
P. 22, Paragraph 4, Line 2:	"has" should read "it has"
P. 22, Paragraph 4, Line 3:	"halfmonth time step" should read "calibration using monthly stress periods and halfmonth time steps"
P. 23, Paragraph 2, Line 1:	"The Fifth Methodology asserts" should read "IDWR asserts in the Fifth Methodology Order"
P. 23, Paragraph 6, Line 1:	"The halfmonth timestep has" should read "Monthly stress period and halfmonth time steps have"
P. 23, Paragraph 6, Line 1:	"ESPAM 2.1" should read "ESPAM"
P. 23, Paragraph 6, Line 2:	"is not a new refinement" should read "are not new refinements"
P. 23, Paragraph 6, Line 2:	"Even with prior versions of ESPAM understanding the impact difference between steady-state modeling verses transient modeling was well understood by me and all members of the ESPAM modeling committee including the Department who frequently discussed and evaluated the different versions of the model." should read "Prior to ESPAM 2.1, the differences between steady-state modeling and transient modeling were well understood by IDWR and the ESHMC members and were frequently discussed during meetings."
P. 23, Paragraph 8, Line 3:	"the pre-moratorium" should read "pumping by pre-moratorium wells"
P. 24, Paragraph 1, Line 2:	"November 28, 2022" should read "November 28, 2022,"
P. 25, Paragraph 5, Line 4:	"November 28, 2022" should read "November 28, 2022,"

Section 7.0

P. 27, Bullet 3, Line 2:	"arbitrary, capricious, and unrealistic" should read "arbitrary and unreasonable"
P. 27, Bullet 3, Line 4:	"considered" should read "considered in computing the average annual diversions"
P. 27, Bullet 4, Line 2:	"monthly project efficiencies have declined." should read "project efficiencies of most SWC members have declined."

P. 27, Bullet 5, Line 1:	“conversions, advancements” should read “conversions and advancements”
P. 27, Bullet 5, Line 2:	Deleted text “, and reductions in irrigated area due to development and urbanization”
P. 27, Bullet 6, Line 1:	“Low” should read “Lower”
P. 28, Bullet 9, Line 1:	“show” should read “during the last 15 years show”
P. 28, Bullet 11, Line 1:	“crop” should read “SWC diversion”
P. 28, Bullet 12, Line 7:	Added text “The monthly efficiency values for September should be used for October.”

Section 8.0

P. 30, Paragraph 1, Line 1:	Added text “The following information was relied upon in preparing this expert report.”
P. 30, Paragraph 4, Line 1:	Added text “Idaho. 1903. Contract Between Idaho State Board of Land Commissioners and Twin Falls Land and Water Company. January 2, 1903.”
P. 32, Paragraph 1, Line 4:	Added text “, and all references listed therein”
P. 32, Paragraph 3, Line 4:	Added text “, and all references listed therein”
P. 32, Paragraph 4, Line 1:	Added text "Sullivan, 2008a. Spronk Water Engineers, Inc. Expert Report Dated July 16, 2008 Prepared for the City of Pocatello. In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area, and all references listed therein.”
P. 32, Paragraph 5, Line 1:	Added text “Sullivan, 2008b. Spronk Water Engineers, Inc. Expert Rebuttal Report Dated August 27, 2008 Prepared for the City of Pocatello. In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area, and all references listed therein.”
P.32, Paragraph 6, Line 1:	Added text “Sullivan, 2008c. Spronk Water Engineers, Inc. Expert Sur-Rebuttal Report Dated September 16, 2008 Prepared for the City of Pocatello. In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area, and all references listed therein.”

Figures

P. 35:	Added Figure 1-1

Tables

P. 57, Table 3-1:	Values changed in column “CWN/Regression & Avg PE” in years 2008, 2011-2015, 2017, 2019, and 2020

P. 57, Table 3-1:	Values changed in column “CWN/Regression & 75% PE” in years 2012-2015, 2017, 2019, and 2020
P. 57, Table 3-1:	Value changed in column “Regression & Avg PE” in year 2015
P. 57, Table 3-1, Note 3:	“(min efficiency = historical average).” should read “(min efficiency = historical average; Oct PE = Sep PE).”
P. 57, Table 3-1, Note 4:	“(min efficiency = 75th percentile PE from historical data).” should read “(min efficiency = 75^{th} percentile PE from historical data; and Oct PE = Sep PE).”
P. 58, Table 3-1:	Values changed in column “CWN/Regression & Avg PE” in years 2008-2015 and 2017-2020
P. 58, Table 3-1:	Values changed in column “CWN/Regression & 75% PE” in years 2008-2015 and 2017-2020
P. 58, Table 3-1:	Value changed in column “Regression & Avg PE” in year 2013 and 2015
P. 58, Table 3-1:	Value changed in column “Regression & 75% PE” in year 2013
P. 58, Table 3-2, Note 3:	“(min efficiency = historical average).” should read “(min efficiency = historical average; Oct PE = Sep PE).”
P. 58, Table 3-2, Note 4:	“(min efficiency = 75th percentile PE from historical data).” should read “(min efficiency = 75^{th} percentile PE from historical data; and Oct PE = Sep PE).”

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FIGURES

TABLE

1.0 INTRODUCTION

On April 21, 2023, the Director of the Idaho Department of Water Resources ("IDWR") issued the *Fifth Amended Final Order Regarding Methodology for Determining Material Injury To Reasonable In-Season Demand and Reasonable Carryover* ("Fifth Methodology Order") describing procedures for IDWR's administration of a delivery call by the Surface Water Coalition ("SWC") that was originally placed in 2005 and has been administered ever since under what is generically referred to herein as the "SWC Methodology."

The SWC members divert from the Snake River between Lake Walcott and Milner Dam under mostly senior natural flow water rights. They also have storage contracts in various upstream Bureau of Reclamation reservoirs. The following are the SWC members:

- A&B Irrigation District ("A&B")
- American Falls Reservoir District #2 ("AFRD2")
- Burley Irrigation District ("BID")
- Milner Irrigation District ("Milner")
- Minidoka Irrigation District ("Minidoka")
- North Side Canal Company ("NSCC")
- Twin Falls Canal Company ("TFCC")

A more detailed summary of the SWC natural flow water rights and storage contracts is contained in SWE's 2007 expert report prepared for the 2008 hearing for the SWC delivery call (SWE 2007a).

On April 21, 2023, the IDWR Director also issued the *Final Order Regarding April 2023 Forecast Supply (Methodology Steps 1-3)* ("April As-Applied Order") describing the Director's implementation of Steps 1-3 of the Fifth Methodology Order in forecasting in-season water supply shortages to the SWC members in 2023. Based on the forecast shortages, the Director ordered that groundwater rights with priority dates junior to December 30, 1953, that are not part of an effectively operating mitigation plan will be subject to curtailment beginning on May 5, 2023.

Finally on April 21, 2023, the IDWR Director issued a *Notice of Hearing, Notice of Prehearing Conference, and Order Authorizing Discovery* that set a hearing on the SWC Methodology for June 6-10, 2023, in Boise, Idaho. According to a subsequent order on May 2, 2023, the deadline for submittal of expert reports from the parties is seven days before the first day of the hearing, which would be May 30, 2023.

The Fifth Methodology Order amends and replaces the Fourth Methodology Order that was issued in 2016, and makes several substantive changes to the SWC Methodology including the following:

- Change in the Baseline Year used to forecast the SWC member demands from an average of the member diversions during 2006, 2008, and 2012 to instead use the member diversions during 2018.
- Changes in the monthly project efficiencies for the SWC members that are used to compute monthly diversion demands for prior months when the shortage computations are updated mid-season (July), at the time of need, and after the irrigation season (November).
- Change in how the priority date for curtailment of groundwater rights is determined using the Eastern Snake Plain Aquifer Model ("ESPAM") from using steady-state curtailment runs to using transient curtailment runs.

It has been over 15 years since the 2008 hearing and April 29, 2008, Order from Hearing Officer Schroeder (former Chief Justice of the Idaho Supreme Court) that resulted in the Second Methodology Order issued in 2010. That was the last time the SWC Methodology was significantly scrutinized, and there are now 15 years of actual operating experience available to evaluate how the SWC Methodology has functioned. In addition, there have been numerous changed conditions over the last 15 years that may have affected surface water and groundwater use in the Upper Snake River Basin including the following:

- Urbanization of formerly irrigated parcels,
- Continued gravity to sprinkler conversions,
- Changes in crops,
- Canal lining,
- Advancements in remote sensing,
- Improved irrigation management,
- More and better measurements of water distribution and water use,
- More automation of irrigation facilities,
- Delivery of mitigation supplies to SWC members,
- Changes in WD01 accounting procedures, and
- Changes in WD01 rental pool rules.

Given these changed conditions and the substantive changes to the SWC Methodology included in the Fifth Methodology Order, now is an appropriate time to review all aspects of the SWC Methodology to determine whether the SWC members are operating with reasonable efficiencies and without waste, the SWC members are protected from material injury due to junior groundwater pumping, the groundwater users are protected from excessive or undue curtailment and mitigation obligations, and the beneficial uses of the interconnected surface water and groundwater resources of the Snake River and the ESPA are maximized.

This expert report was prepared on behalf of the following entities who successfully petitioned to intervene in the SWC Methodology matter ("ESPA Cities"):

- City of Idaho Falls,
- City of Pocatello, and
- Coalition of Cities[1].

A map showing the locations of the ESPA Cities, the service area boundaries of the SWC members, and the ESPA Area of Common Groundwater is attached as **Figure 1-1**.

The compressed schedule established by the Director to complete discovery and prepare expert reports left insufficient time to perform all of the necessary work to thoroughly review the Fifth Methodology Order, the April As-Applied Order, and the historical operations of the SWC members during the last 15 years. The time limitations have necessitated that this report focus on certain key elements of the Fifth Methodology Order and eschew the more thorough review and analysis of the order that I would have performed had more time been made available prior to the expert report deadline and June hearing. Each section of this expert report describes my review, analysis, and expert opinions on a selected element of the Fifth Methodology Order. In addition to this expert report, I prepared and submitted two declarations in support of pre-hearing motions filed by the ESPA Cities. One of those declarations contains additional details regarding my prior work on the SWC Delivery Call and related matters.

My involvement in the SWC Delivery Call extends back to the original delivery call made by the SWC in 2005. In response to that delivery call, I compiled extensive data and analyzed the operations of the SWC irrigation systems. This included several weeks in the field observing diversion and conveyance facilities, irrigated farms, and irrigation application methods. In addition, I was present at the depositions of managers and staff of each of the SWC members regarding irrigation system operations, system losses and efficiencies, record keeping, and other related matters. Based on this information, I prepared analyses of the historical irrigation operations of each SWC member over the

[1] The Coalition of Cities includes the Cities of Bliss, Burley, Carey, Declo, Dietrich, Gooding, Hazelton, Heyburn, Jerome, Paul, Richfield, Rupert, Shoshone, and Wendell.

period from 1990 – 2006. The results of my work were documented in several expert reports and testimony presented at an IDWR hearing in February 2008.

Since the 2008 hearing regarding the SWC delivery call, I have reviewed the various amended methodology orders and the various as-applied orders concerning the SWC Methodology that have been issued over the years. In May 2010, I participated in a hearing on revisions to the SWC Methodology proposed by IDWR and testified at the hearing. I have also been involved in two technical working groups ("TWG") convened by IDWR to discuss potential changes to the SWC Methodology. The first was in early 2015 and the second in late 2022. I submitted comments to IDWR and the TWG in both instances.

I am incorporating into this Expert Report by reference the following expert reports and other information previously presented to IDWR and other parties:

- Franzoy, 2007. Franzoy Consulting, Inc. Expert Rebuttal Report Prepared in Rebuttal to Analyses and Conclusions of Experts for the Surface Water Coalition Dated November 7, 2007. Prepared for the City of Pocatello. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC.
- Sullivan, 2007a. Spronk Water Engineers, Inc. Updated Expert Report Dated September 26, 2007 (revised December 2007). Prepared for the City of Pocatello. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC.
- Sullivan, 2007b. Direct testimony of Gregory K, Sullivan, P.E. September 26, 2007 (Revised December 2007). Submitted on behalf of the City of Pocatello. In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of the SWC.
- Sullivan, 2007c. Spronk Water Engineers, Inc. Expert Rebuttal Report. November 7, 2007 (Revised December 2007). Prepared for the City of Pocatello. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC.
- Sullivan, 2015. Email to IDWR. Pocatello Comments on Draft Staff Memo. March 10, 2015.
- Sullivan and Netter, 2023. Spronk Water Engineers, Inc. Comments on behalf of the Coalition of Cities and the City of Pocatello on the Idaho Department of Water Resources Summary of Recommended Technical Revisions to the 4th Amended Final Order Regarding Methodology for Determining Material Injury to

Reasonable In-Season Demand and Reasonable Carryover for the Surface Water Coalition, by Kara Ferguson and Matt Anders on December 23, 2022. Comments Submitted on January 1, 2023.

- Sullivan, 2023a. Declaration of Gregory K, Sullivan, P.E. May 7, 2023. Case No. CM-DC-2010-0001.
- Sullivan, 2023b. Declaration of Gregory K, Sullivan, P.E. May 7, 2023. Case No. CM-DC-2010-001.

I stand by, reaffirm, and endorse my prior opinions and analyses described in the foregoing materials.

2.0 BASELINE YEAR

The Fifth Methodology Order changed the Baseline Year ("BLY") used to forecast the SWC diversion demands and reasonable carryover from the average diversions during 2006, 2008, and 2012 ("06/08/12") because the average diversions during these years reportedly no longer comply with a condition of the SWC Methodology that the BLY represent a year of above average diversions. Diversions of the SWC members reported in paragraph 27 of the Fifth Methodology Order indicated that the combined diversions of the SWC Members during 06/08/12 averaged 3,194,722 AF, which is 5,667 AF (0.18%) less than the combined diversions during 2000-2021 that averaged 3,200,389 AF. Annual diversions for the SWC members during 2000-2021 from the materials disclosed by Matt Anders (IDWR) during his deposition are summarized in **Table 2-1**.

The IDWR support for the average combined SWC diversions during 2000-2021 of 3,200,389 AF in paragraph 27 is provided in a backup file of diversion data disclosed by Matt Anders (IDWR) during his May 2023 deposition. However, the 06/08/12 average combined SWC diversions from the same data file are different than the figures reported in paragraph 27. The updated 06/08/12 combined diversions average 3,200,349 AF, which is only 40 AF (0.001%) less than the 2000-2021 average diversions.

The 06/08/12 average diversions in paragraph 27 are from the Fourth Methodology Order. Comparison of the backup data for the Fourth Methodology Order with the data disclosed by Mr. Anders shows that IDWR made some revisions to the prior data used for the Fourth Methodology Order. To be consistent, the same data should be used to compute and compare the 06/08/12 average and the 2000-2021 average.

To be sure, 3,200,349 AF is less than 3,200,389 AF, and so the 06/08/12 average is mathematically below average. However, this difference is insignificant and de minimis. Assuming a typical irrigation season from April 1 through October 31 (214 days), the combined diversions of the SWC members average approximately 15,000 AF/day. Therefore, the 40 AF that the 06/08/12 average diversions are below the 2000-2021 average represents less than five minutes of the combined amount that the SWC members divert on average.

The 40 AF that the 06/08/12 average diversions is below the 2000-2021 average is much less than the accuracy of the measuring flumes for the SWC member canals. Assuming the measurement accuracy of the SWC measuring devices is +/- 5%, the combined measurement error would be approximately 160,000 AF/year, which dwarfs the 40 AF that the 06/08/12 average diversions are below the 2000-2021 average. The Director's determination that the 06/08/12 average diversions no longer meet the above average criteria appears arbitrary, and there is no clear and convincing evidence that this is the case.

Finally, the 22-year period from 2000-2021 that was used to compute the average diversions of the SWC members arbitrarily and conspicuously does not include the most recent year of diversion data, 2022. If the diversion data from 2022 are included, the average combined diversion for 2000-2022 is 3,189,818 AF, which is 10,530 AF less than the 06/08/12 average of 3,200,349 AF. In other words, the 06/08/12 average diversions are above the 2000-2022 average, and based on this comparison, 06/08/12 should still qualify as an above average figure.

The Director selected 2018 as the new BLY for the SWC Methodology because it reportedly met all of the BLY criteria, including being a year of above average diversions. The combined SWC member diversions during the proposed 2018 BLY (3,341,939 AF) are approximately 142,000 AF greater than the 06/08/12 average diversions (3,200,349 AF). So, the 40 AF (5,667 AF uncorrected) that the 06/08/12 average diversions are below the 2000-2021 average will translate into a much larger increase in the BLY combined diversions. In turn, this large increase will also result in substantially greater projected shortages to the SWC members under the Fifth Methodology Order than under the Fourth Methodology Order.

Review of the data in the Anders' spreadsheet indicates that the 06/08/12 average diversions are no longer above average because the diversions of six of the seven SWC members have actually increased since the Fourth Methodology Order was issued in 2016. Furthermore, the Anders spreadsheet does not factor in that the legally established delivery rate for TFCC is one cfs for each eighty acres of land, or five-eighths of a miner's inches for each acre of land (Idaho, 1903).

The diversion averaging period used for comparison to the BLY diversions in the Fourth Methodology Order was 2000 – 2014. Average combined diversions by the SWC members during 2000 – 2014 averaged 3,154,945 AF. During the recent 2015 – 2021 period, combined diversions by the SWC members increased by an average of 142,826 AF as shown in **Table 2-1**. IDWR performed no analyses to assess the reasonableness of the increased SWC member diversions since 2014 that prompted the need to change the BLY.

3.0 PROJECT EFFICIENCIES

Following the initial forecast of the shortages to the SWC members that is made in April based on the BLY estimate of the RISD, Step 6 of the Methodology Order specifies that the RISD will be updated approximately halfway through the irrigation season (~July) using the monthly figures for each SWC member of the Crop Water Need ("CWN") and the Project Efficiency ("PE") up to that point during the irrigation season, and monthly baseline demand figures from the BLY for the remaining months. Additional updates to the RISD's and shortages of the SWC members based on CWN and PE are made shortly before the Time of Need (Step 7) and following the end of the irrigation season (Step 9). The following is the formula that IDWR uses to compute the RISD at mid-season, Time of Need, and end of season (Fifth Methodology Order P. 16):

$$RISD_{milestonex\_x} = \sum_{j=1}^{m}\left(\frac{CWN_j}{E_{p,j}}\right) + \sum_{j=m+1}^{7} BD_j$$

Where:

$RISD_{milestone\_x}$ = reasonable in season demand at specified evaluation milestones during the irrigation season,
CWN = crop water need for month j,
E_p = baseline project efficiency for month j,
BD = baseline demand for month j,
j = index variable, and
m = upper bound of summation, equal to the month calculation occurs, where April = 1, May =2, … October = 7.

Monthly CWN values are computed for each SWC member based on Agrimet evapotranspiration data, precipitation data, and cropping information using the following formula (Fifth Methodology Order P. 14):

$$CWN = \sum_{i=1}^{n}(ET_i - W_e)A_i$$

Where,

CWN = crop water need
ET_i = consumptive use of specific crop type,
W_e = effective precipitation,
A_i = total irrigated area of specific crop type,
i = index variable representing the different specific crop types grown within the irrigation entity, and
n = upper bound of summation equal to the total number of different specific crop types grown within the irrigation entity.

The baseline project efficiencies for the monthly RISD calculation are computed for each SWC member for each month from April – October based on historical computations of CWN and historical monthly diversions adjusted to remove water not used for irrigation and to add water leased or rented to others. The following is the formula used to compute the monthly project efficiencies (Fifth Methodology Order P. 13):

$$E_p = \frac{CWN}{Q_D}$$

Where:

E_p = project efficiency,
CWN = crop water need, and
Q_D = irrigation entity diversion of water specifically put to beneficial use for the growing of crops within the irrigation entity.

In the Fourth Methodology Order, monthly project efficiencies for each SWC member for the preceding 8 years that were within two standard deviations of the average were averaged to compute the monthly values used in the RISD calculations. In the Fifth Methodology Order, the averaging period was changed to use data from the preceding 15 years. The following are the average monthly project efficiencies for each SWC member that will be used for the Fifth Methodology Order (P. 14):

Month	A&B	AFRD2	BID	Milner	Minidoka	NSCC	TFCC	Monthly Avg.
4	0.98	0.33	0.45	0.87	0.43	0.24	0.31	0.51
5	0.47	0.22	0.32	0.39	0.35	0.24	0.30	0.33
6	0.66	0.40	0.49	0.60	0.56	0.41	0.51	0.52
7	0.74	0.44	0.52	0.67	0.63	0.48	0.58	0.58
8	0.58	0.41	0.42	0.55	0.52	0.43	0.46	0.48
9	0.45	0.27	0.32	0.45	0.38	0.32	0.27	0.35
10	0.18	0.16	0.09	0.14	0.11	0.06	0.04	0.11
Season Avg.	0.58	0.32	0.37	0.52	0.43	0.31	0.35	

SWC Member Average Monthly Project Efficiencies from 2007-2021.[12]

Graphs illustrating monthly and annual average project efficiencies for 2007 – 2021 with values more than two standard deviations from the average removed are shown in **Figure 3-1** and **Figure 3-2**. **Figure 3-1** includes separate graphs of the monthly average efficiencies for each SWC member (solid black line) along with the seasonal average efficiency (dotted black line); both from the table in the Fifth Methodology Order. Also shown for comparison purposes is the reasonable annual efficiency for each SWC member that I determined in 2007 as a part of my analysis of the SWC member irrigation systems (blue line). Additional discussion of the reasonable annual efficiencies is provided in Section 3.1 below.

Figure 3-2 shows the average monthly project efficiencies during 2007 – 2021 from the Fifth Methodology Order for each SWC member on the same graph. While the monthly project efficiencies for each SWC member vary from one another, the graph depicts a similar characteristic bell-shaped project efficiency curve for each SWC member. These characteristic curves are generally shifted up or down from one another due in part to differences in conveyance losses. A relatively long canal system like AFRD2 will generally have higher conveyance losses and lower project efficiencies than a relatively short canal system like A&B that will generally have lower conveyance losses and higher project efficiencies.

3.1 Reasonableness of Project Efficiencies

The monthly project efficiencies in the Fifth Methodology Order represent the actual efficiencies that result from dividing monthly CWN by monthly adjusted diversions for each SWC member. To my knowledge and per the deposition of Matthew Anders on May 12, 2023, IDWR has not attempted to assess whether the monthly project efficiencies are reasonable in comparison to industry standards for large, well-managed irrigation districts.

Reasonably attainable project efficiencies can be determined for each SWC member based on the conveyance efficiency in delivering water from the river heading to the farms (including allowances for reasonable operational waste) multiplied by a reasonable on-farm efficiency. This is essentially the procedure that IDWR used to analyze the delivery call of the Unit B pumping division of the A&B Irrigation District, and which resulted in the January 29, 2008, Order that found Unit B had not suffered injury because it was not short of water. In that analysis, IDWR determined that a reasonable project efficiency for the Unit B was 75% based on minimal conveyance losses (3.1% in 2006) and the following reported irrigation application efficiencies for sprinklers (Unit B is predominantly sprinkler irrigated):

47. Reported application efficiencies for various sprinkler irrigation systems are as follows:

Sprinkler System	Application Efficiency
stationary lateral (wheel or hand move)	60 – 75%
solid set lateral	60 – 85%
center pivot lateral	75 – 85%

Idaho Irrigation Water Conservation Task Force, 1994, p.38, and Report Regarding Evaluation of Irrigation Diversion Rates, Report to the SRBA District Court Prepared by the Idaho Department of Water Resources, January 14, 1999, p. 38.

This is also the same procedure that I employed in assessing the irrigation operations of the SWC members that is described in my expert reports and testimony presented at the 2008 hearing in the SWC Delivery Call.

Conveyance efficiencies for the SWC members are knowable and can be determined based on records of diversions and deliveries and based on the operational experience of the SWC managers and staff. Achievable on-farm irrigation efficiencies for various application methods (flood, furrow, sprinkler, drip, etc.) are also well established in the technical literature for the industry. The sprinkler efficiencies used in the A&B Order are examples of application efficiencies reported in the literature. Design irrigation application efficiencies generally represent the efficiencies that can be achieved assuming well managed irrigation systems. In my opinion, industry standard design efficiencies represent a level of performance that the SWC members should be expected to achieve before requiring curtailment of junior groundwater users because of computed irrigation water shortages.

My prior work on the SWC Delivery Call that is documented in the expert reports submitted along with testimony in 2008 found that several of the SWC members – A&B, AFRD2, Burley, Milner, and Minidoka – were generally operating with reasonable project efficiencies while others – NSCC and TFCC – were operating at less than reasonable levels.

I analyzed the operations of the SWC members during 1990 – 2006 and determined their actual project efficiencies for each year. In addition, reasonable project efficiencies were estimated based on reported conveyance efficiencies and industry standard application efficiencies weighted based on the mix of gravity and sprinkler irrigation at that time. A summary of the results from my 2007 expert report is provided in **Figure 3-3** along with averages of the monthly project efficiencies from paragraph 32 of the Fifth Methodology Order.

As seen in **Figure 3-3**, the maximum annual efficiencies of A&B, AFRD2, Burley, Milner, and Minidoka during the 1990 – 2006 period all reached the independently computed reasonable project efficiencies that were determined from analysis of the SWC systems. This validated the methodology used to determine the reasonable project efficiencies and showed that these five SWC members were capable of operating at the reasonable efficiency levels. The efficiencies lower than the maximums tended to occur in wetter years with more ample water supplies. The SWC members may at times operate at lower efficiencies than the reasonable values when water supplies are plentiful because it is generally easier to operate an irrigation system with an excess of diversions. However, the SWC should be held to a higher operational standard that they have shown they can achieve when junior groundwater users are being required to mitigate or be curtailed.

The maximum and average project efficiencies determined for NSCC and TFCC during 1990 – 2006 are well below the reasonable efficiencies determined for these two users based on their reported conveyance losses and irrigation application practices.

In my opinion, the analyses that I presented in expert reports and testimony during the 2008 Hearing on the SWC Methodology established reasonable annual project efficiencies that should be used in determining the SWC diversion requirements. These analyses showed that five of the seven SWC members had performed at the reasonable project efficiency levels, while NSCC and TFCC were operating at efficiencies well below reasonable levels. My opinions should not be construed as suggesting that the SWC members must operate at certain efficiency levels. However, when determining whether they are short of water, thus requiring mitigation or curtailment of junior groundwater users, reasonable project efficiencies using the procedures that I employed for my 2007 expert report should be used in determining the shortages.

Had there been time, I would have compiled the necessary information regarding the operations of the SWC members to update the operations analyses that I performed in 2007. Until these analyses can be updated, the reasonable project efficiency values that I determined in 2007 are reasonable for use in the SWC Methodology. This is because it is reasonable to expect that the reasonable project efficiencies for the SWC members should have increased during the last 15 years based on continued gravity to sprinkler conversions and general advancements in irrigation system operation and management.

Despite the expected advances in irrigation system efficiencies during the last fifteen years, comparison of the average project efficiencies determined by IDWR for 2007 – 2021 (black line in **Figure 3-3**) are lower than the average project efficiencies determined for 1990-2006 (red line in **Figure 3-3**). It appears that the declines in average project efficiencies since 2006 are due to these systems not being managed as well as they were in the past.

3.2 Proposed Adjustments to Fifth Methodology Order Efficiencies

If IDWR will not review and assess the reasonableness of the SWC member project efficiencies like it did in the A&B Delivery Call, and like I did in my expert reports and testimony presented in the 2008 hearing, I have developed an alternative proposal for assessing and revising the monthly project efficiencies used in the Fifth Methodology Order. This alternative builds upon the actual efficiencies that the SWC members have demonstrated they routinely achieve and conforms to the framework of the Fifth Methodology Order.

First, I offer the following opinions regarding the patterns of the actual monthly project efficiencies that are summarized in **Figure 3-1**:

- April: Efficiencies tend to be lower than mid-season efficiencies because of temporarily high conveyance losses during the initial period while the distribution system is "wetting." In addition, diversions may contribute to filling of soil moisture for crop use later in the season resulting in lower apparent efficiencies because the soil moisture filling is not included in the formula. Efficiencies are high for A&B and Milner, likely because their diversions tend to commence later in the month resulting in high CWNs use relative to diversions that are satisfied in part by soil moisture and possibly supplemental pumping.
- May: Similar to April, efficiencies tend to be lower than mid-season efficiencies because portions of the diversions are stored in soil moisture for later use. Also, spring precipitation events can reduce CWNs without a corresponding reduction in diversions.
- June-August: Efficiencies during June – August are highest when CWNs are peaking, and the systems are being operated most efficiently. The peak computed efficiencies may result from a portion of the CWNs being met from stored soil moisture and supplemental groundwater pumping.
- September: Efficiencies drop below mid-season values as CWNs decline due to harvesting and lower temperatures without a commensurate decline in diversions. In other words, the CWN declines are greater than the diversion declines.
- October: Efficiencies are typically very low because CWNs decline further due to harvesting and lower temperatures (including freezes) while relatively high diversions continue.

The low monthly average project efficiencies in April, May, September, and October can cause unreasonable spikes in the computed monthly diversion demand when the monthly

CWN is higher than average. This is because the actual efficiency in such a month would generally be higher than the monthly average value used in the demand calculation. This is demonstrated in the analyses presented below.

To further assess the project efficiencies used in the Fifth Methodology Order, graphs were prepared to assess the relationships between:

- Annual Adjusted Diversion vs. Annual CWN (**Figure 3-4**),
- Monthly Adjusted Diversion vs. Monthly CWN (**Figure 3-5 – Figure 3-11**),
- Annual Project Efficiency vs. Annual CWN (**Figure 3-12**), and
- Monthly Project Efficiency vs. Monthly CWN (**Figure 3-13 – Figure 3-19**).

The annual and monthly <u>Adjusted Diversion vs. CWN</u> graphs indicate that there is some correlation between adjusted diversion and CWN. The strength of the correlation indicated by the R-squared value varies by SWC member and by month. In addition to the scatter plots of adjusted diversion vs CWN, the graphs in **Figure 3-4 – Figure 3-11** also show the RISD predictor used in the Fifth Methodology Order (CWN/PE), plotted as a black line. In almost all graphs, the black line exhibits a greater slope than the linear trendline plotted through the data points. This indicates that the CWN/PE predictor is not a robust predictor of diversion demand. In many months, the monthly diversions appear relatively insensitive to changes in CWN. This is indicated in the plots with a relatively flat trendline juxtaposed with a relatively steep CWN/PE line.

The annual and monthly graphs of <u>Project Efficiency vs. CWN</u> in **Figure 3-12 – Figure 3-19** show moderate to strong positive correlations between project efficiency and CWN for the SWC members in many months. The months with moderate to strong PE to CWN correlations (R-squared > 50%) tend to be months with significant differences between the slopes of the diversion vs. CWN trendline and CWN/PE predictor (black line) in **Figures 3-4 through 3-10**. It generally appears that the greater the disparity between slopes of the Diversion to CWN trendline and the CWN/PE predictor, the stronger the correlation between PE and CWN. The following is a list of months for each SWC member in which this relationship exists:

- A&B – Jul, Aug, Sep, Oct;
- AFRD2 – May, Jul, Sep;
- BID – May, Jun, Aug, Sep, Oct;
- Milner – May, Oct;
- Minidoka – May, Jul, Aug, Sep, Oct;
- NSCC – May, Jun, Jul, Aug, Sep, Oct; and,
- TFCC – May, Jun, Jul, Aug, Sep, Oct.

In my opinion, months with strong PE to CWN correlations reflect months in which there tend to be over-diversions relative to the CWN. In such months, the CWN is easily met and months with greater CWN are months with greater project efficiency.

IDWR's use of fixed monthly project efficiencies for computing RISD from monthly CWN is inconsistent with the relationships in **Figures 3-13** through **3-19** that indicate for many months that project efficiencies vary with CWN. Rather than using the fixed monthly values for project efficiency in Paragraph 32 of the Fifth Methodology Order, the SWC Methodology would be improved in many months by using regression equations based on monthly CWN to compute the monthly project efficiencies that are used in the RISD calculations.

I propose that the regression equations be used in the months of April – September with R-squared values greater than 0.50. In the months in which the regression equation is used, I propose that a floor for the monthly efficiencies be specified based on the average monthly efficiency during 2007 – 2021. This will ensure that the demand calculations use monthly project efficiencies that are at or above average consistent with efficiencies that the historical operational data show they have routinely attained.

In the other May – September months with R-squared values less than 0.50, the regression equation is not a good predictor of the project efficiency. In these months, I propose that the 75th percentile efficiency be used (i.e., the value at which 25% of the monthly project efficiencies are greater). To simplify the procedure, the 75th percentile method could be used in all May – September months.

To avoid use of unreasonably low project efficiencies in October, I propose that the 75th percentile efficiency for September be used for computing the October demand for all SWC members.

The proposed revised procedure for determining the monthly project efficiencies used in computing the monthly diversion demands will result in efficiency values that are at or above the historical averages. This will help avoid unreasonably low efficiency values creating unreasonable shortages to the SWC members requiring undue mitigation or curtailment of junior groundwater users (that generally operate with relatively high irrigation efficiencies).

A hindcast analysis for TFCC and AFRD2 was performed to illustrate the effects of using alternate methods of computing project efficiencies. The project efficiencies were computed using (1) the proposed monthly averages from the Fifth Amended Methodology Order, (2) the regression equations shown on **Figure 3-14** and **Figure 3-19** limited to a minimum of the historical monthly average project efficiency, and (3) the regression equations on **Figure 3-14** and **Figure 3-19** limited to a minimum of the 75th percentile historical monthly project efficiency. If the regression R-Squared is less than 0.5, the monthly average project efficiency was used for (2), and the 75th percentile historical monthly project efficiency was used for (3). **Table 3-1** and **Table 3-2** show the 2007 – 2021 computed demands (CWN/PE) and the November 1 RISD shortfalls using the three different project efficiency methods for TFCC and AFRD2.

In my opinion, the foregoing discussion clearly and convincingly establishes that the SWC members often operate at unreasonably low project efficiencies, particularly NSCC and TFCC. The proposed procedure will ensure to a clear and convincing standard, that (a) shortages to the SWC members will be computed only when they are operating at reasonable project efficiencies, (b) the SWC members are protected from material injury by junior groundwater pumping, (c) the groundwater users are protected from excessive or undue mitigation obligations and curtailment, and (d) the beneficial uses of the interconnected surface water and groundwater resources of the Snake River and the ESPA are maximized.

4.0 IRRIGATED AREA

The 2008 Order from Hearing Officer Schroeder in the SWC Delivery Call found that non-irrigated acres should not be included in determining the irrigation demands of the SWC members:

> *"Non-irrigated acres should not be considered in determining the irrigation supply necessary for SWC members. IGWA has established that at least 6,600 acres claimed by TFCC in its district are not irrigated. Similar information was submitted concerning the Minidoka Irrigation District, indicating that the claimed acreage of 75,152 includes 5,008 acres not irrigated and Burley Irrigation District has some 2,907 acres of the 47,622 acres claimed not irrigated. These amounts may, of course, change as acreage is removed from irrigation or possibly added back."*
> (IDWR, 2008 at P. 53)

The April As-Applied Order determined that the following acreages for the SWC members will be used to compute the monthly CWN and RISD values using the equations listed above in Section 3.0.

6. Based on the information submitted by the SWC, the Department will use the following total irrigated acres:

	Total Irrigated Acres[1]	Data Source
A&B	15,924	SRBA Partial Decree
AFRD2	62,361	SRBA Partial Decree
BID	46,035	2013 shapefile submitted by BID, reduced by Department for overlapping acres and acres outside of service area.
Milner	13,264	2010 service area shapefile, reduced by Department for overlapping acres and acres outside of service area.
Minidoka	75,093	SRBA Partial Decree
NSCC	154,067	SRBA Partial Decree
TFCC	194,732	2013 shapefile submitted by TFCC, reduced by Department for overlapping acres and acres outside of service area.

As indicated in the above table, the total irrigated area figures for the SWC members are based either on figures from their partial decrees or from shapefiles submitted to IDWR many years ago. Neither of these sources have been shown to reflect the acres actually irrigated by the SWC members.

During the meetings of the SWC TWG held in late 2022, IDWR presented analyses of the SWC member irrigated area in 2011, 2017, and 2021 with non-irrigated acres removed.

The following is a summary of the irrigated area figures that IDWR presented for the three years.

SWC Irrigated Acres

SWC Member	2011 Acres*	2017 Acres*	2021 Acres*	Methodology Acres
A&B	21,585	21,634	21,625	15,924
AFRD2	68,368	66,606	68,384	62,361
Burley	44,113	44,168	44,139	46,035
Milner	13,239	13,202	13,233	13,264
Minidoka	71,295	72,016	71,073	75,093
NSCC	220,953	218,498	220,937	154,067
TFCC	179,486	180,956	179,456	194,732

* with non-irrigated acres removed

According to deposition testimony from Matt Anders, IDWR overlaid aerial imagery from 2011, 2017, and 2021 on the irrigated area shapefiles from the SWC members and determined whether each parcel was irrigated, not irrigated, or partially irrigated. The partially irrigated parcels included hardened acres (roads, buildings, etc.) and other areas that that were not irrigated. If the non-irrigated portions of the partially irrigated parcels were removed, the 2011, 2017, and 2021 irrigated area figures would be lower than the amounts shown in the above table.

The highlighted methodology acres in the above table for Burley, Minidoka, and TFCC represent irrigated acres used in the SWC Methodology that exceed that irrigated acres determined by IDWR. Clearly, based on IDWR's own data, the highlighted methodology acres do not represent the actual irrigated areas of the SWC members. In my opinion, it would be more appropriate to use the 2021 acres for purposes of the demand calculations. The acres in 2021 are shown to be generally consistent with acreages from 2011 and 2017, all of which are less than IDWR's proposed methodology acres.

The 2021 acres for the TFCC are 15,276 acres less than the methodology acres. Based on the weighted average annual crop irrigation requirement for the TFCC over the last 20 years of approximately 2.2 AF/acre and an average project efficiency of 35%, the acreage difference will overstate the TFCC annual demand by approximately 96,000 AF. This is more than the projected 2023 TFCC shortage of 75,200 AF in the April As-Applied Order.

5.0 SUPPLEMENTAL GROUNDWATER

According to the Fifth Supplemental Order, the use of supplemental groundwater may be considered in determining the irrigated acreage of the SWC members.

> *"In determining the total irrigated acreage, the Department may account for supplemental ground water use. The Department currently does not have sufficient information to accurately determine the contribution of supplemental ground water to lands irrigated with surface water by the SWC. If and when reliable data is available to the Department, the methodology will be amended to account for the supplemental ground water use."*
> (Fifth Methodology Order at P. 40)

IDWR has been asserting a lack of information regarding the use of supplemental groundwater by the SWC members for over ten years. The subject of supplemental groundwater use by the SWC members was raised as a concern in the SWC TWG meetings in 2015 and 2022, and the response has always been that there is not enough information.

In my 2007 expert report for the SWC Delivery Call, I summarized the supplemental groundwater acres based on information the SWC members submitted to the IDWR Director in response to his request for information. The following is the tabulation of supplemental groundwater acres that was in my 2007 report.

Table 3

Supplemental Ground Water Acreage
Surface Water Coalition
(acres)

District/Company	Acres
A&B Irrigation District	-
American Falls Reservoir District #2	11,462
Burley Irrigation District	263
Milner Irrigation District	1,890
Minidoka Irrigation District	4,650
North Side Canal Company	16,358
Twin Falls Canal Company	13,775

Source: Supplemental Response to Director's Information Request, April 15, 2005

IDWR maintains a database and shapefiles for groundwater rights and surface water rights in the state. It would be a relatively simple matter to overlay the shapefiles of the groundwater water right acreages on the shapefiles of the surface water irrigated areas for the SWC members to determine the surface water acres with access to groundwater.

In addition, IDWR now requires all ESPA groundwater pumping to be measured or estimated, so there should be pumping records available for the groundwater rights having acres that overlap the irrigated area shapefiles for the SWC members.

A reasonable mechanism could be developed to estimate the supplemental groundwater use by the SWC members. Repeated assertions that insufficient information is available to assess the use of supplemental groundwater use by the SWC members is unreasonable and is starting to ring hollow.

6.0 TRANSIENT GROUNDWATER MODELING

Until the Fifth Methodology Order, all prior methodology orders determined the priority date for curtailment of junior groundwater users because of a determination of material injury to the SWC members caused by a shortage in RISD or a shortage to reasonable carryover based on steady-state runs of the ESPAM. Repeated ESPAM runs were made simulating the impacts of pumping junior to various assumed priority dates until the annual impact at steady-state to the near Backfoot to Minidoka reach of the Snake River matched the amount of the predicted combined shortage to the SWC members.

The Fifth Methodology Order proposes a sea-change in the procedure for determining the priority date for curtailment of junior groundwater users. Instead of steady-state runs, IDWR will perform transient runs of the ESPAM to determine the priority date of curtailment. IDWR will make repeated transient runs of the ESPAM simulating the impacts of curtailing pumping junior to various assumed priority dates until the impact on the near Blackfoot to Minidoka reach between <u>May 1 and September 30</u> in the first year of curtailment totals the amount of the predicted combined shortage to the SWC members.

In the April As-Applied Order, IDWR determined curtailment of groundwater rights with priority dates junior to December 30, 1953, was necessary to produce a reach gain to the near Blackfoot to Minidoka reach between May 1, 2023, and September 30, 2023, totaling 75,200 AF (forecast combined shortage to the SWC members in 2023).

IDWR now asserts in the Fifth Methodology Order that it must move from steady-state to transient modeling because it has a better understanding of applying the two different types of modeling and that the calibration using monthly stress periods and halfmonth time steps is a refinement that now allows such a change.

> *"Furthermore, the Department now has multiple years of experience with the methodology to better understand the impact of applying steady-state modeling versus transient modeling to determine a curtailment priority date that would supply adequate water to the senior water right holders. The first version of the ESPA groundwater flow model was not calibrated at a time-scale that supported in-season transient modeling. In contrast, the current version was calibrated using monthly stress periods and halfmonth time steps, a refinement that facilitates in-season transient modeling for calculating the response to curtailment of groundwater use. The purpose of this Fifth Amended Final Order Regarding Methodology for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover ("Fifth Methodology Order") is to update the Director's methodology for determining material injury to storage and natural flow water*

rights either held by or committed to members of the SWC consistent with the Director's ongoing obligation to use the best available science and information." (Fifth Methodology Order at P.2)".

IDWR asserts in the Fifth Methodology Order that curtailment of groundwater rights junior to a curtailment date determined based on steady-state modeling would not produce sufficient water during the first year of curtailment to offset the impact to the senior surface water rights.

> *"Only 9% to 15% of the steady state response is predicted to accrue to the near Blackfoot to Minidoka reach between May 1 and September 30 of the same year. Fifty percent of the steady-state response is predicted to accrue at the near Blackfoot to Minidoka reach within approximately four years. Ninety percent of the steady-state response is predicted to accrue at the near Blackfoot to Minidoka reach within approximately 24 years."* (Fifth Methodology Order at P. 30).

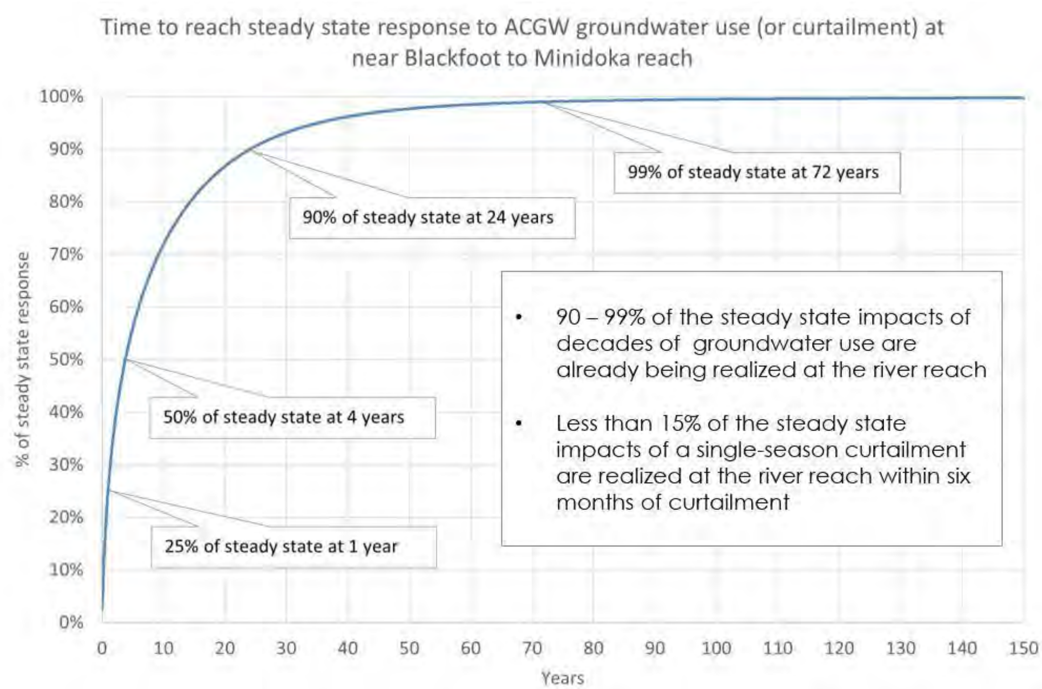
The Fifth Methodology Order cites the mechanism used for surface water administration in support of the need for transient curtailment analysis.

> *"In surface water administration, uses by holders of junior priority surface water rights are curtailed until the senior surface water rights are fully satisfied, absent a futile call and if the senior surface water users need the water to accomplish a beneficial use. In other words, under surface water administration, junior surface water rights are generally curtailed unless the senior gets water in the quantity and at the time and place required."* (Fifth Methodology Order at P. 35).

Monthly stress periods and halfmonth time steps have been part of the ESPAM model since 2013 and are not new refinements. Prior to ESPAM 2.1, the differences between steady-state modeling and transient modeling were well understood by IDWR and the ESHMC members and were frequently discussed during meetings.

In my opinion, given the circumstances of the conjunctive administration of groundwater and surface water in the Upper Snake River Basin, use of steady-state modeling to determine the priority date of curtailment is reasonable and appropriate. In addition, as described below, administration that treats ground water rights like surface water rights (i.e., by requiring curtailment to satisfy seniors) is grossly inefficient and results in disproportionate impacts on junior ground water users.

There has been a moratorium against new groundwater development in the ESPA without mitigation since 1993. Therefore, all pre-moratorium wells have been pumping for at least 30 years, and most wells for much longer. As a result, the effects of the pumping by pre-moratorium wells on Snake River flows have reached near steady state. This is evident in the following results of a curtailment run that was presented by Jennifer Sukow (IDWR) during the November 28, 2022, TWG meeting (Slide 6) that show the effects of ESPA pumping are approximately 93% of steady-state after 30 years and 98% of steady-state after 50 years:



It follows that the steady-state curtailment runs that IDWR has used for eighteen years, since the Director issued his first SWC curtailment order in 2005, represent reasonable estimates of the last increment of depletions to the near Blackfoot to Minidoka reach being caused by wells that are junior to the simulated curtailment date. These impacts reflect the aggregated impacts of all current and prior pumping by the junior wells. In my opinion, steady-state modeling is the technically correct way to determine the curtailment date for the SWC Methodology.

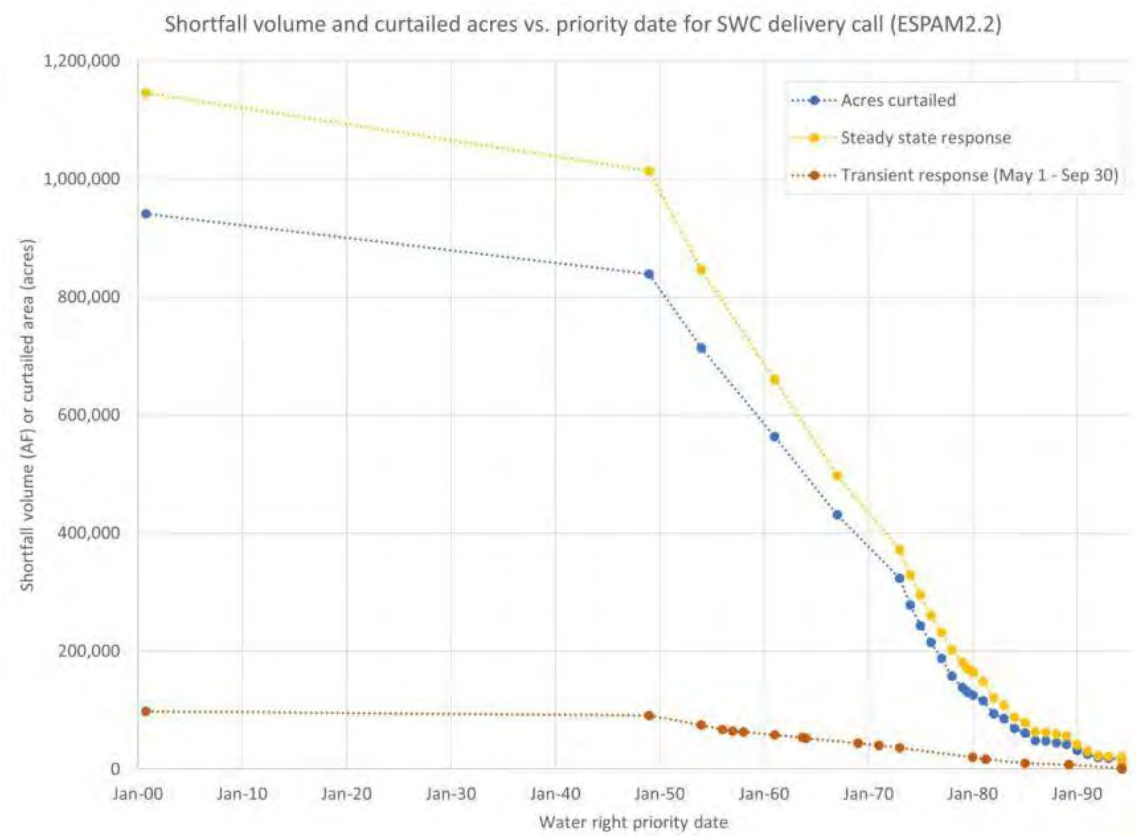
In Colorado, it was recognized early on that it was impractical to conjunctively administer wells and surface water rights in the same manner as administration between surface water rights because of the delayed impacts on surface streams from curtailing groundwater pumping. Use of transient modeling effectively attempts to administer groundwater rights as if they were surface water rights, which is ill advised because of the delayed response of streamflows to groundwater curtailment. A more elegant and efficient solution is to require junior groundwater users to offset impacts to senior surface water rights caused by current and prior pumping. In that way, the seniors are protected from injury and the junior groundwater users can continue to pump. This was the practice in Idaho until the imposition of the Fifth Methodology Order and has been the practice in Colorado for over 50 years.

In Colorado, junior groundwater users are required to have a judicially or administratively approved plan in place that is capable of replacing the injurious impacts on surface users in time, place, and amount in order for the juniors to pump any groundwater. Otherwise, the junior groundwater user is permanently curtailed unless or until they can obtain approval of a replacement plan.

In sum, the process of determining curtailment dates based on steady-state runs should *continue* to be applied in the Upper Snake River Basin because it will properly assign the obligation for mitigating any computed shortages to the SWC members to the junior groundwater users whose current and prior pumping is the cause of the shortage.

Further, in my opinion, implementation of transient groundwater modeling in the Fifth Methodology Order will cause injury to certain groundwater users by requiring them to mitigate for impacts to senior surface water rights that they did not cause.

Consider the present situation with a predicted shortage to the TFCC of 75,200 AF in 2023. It is the last 75,200 AF of depletions to the near Blackfoot to Minidoka reach that created the current shortage. Based on the following graph presented by Jennifer Sukow during the November 28, 2022, TWG meeting, curtailment of pumping from wells junior to sometime in the mid-1980s would produce 75,200 AF/y of water at steady state to the near Blackfoot to Minidoka reach.



In other words, the last 75,200 AF of depletions to this reach that created the shortage to the TFCC was caused by wells junior to the mid-1980s.

Under the prior appropriation doctrine, the wells senior to the mid-1980s are entitled to the conditions that existed at the time of their appropriation. Among those conditions would be that the last 75,200 AF of depletion to the near Blackfoot to Minidoka reach caused by more junior wells would not have occurred and would not have created the shortage to TFCC that exists in 2023. Curtailing or requiring mitigation from groundwater rights in 2023 with priority dates senior to the mid-1980s would injure those groundwater rights because pumping under these more senior groundwater rights did not create the shortage to the TFCC this year. The obligation to mitigate the 75,200 AF of shortage to the TFCC in 2023 should be shouldered by wells junior to the mid-1980s. These are the wells whose current and prior pumping created the shortage in 2023.

7.0 SUMMARY OF OPINIONS

Based on my review and analysis of the materials disclosed by IDWR, my involvement in SWC Delivery Call matters since 2005, and my 37 years of experience in conjunctive administration of groundwater and surface water rights, the following is summary of my professional opinions on the Fifth Methodology Order and the April As-Applied Order.

1. IDWR made substantive changes to the SWC Methodology in the Fifth Methodology Order including a change in the BLY used to forecast SWC member demands at the beginning of the year, changes in the monthly project efficiencies used to compute demands mid-season, and changes in how the priority date for curtailment of junior groundwater users is determined.
2. It has been over 15 years since the last comprehensive review of the SWC Methodology. During that time, there have been numerous changed conditions that dictate that all elements of the SWC Methodology be reassessed to determine if they remain appropriate for determining shortages to the SWC members caused by junior groundwater pumping and whether the proposed changes to the SWC Methodology are reasonable and appropriate.
3. The proposed change in the BLY from 06/08/12 to 2018 that increased the combined BLY demand by approximately 142,000 AF was arbitrary and unreasonable given that the 06/08/12 BLY is only 40 AF (0.001%) less than the 2000 – 2021 average diversions. Further, if the diversions from 2022 are considered in computing the average annual diversions, then the 06/08/12 diversions would still be above average and would still qualify as a BLY.
4. The combined diversions of the SWC members have increased by an average of 148,826 AF since 2005 while average project efficiencies of most SWC members have declined. IDWR has not analyzed the reasonableness of these changes in light of the substantive increases these changes will cause to the computed shortages of the SWC members.
5. Continued sprinkler conversions and advancements in irrigation technology and management suggest that project efficiencies should have increased over the last 15 years rather than decreased.
6. Lower project efficiencies for certain of the SWC members in some or all months will cause unreasonable increases in computed diversion demands and water shortages, especially for TFCC.

7. Unreasonably low efficiencies during the shoulder months of April, May, September, and October will cause unreasonable monthly water demands, especially in months when the CWN is greater than average.
8. Industry standard procedures should be employed to assess the reasonableness of the monthly project efficiencies of the SWC members, including the reductions in project efficiencies that have occurred over the last 15 years. IDWR employed such procedures in evaluating whether Unit B was short of water in assessing the A&B delivery call in 2008.
9. Scatter plots of monthly diversions vs CWN during the last 15 years show that CWN is often a poor predictor of the diversion demands of the SWC members. This indicates that the SWC Methodology should be examined and revised to improve how the diversion demands of the SWC members are determined.
10. Project efficiencies are unexpectedly well-correlated to CWN for many SWC members in some months and for NSCC and TFCC in most months. This is a symptom of more water being diverted than is needed to meet crop water demand.
11. Use of CWN and average monthly project efficiencies will overstate SWC diversion demands in months with above average CWN.
12. The SWC Methodology would be improved by changing the way that monthly project efficiencies are determined for computing RISD. Regression equations based on CWN should be used for months with a moderate to strong correlation (R-squared > 0.5) with a floor no lower than the average monthly efficiency during the past 15 years. In months without a good correlation to CWN (R-squared < 0.5), project efficiencies should be set at the 75th percentile of efficiencies during the past 15 years. The monthly efficiency values for September should be used for October.
13. The irrigated area determined from shapefiles submitted by several of the SWC members exceeds the irrigated area determined by IDWR from analysis of aerial imagery and remote sensing in recent years. It is unreasonable and unlawful for non-irrigated acreages to be included in computing the CWN of the SWC members.
14. The discrepancy between claimed and actual irrigated area is especially egregious for TFCC which claims an irrigated area that is 15,276 acres greater than the irrigated area determined by IDWR in 2021. Based on an average annual ET rate of 2.2 AF/ac and an average project efficiency of 35%, the acreage discrepancy for TFCC would amount to approximately 96,000 AF, which is greater than the forecast shortage for TFCC in 2023 of 75,200 AF in the 2023 April As-Applied Order.

15. The SWC Methodology has long specified that supplemental groundwater pumping be considered in determining whether shortages to the SWC members exist. However, IDWR has done nothing over the past fifteen years to quantify or estimate the supplemental pumping of the SWC members. This is despite the availability of groundwater right mapping and groundwater pumping records that could be analyzed to reasonably determine the supplemental pumping of the SWC members.
16. The change in use of the ESPAM to determine the priority date of curtailment based on transient groundwater modeling is unreasonable because it will result in groundwater users having to mitigate or be curtailed for shortages to the SWC members that they did not cause. This is counter to the prior appropriation system and will cause injury to groundwater users.
17. Steady-state groundwater modeling is more appropriate for use in determining the priority date of curtailment for purposes of the SWC Methodology because virtually all of the ESPA pumping has been occurring since at least the early 1990s when the moratorium against new wells was instituted, and by 2023, the effects of ESPA pumping on Snake River flows have reached near-steady state.
18. Use of transient groundwater modeling to determine the priority date of curtailment improperly attempts to conjunctively administer groundwater rights under surface water right administration procedures. Conjunctive administration through curtailment is extremely inefficient and counter to mechanisms developed in Colorado and other western states in which conjunctive administration is enacted through replacement of depletions rather than through curtailment.

8.0 INFORMATION RELIED ON

The following information was relied upon in preparing this expert report.

Anders, Matthew. 2023. Deposition of Matthew Anders, P.G. on May 12, 2023. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by A&B Irrigation District, American Falls Reservoir District #2, Burley Irrigation District, Milner Irrigation District, Minidoka Irrigation District, North Side Canal Company, and Twin Falls Canal Company ["SWC"]. Including documents produced at deposition.

Franzoy, 2007. Franzoy Consulting, Inc. Expert Rebuttal Report Prepared in Rebuttal to Analyses and Conclusions of Experts for the Surface Water Coalition Dated November 7, 2007. Prepared for the City of Pocatello. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of the SWC.

Idaho. 1903. Contract Between Idaho State Board of Land Commissioners and Twin Falls Land and Water Company. January 2, 1903.

IDWR. 1993. Order Amending Moratorium Order Date May 15, 1992. In the Matter of Applications for Diversion of Surface and ground Water within the Snake River Basin Upstream from the USGS Gauge on the Snake River near Weiser. January 6, 1993.

IDWR. 2008. Order. In the Matter of the Petition for Delivery Call of A&B Irrigation District for the Delivery of Ground Water and for the Creation of a Ground Water Management Order. January 29, 2008.

IDWR 2010a. Final Order Regarding Methodology Order for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. April 7, 2010. Including IDWR backup documents.

IDWR 2010b. Amended Final Order Regarding Methodology Order for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. June 16, 2010. Including IDWR backup documents.

IDWR 2010c. Second Amended Final Order Regarding Methodology Order for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. Including IDWR backup documents. June 23, 2010.

IDWR, 2013. Enhanced Snake Plain Aquifer Model Version 2.1. Report. January 2013. Available from: https://research.idwr.idaho.gov/files/projects/espam/browse/ESPAM_2_Final_Report/ Last Accessed: May 30, 2023.

IDWR 2014. Final Order in the Matter of Petition to Amend Rule 50. August 29, 2014.

IDWR 2015. Third Amended Final Order Regarding Methodology Order for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. April 16, 2015.

IDWR 2016. Fourth Amended Final Order Regarding Methodology Order for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. April 19, 2016. Including IDWR backup documents.

IDWR 2022a. Presentations and backup documents provided as part of the Surface Water Coalition Delivery Call Technical Working Group. Meetings held on November 16, 17, and 28 and December 1, 9, and 14 in 2022.

IDWR 2022b. Summary of Recommended Technical Revisions to the 4th Amended Final Order Regarding Methodology for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover for the Surface Water Coalition. By: Kara Ferguson, Staff Hydrologist & Matt Anders, Hydrology Section Supervisor. December 23, 2022.

IDWR. 2023a. 37.03.11 – Rule for Conjunctive Manage of Surface and Ground Water Resources. IDAPA 37 – Department of Water Resources. Water Compliance Bureau. Available from: https://adminrules.idaho.gov/rules/current/37/. Last Accessed: May 22, 2023.

IDWR. 2023b. Fifth Amended Final Order Regarding Methodology Order for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. April 21, 2023.

IDWR. 2023c. Final Order Regarding Aril 2023 Forecast Supply (Methodology Steps 1-3). In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC. April 21, 2023.

Sullivan, 2007a. Spronk Water Engineers, Inc. Updated Expert Report Dated September 26, 2007 (revised December 2007). Prepared for the City of Pocatello. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC, and all references listed therein.

Sullivan, 2007b. Direct testimony of Gregory K, Sullivan, P.E. September 26, 2007 (Revised December 2007). Submitted on behalf of the City of Pocatello. In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of the SWC.

Sullivan, 2007c. Spronk Water Engineers, Inc. Expert Rebuttal Report. November 7, 2007 (Revised December 2007). Prepared for the City of Pocatello. In the Matter of the Request of Administration in Water District 120 and the Request for Delivery of Water to Senior Surface Water Rights by the SWC, and all references listed therein.

Sullivan, 2008a. Spronk Water Engineers, Inc. Expert Report Dated July 16, 2008 Prepared for the City of Pocatello. In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area, and all references listed therein.

Sullivan, 2008b. Spronk Water Engineers, Inc. Expert Rebuttal Report Dated August 27, 2008 Prepared for the City of Pocatello. In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area, and all references listed therein.

Sullivan, 2008c. Spronk Water Engineers, Inc. Expert Sur-Rebuttal Report Dated September 16, 2008 Prepared for the City of Pocatello. In the Matter of the Petition for Delivery Call of A&B Irrigation District for Delivery of Ground Water and for the Creation of a Ground Water Management Area, and all references listed therein.

Sullivan, 2015. Email to IDWR. Pocatello Comments on Draft Staff Memo. March 10, 2015.

Sullivan and Netter, 2023. Spronk Water Engineers, Inc. Comments on behalf of the Coalition of Cities and the City of Pocatello on the Idaho Department of Resources Summary of Recommended Technical Revisions to the 4th Amended Final Order Regarding Methodology for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover for the Surface Water Coalition, by Kara Ferguson and Matt Anders on December 23, 2022.

Sullivan, 2023a. Declaration of Gregory K, Sullivan, P.E. May 7, 2023. In the Matter of Distribution of Water to Various Water Rights Held by or for the SWC.

Sullivan, 2023b. Declaration of Gregory K, Sullivan, P.E. May 7, 2023. In Regard to Irrigated Acres in the SWC Methodology Order. In the Matter of Distribution of Water to Various Water Rights Held by or for the Benefit of the SWC.

FIGURES

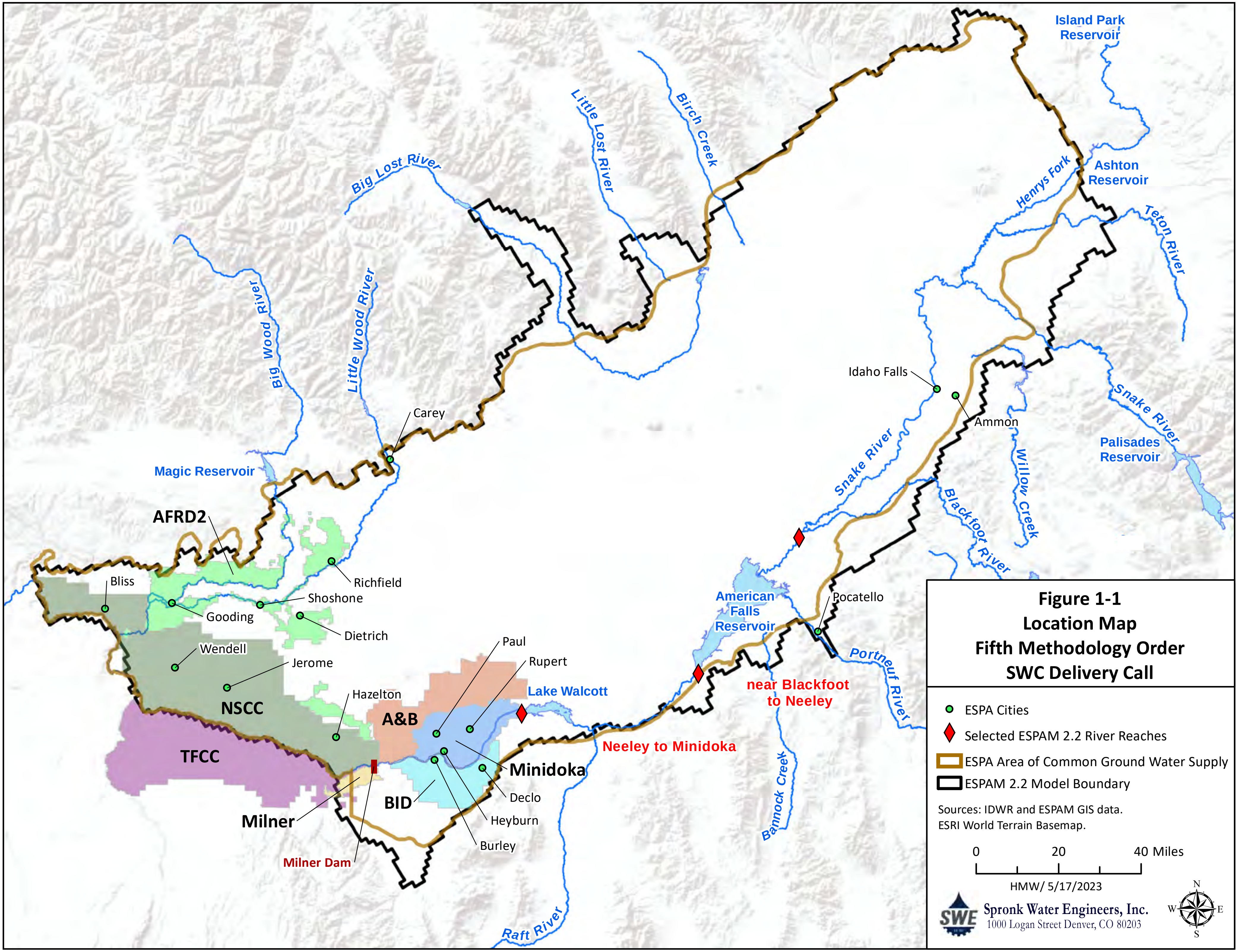
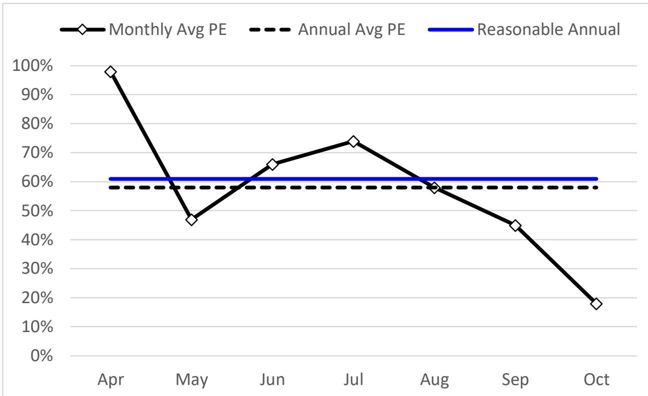


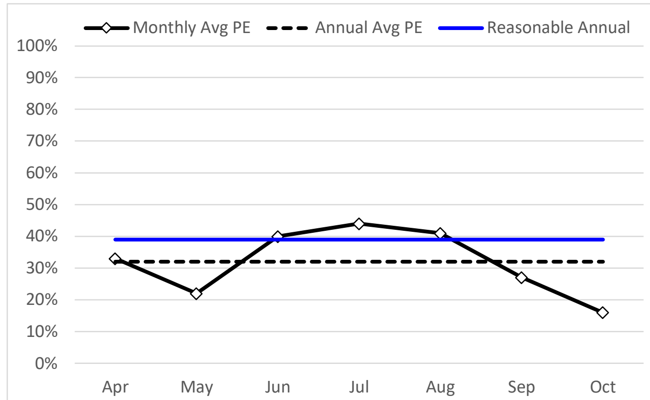
Figure 1-1
Location Map
Fifth Methodology Order
SWC Delivery Call

Figure 3-1
Annual and Monthly Average Project Efficiency
Surface Water Coalition Members
2007 - 2021
Exclude PE Outlier Months (> +/- 2 Std Dev)

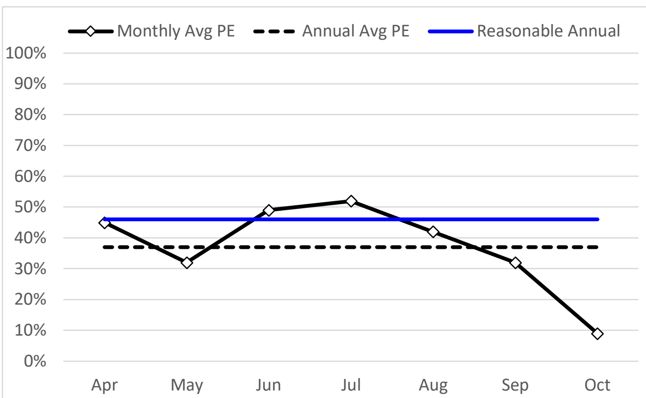
A&B



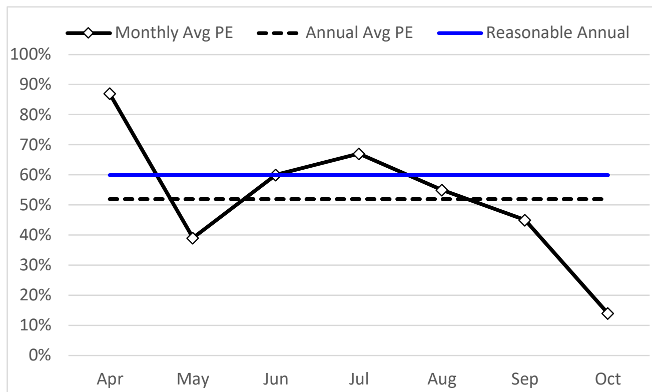
AFRD2



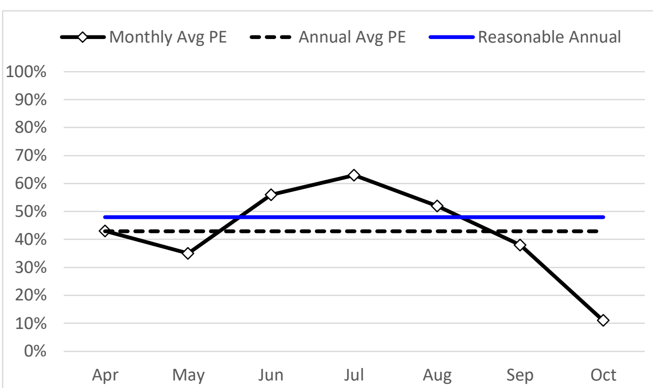
BID



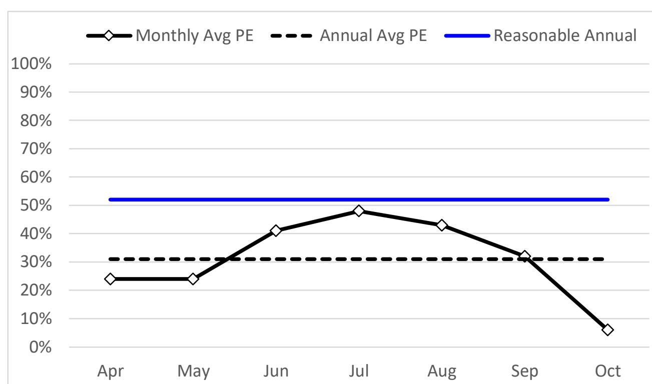
Milner



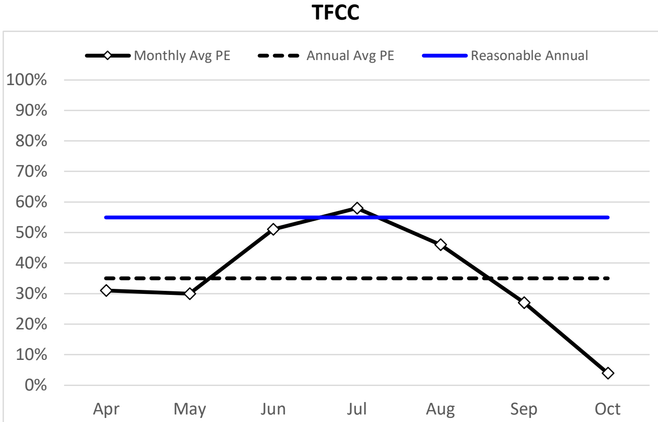
Minidoka



NSCC



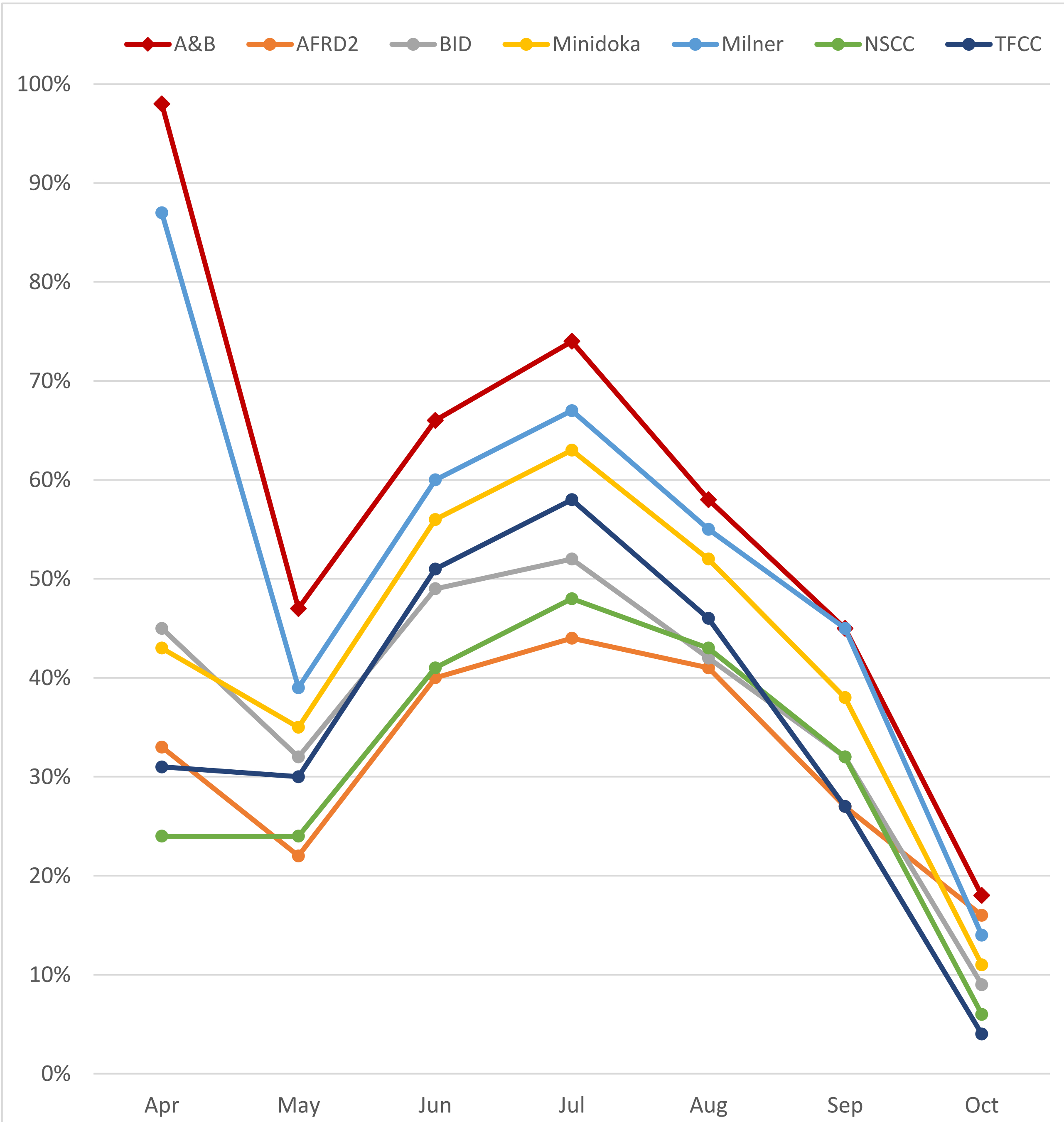
TFCC



Notes:

(1) Monthly and Annual Average PE values from the Fifth Amended Methodology Order (P. 14; IDWR, April 2023).
(2) Reasonable Annual PE from Spronk 2007 report (Sullivan, 2007a).

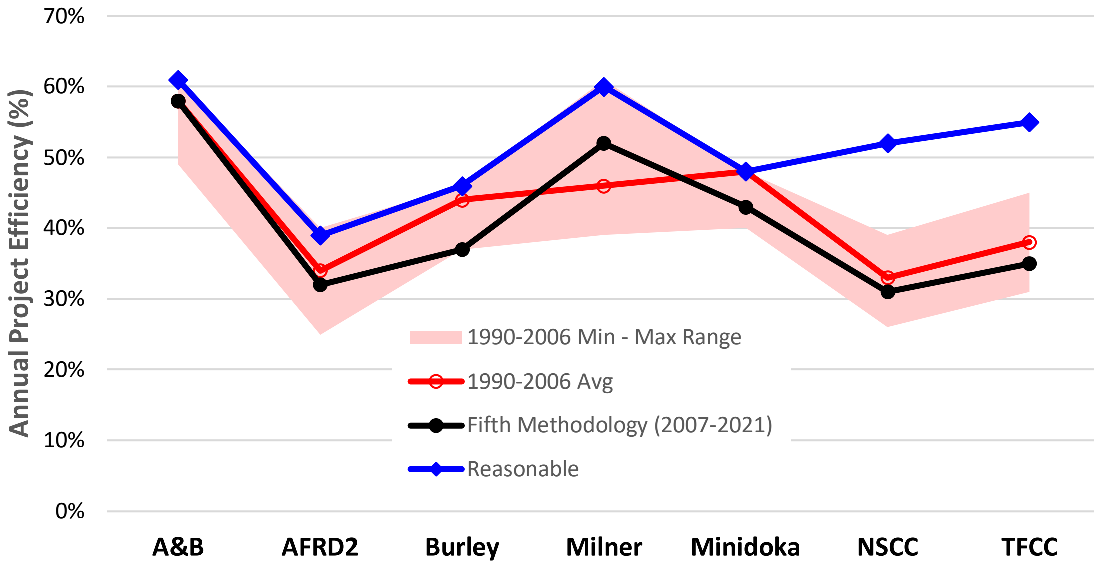
Figure 3-2
Monthly Average Project Efficiency
Surface Water Coalition Members
5th Amended Methodology Order



<u>Notes:</u>
Monthly average PE values from Fifth Amended Methodology Order (P. 14; IDWR, April 2023).

Figure 3-3

Reasonable and Actual Project Efficiencies
2008 Hearing vs. Fifth Methodology Order



SWC Member	(1) Reasonable (Achievable) Project Efficiencies	(2) Actual Project Efficiencies (1990-2006) Min	Average	Max	(3) Fifth Methodology Order (2007-2021)
A&B	61%	49%	58%	61%	58%
AFRD2	39%	25%	34%	40%	32%
Burley	46%	37%	44%	46%	37%
Milner	60%	39%	46%	61%	52%
Minidoka	48%	40%	48%	48%	43%
NSCC	52%	26%	33%	39%	31%
TFCC	55%	31%	38%	45%	35%

Notes:

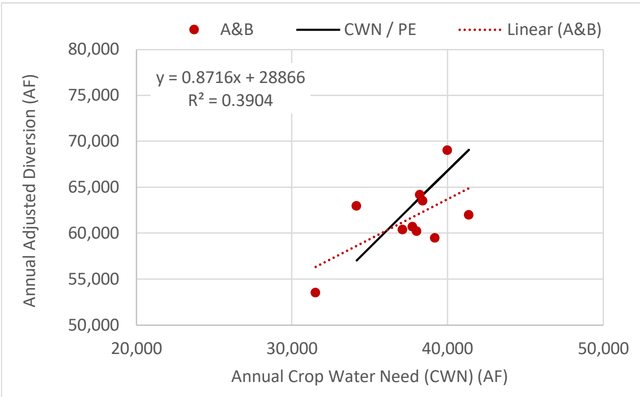
(1) From September 26, 2007 Sullivan Expert Report, SWC Delivery Call.
Based on reported conveyance efficiency x achievable on farm efficiencies.

(2) From September 26, 2007 Sullivan Expert Report, SWC Delivery Call.
Based on analysis of SWC operations for 1990 - 2006.

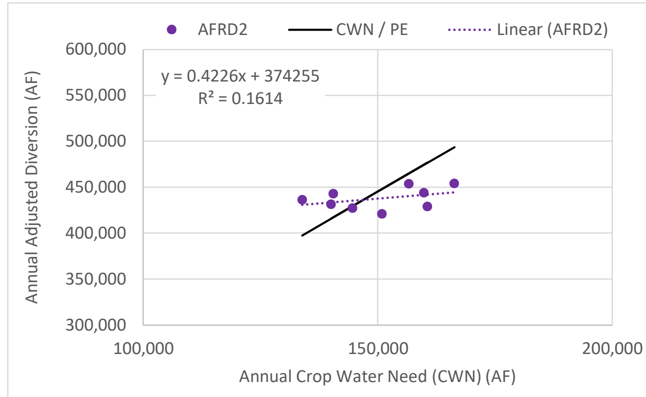
(3) From April 21, 2023 Fifth Methodology Order at 14.
Based on average of monthly efficiencies during 2007 - 2021.

Figure 3-4
Annual Adjusted Diversion v. Annual Crop Water Needs (CWN)
Surface Water Coalition Members
2007 - 2021
Exclude PE Outlier Months (> +/- 2 Std Dev)

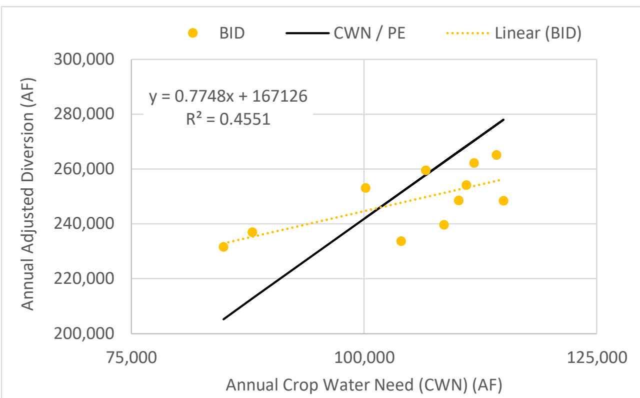
A&B



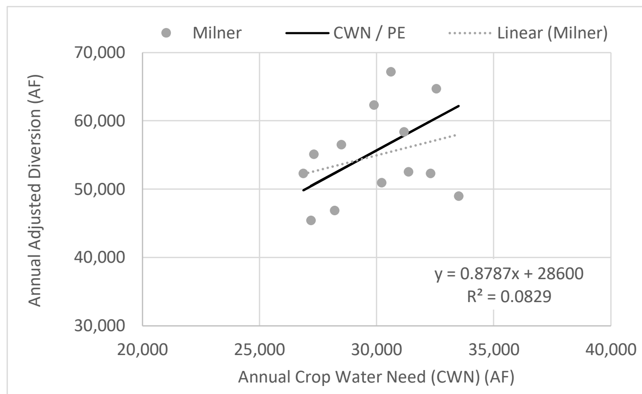
AFRD2



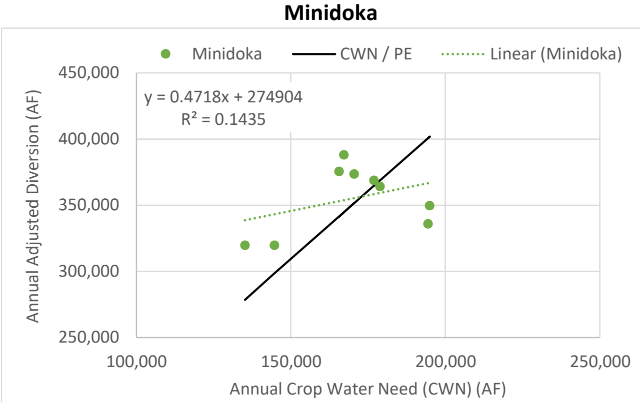
BID



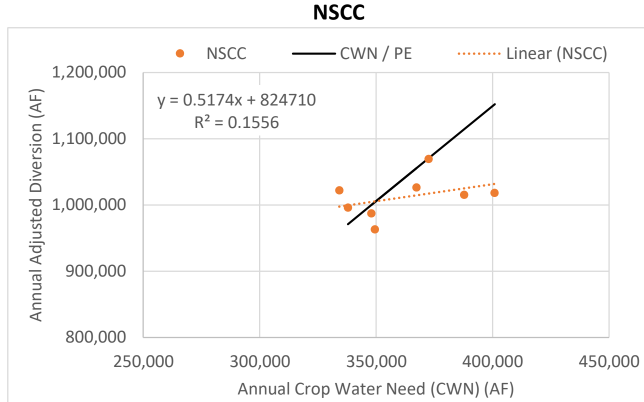
Milner



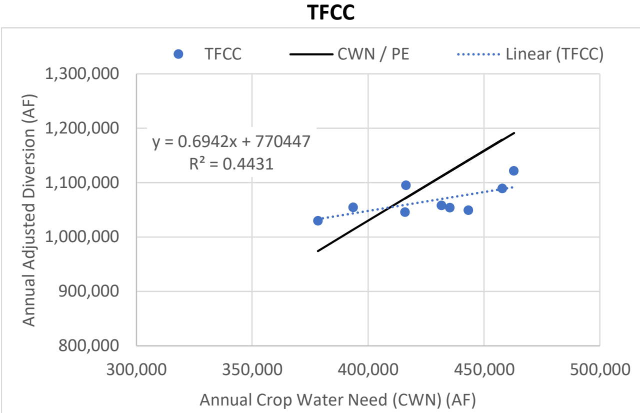
Minidoka



NSCC

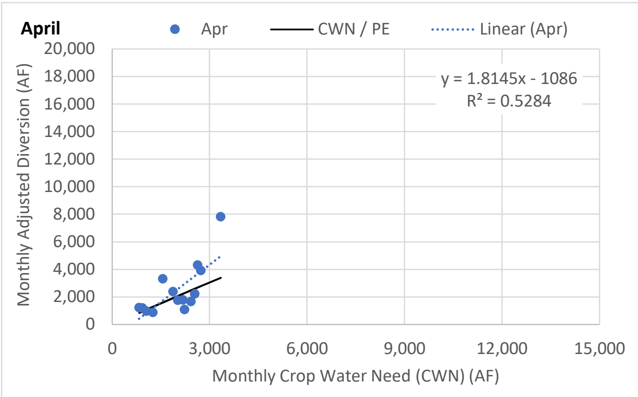


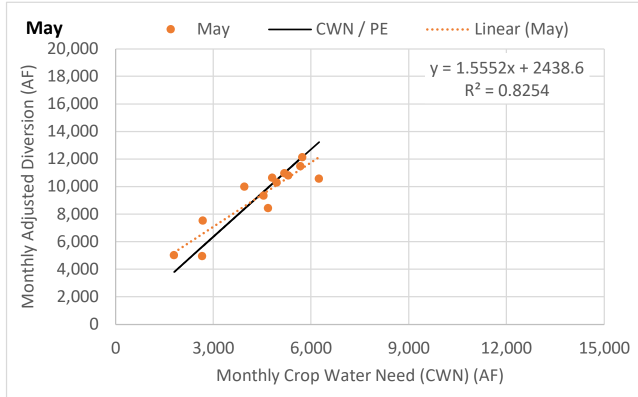
TFCC

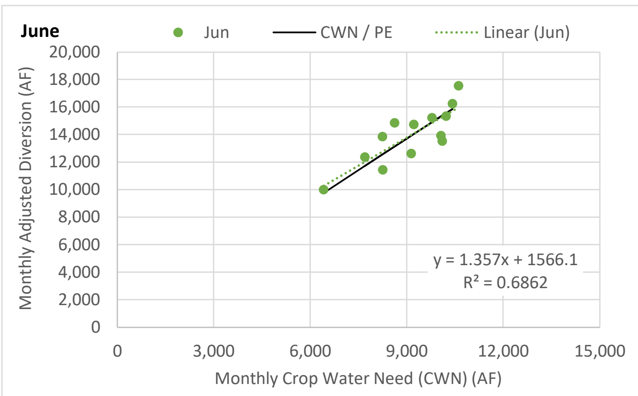


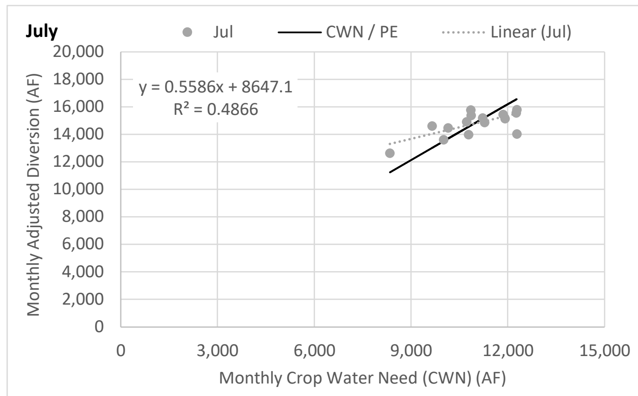
Notes:
Note different scales.
(1) Annual Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area (IDWR spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx"
(2) Annual Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (see IDWR spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx"
(3) Annual PE (colored dots) computed as the annual CWN (1) divided by the ann Adjusted Diversion (2).
(4) CWN/PE (black line) is the annual CWN (1) divided by the annual average Project Efficiency (PE).

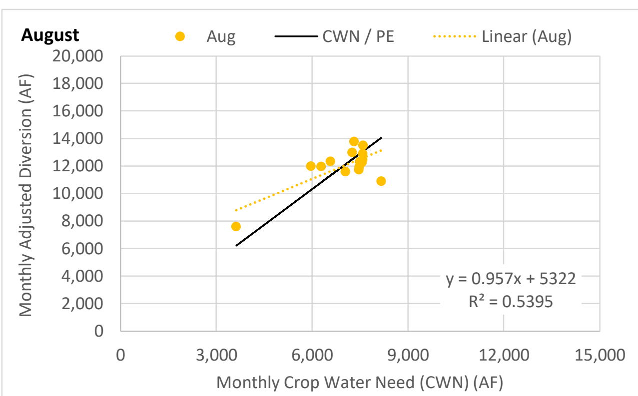
Figure 3-5
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)
A&B
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

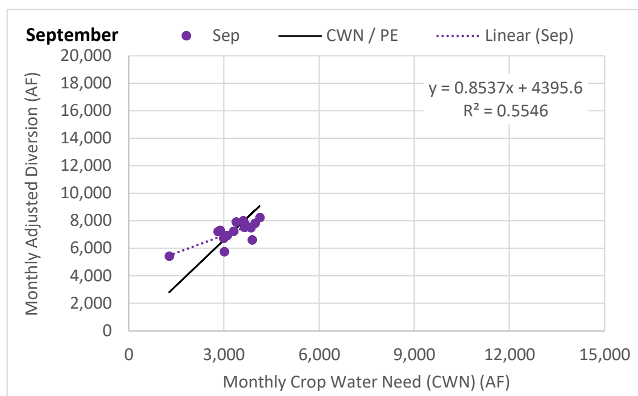


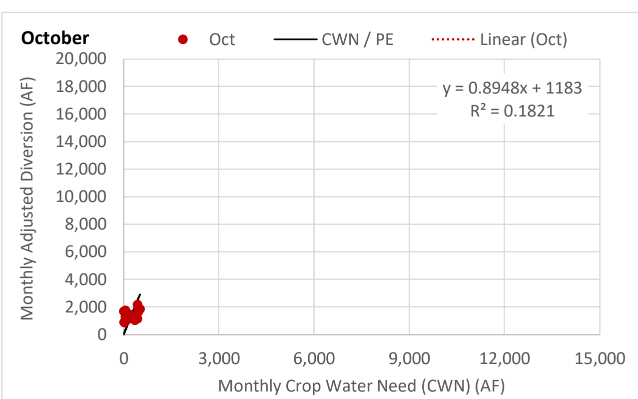








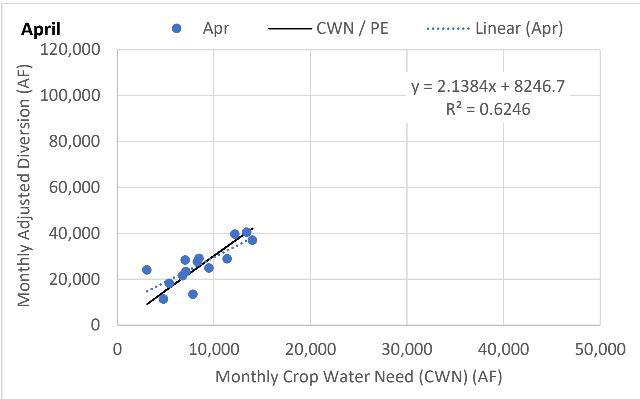


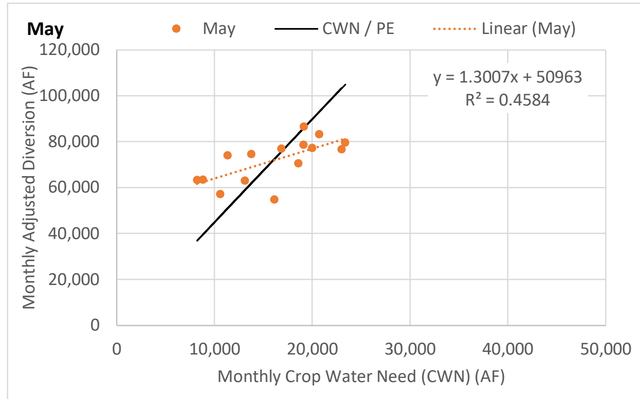


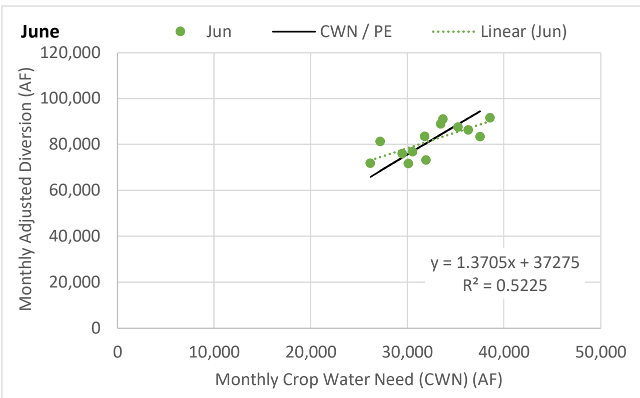
Notes:

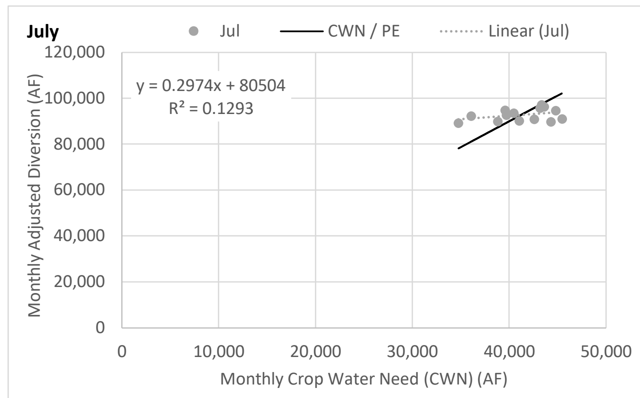
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).
(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

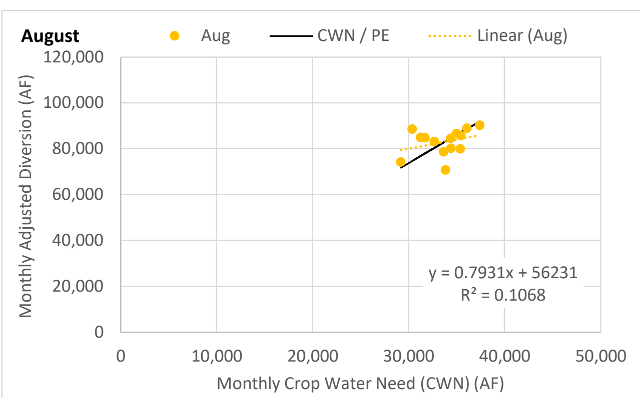
Figure 3-6
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)
AFRD2
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

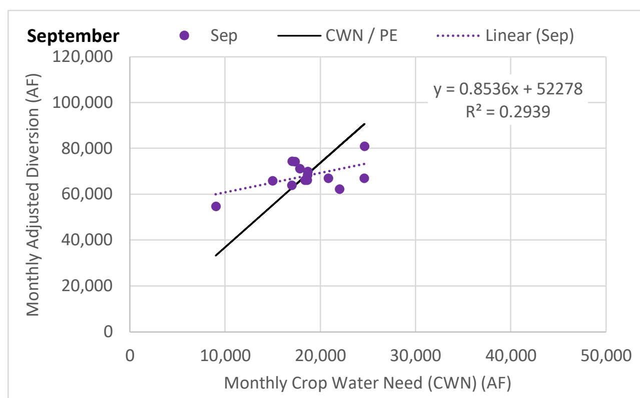


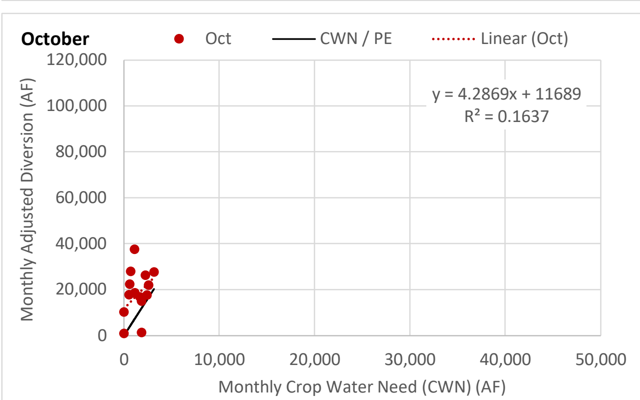












Notes:

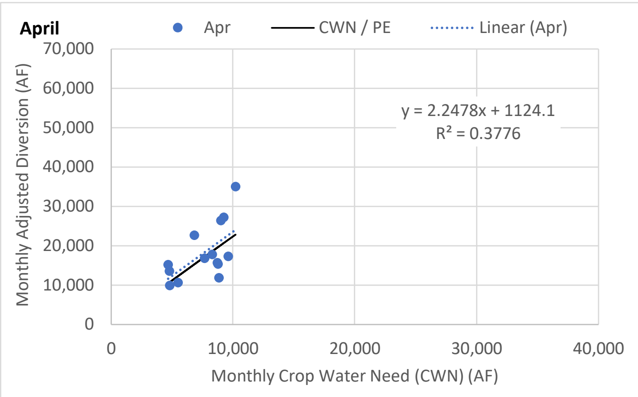
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

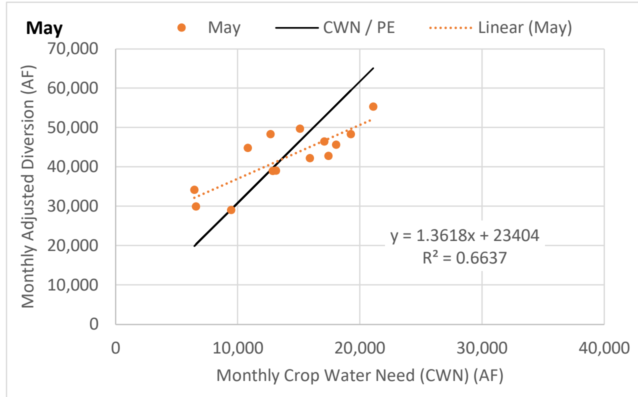
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

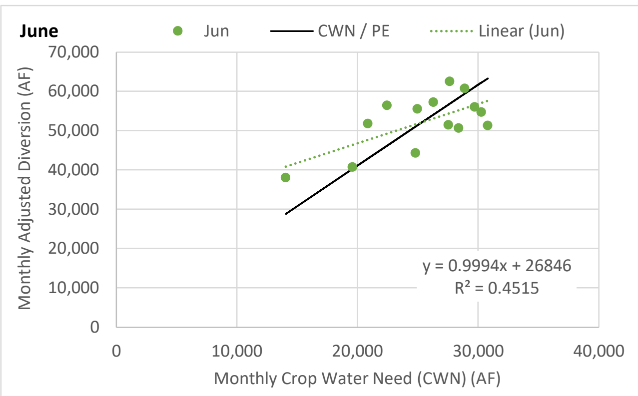
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

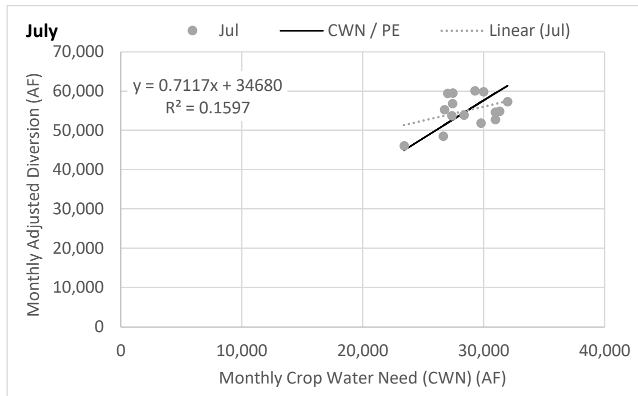
(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

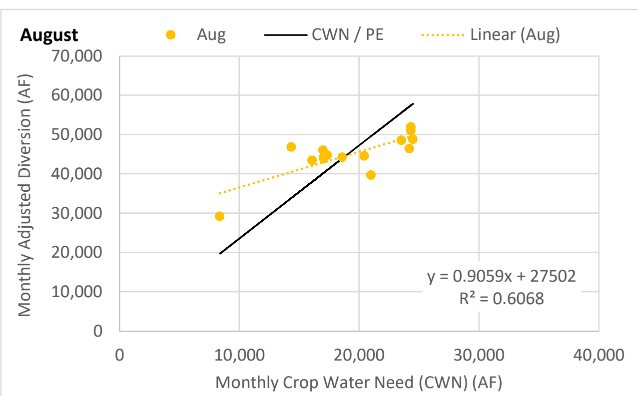
Figure 3-7
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)
BID
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

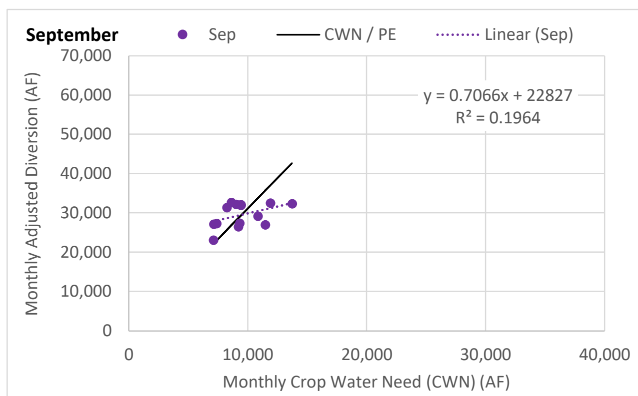


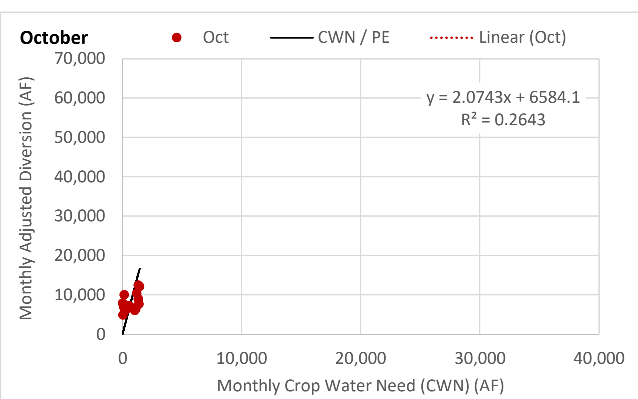












Notes:

(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by month Adjusted Diversion (2).

(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

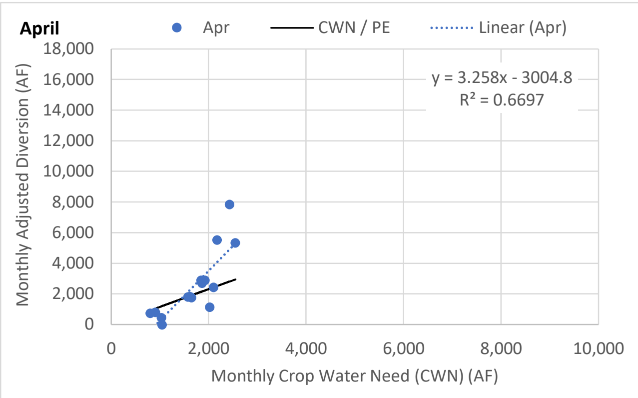
Figure 3-8

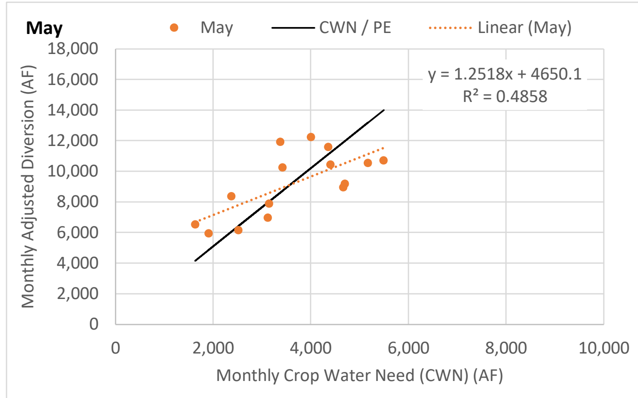
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)

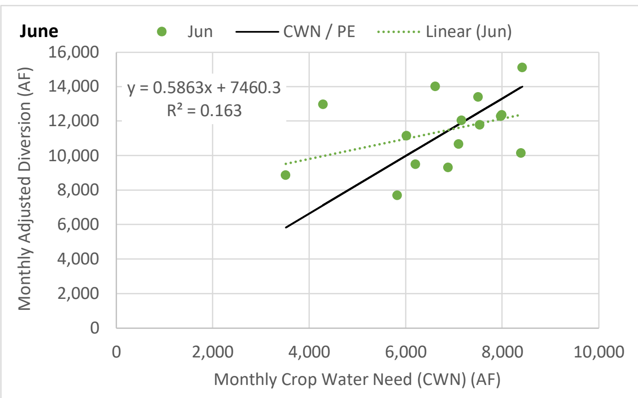
Milner

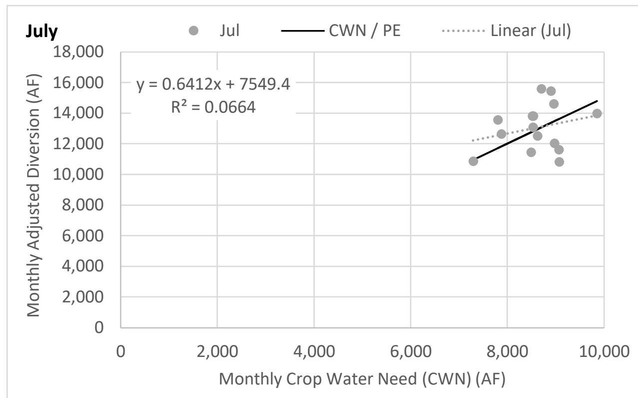
2007 - 2021 (AF)

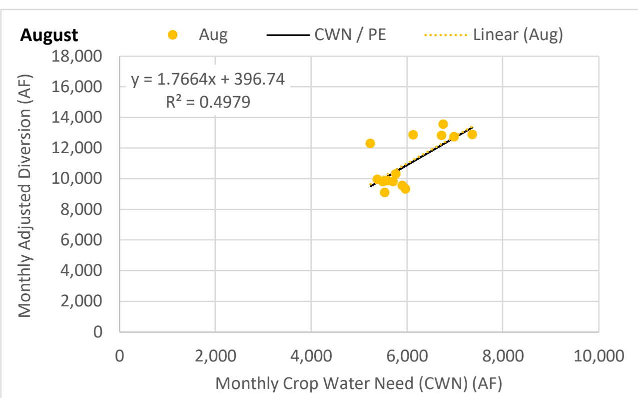
Exclude PE Outlier Months (> +/- 2 Std Dev)

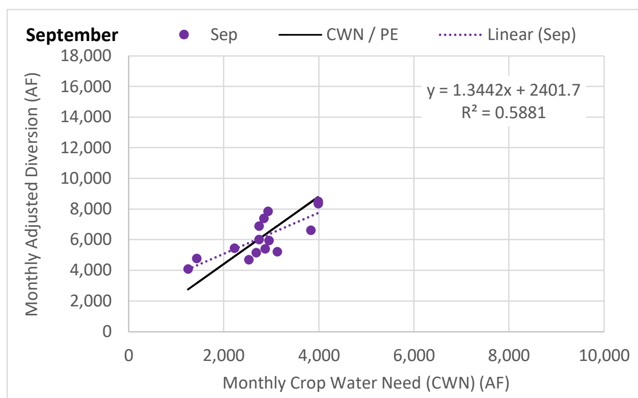


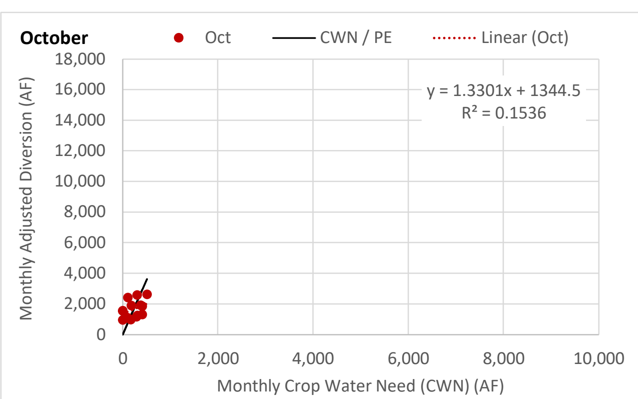












Notes:

(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by month Adjusted Diversion (2).

(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

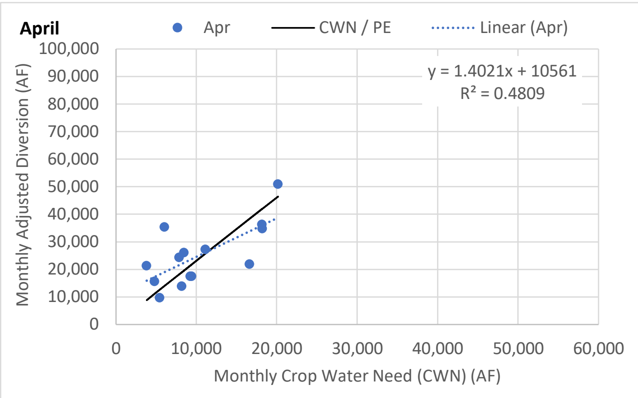
Figure 3-9

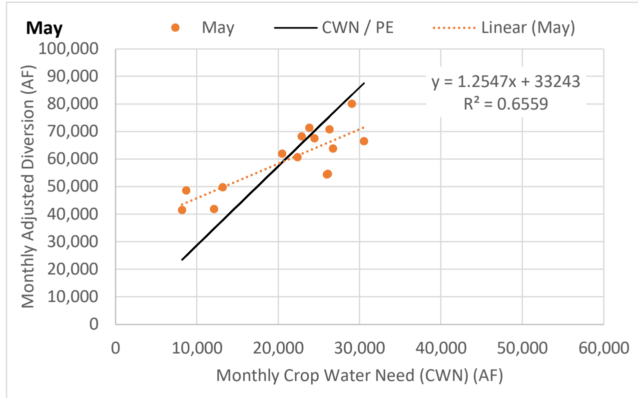
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)

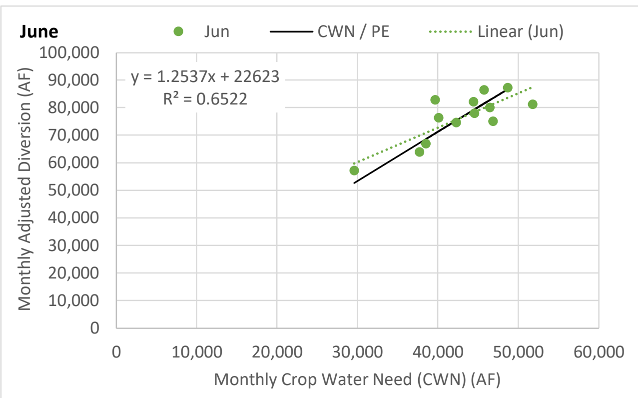
Minidoka

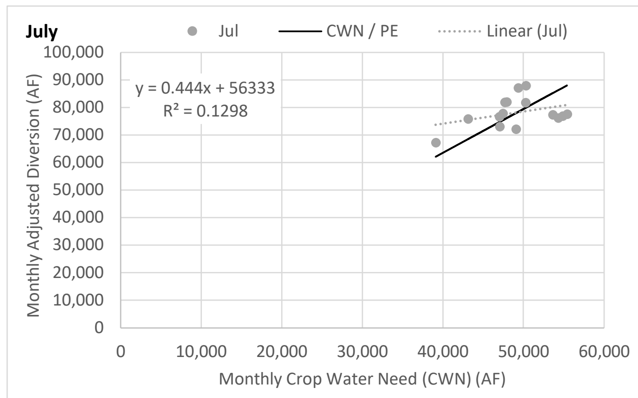
2007 - 2021 (AF)

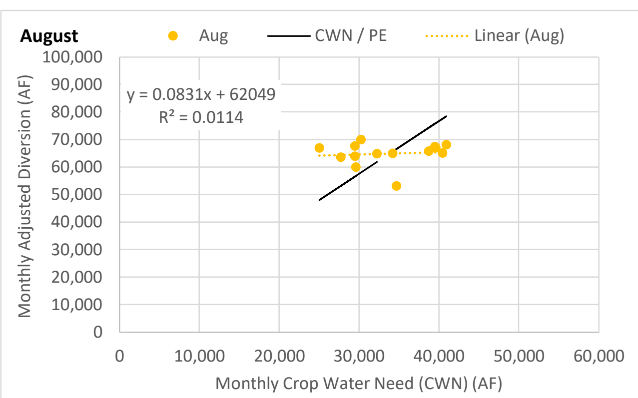
Exclude PE Outlier Months (> +/- 2 Std Dev)

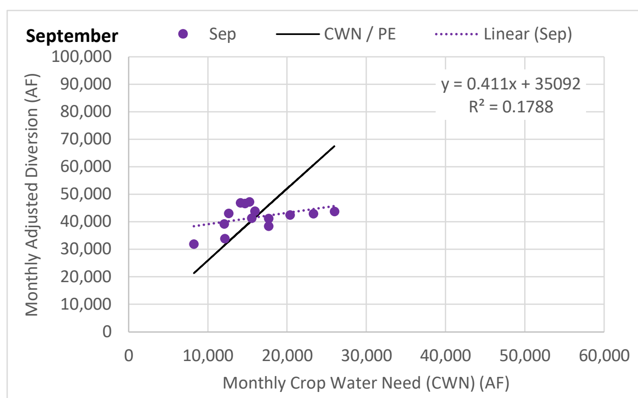


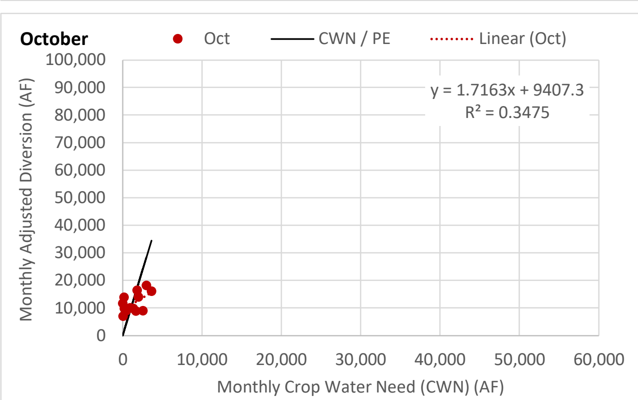












Notes:

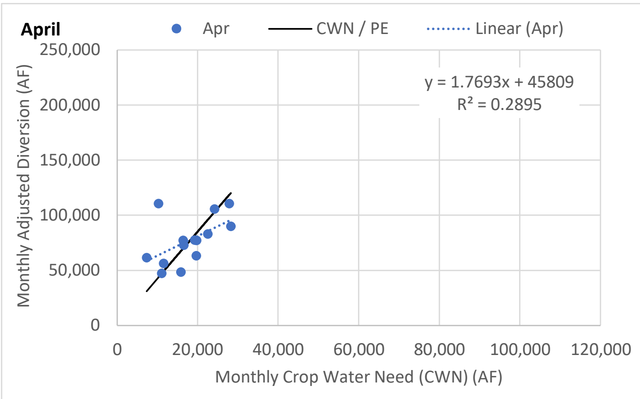
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

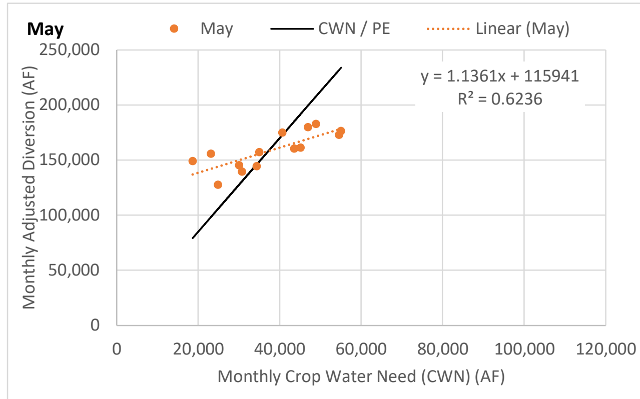
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

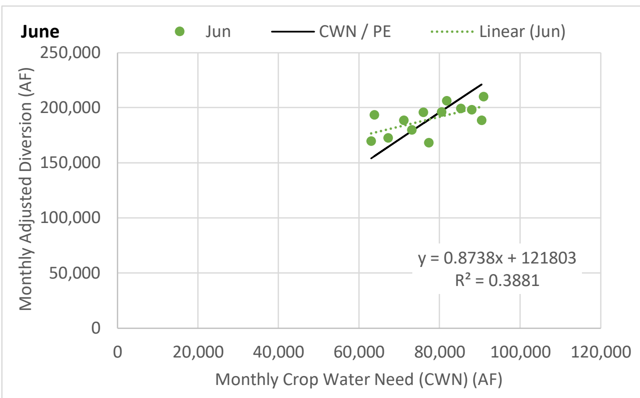
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by month Adjusted Diversion (2).

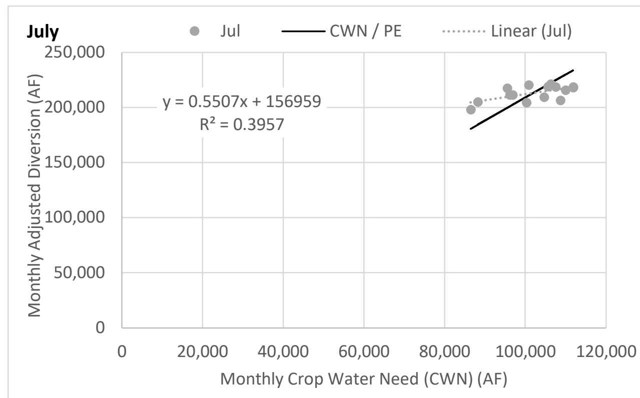
(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

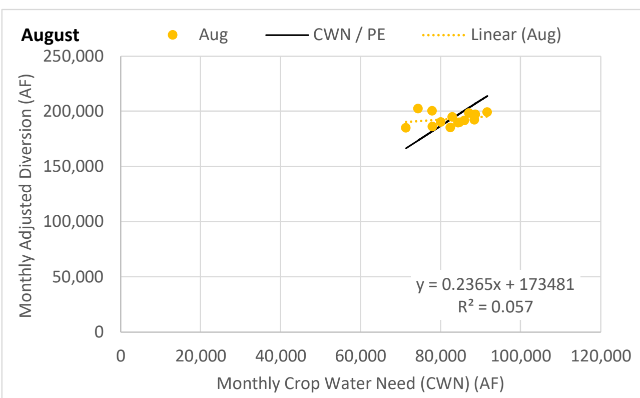
Figure 3-10
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)
NSCC
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

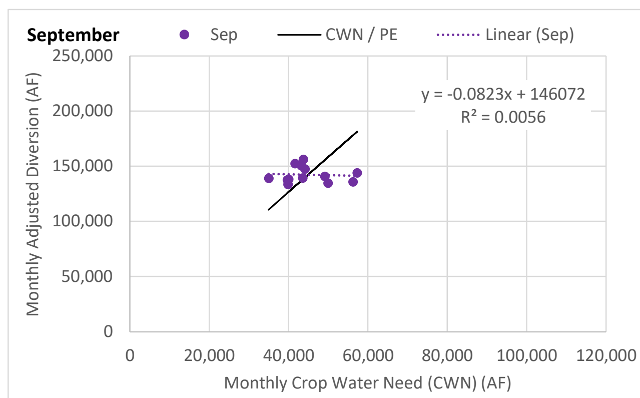


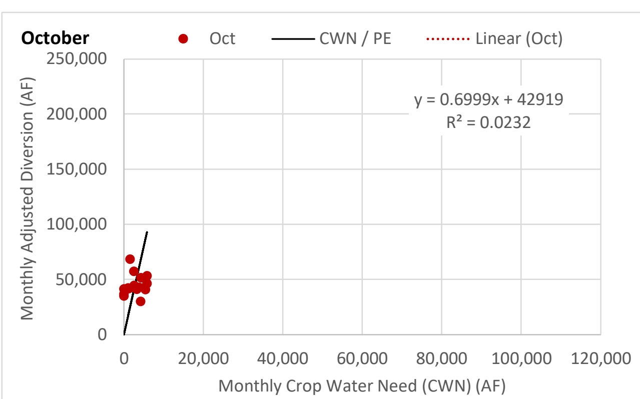








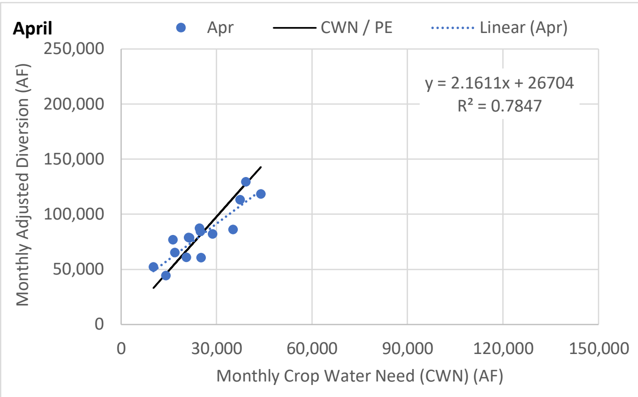


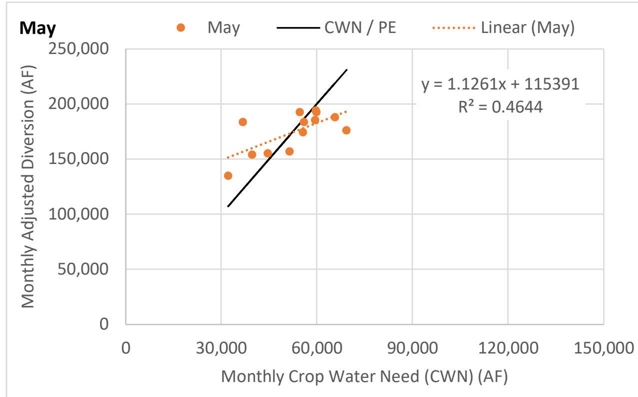


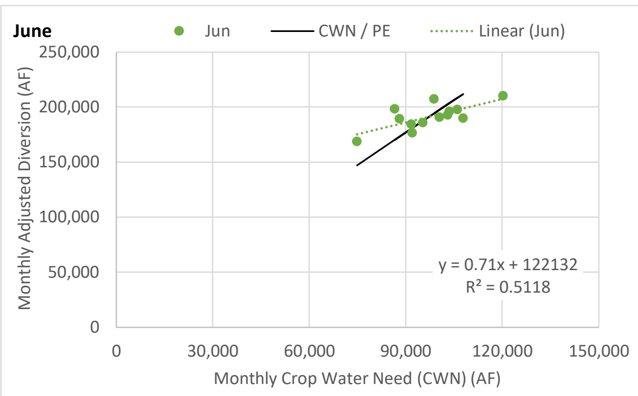
Notes:

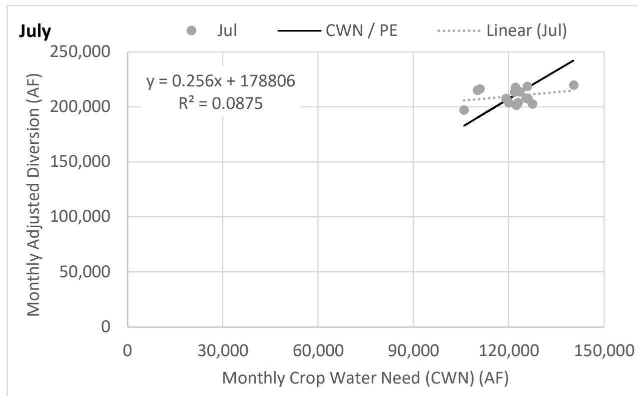
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by month Adjusted Diversion (2).
(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

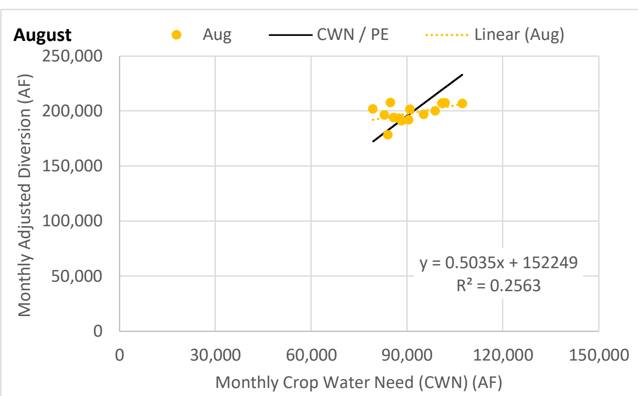
Figure 3-11
Monthly Adjusted Diversion v. Monthly Crop Water Need (CWN)
TFCC
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

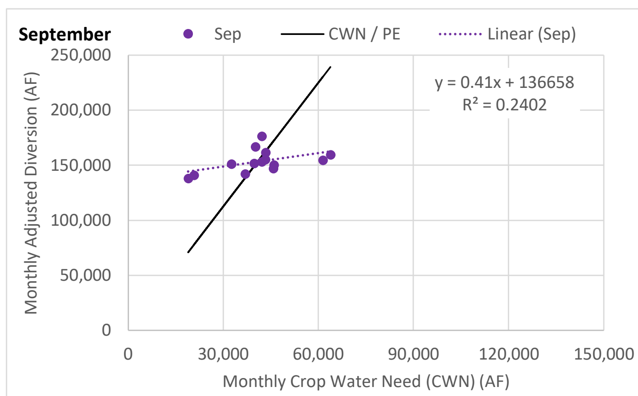


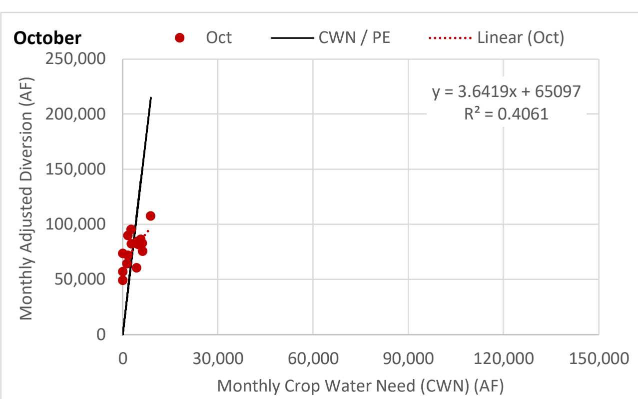










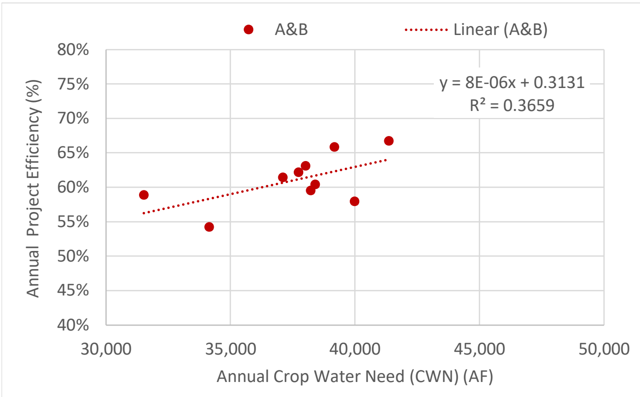


Notes:

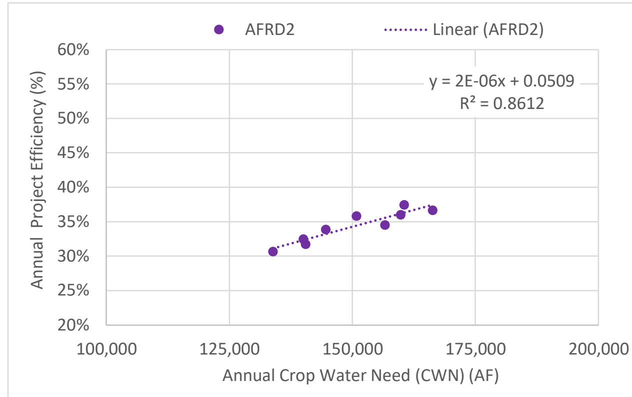
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_ used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montł Adjusted Diversion (2).
(4) CWN/PE (black line) is the monthly CWN (1) divided by the monthly average Project Efficiency (PE) from 5th Amended Methodology Order.

Figure 3-12
Annual Project Efficiency v. Annual Crop Water Need (CWN)
Surface Water Coalition Members
2007 - 2021
Exclude PE Outlier Months (> +/- 2 Std Dev)

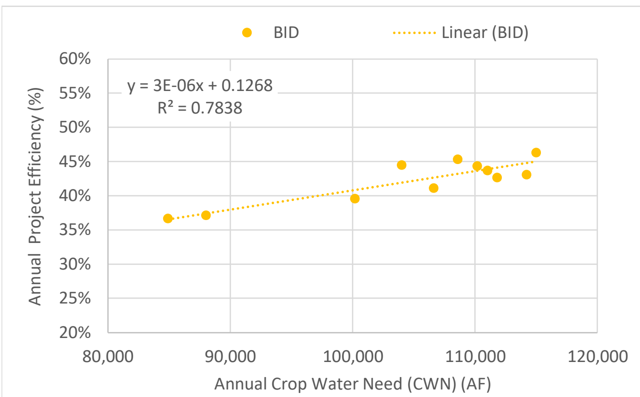
A&B



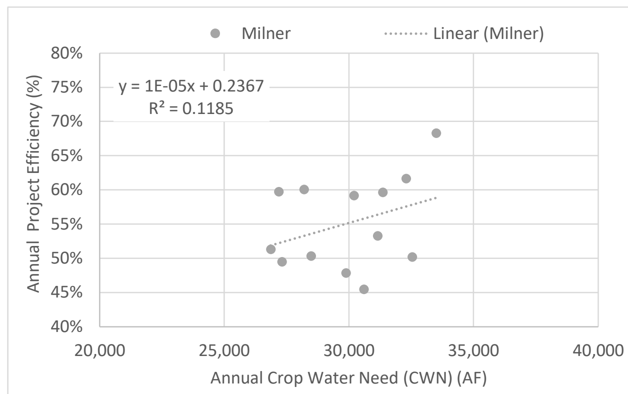
AFRD2



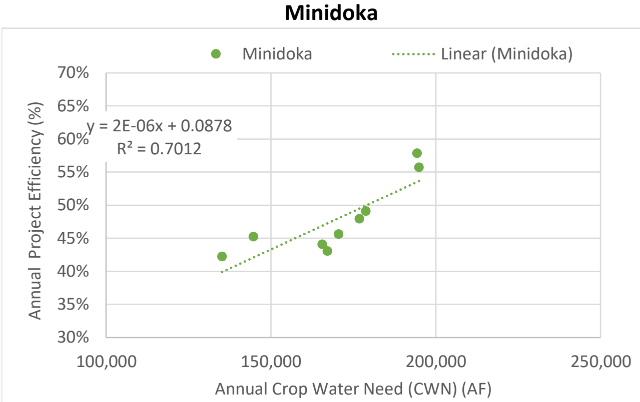
BID



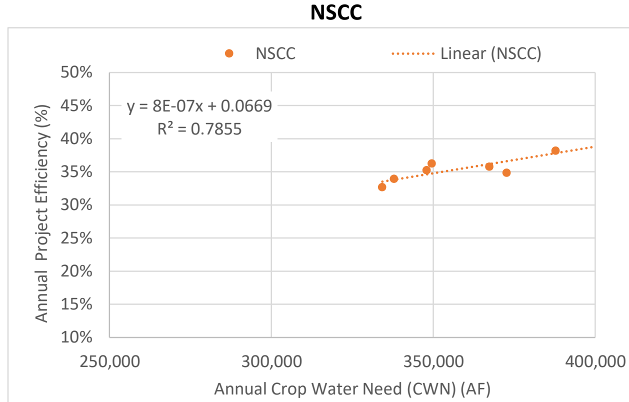
Milner



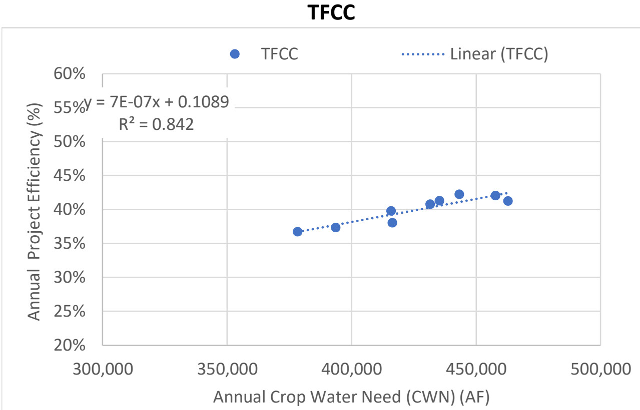
Minidoka



NSCC

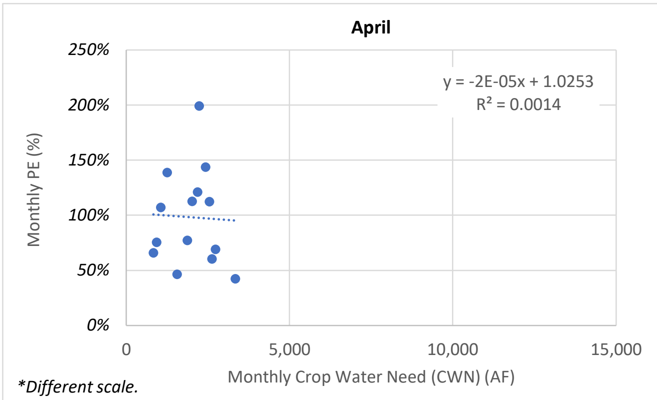


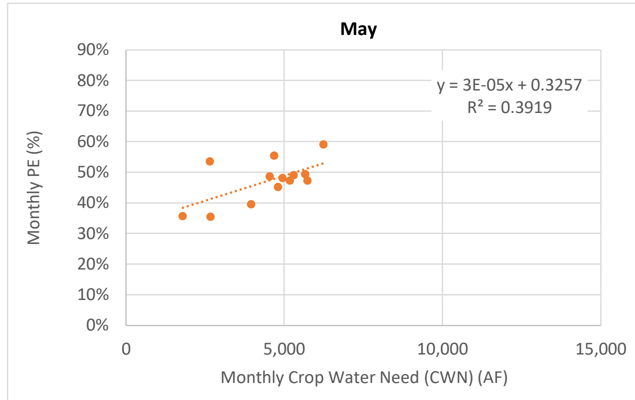
TFCC

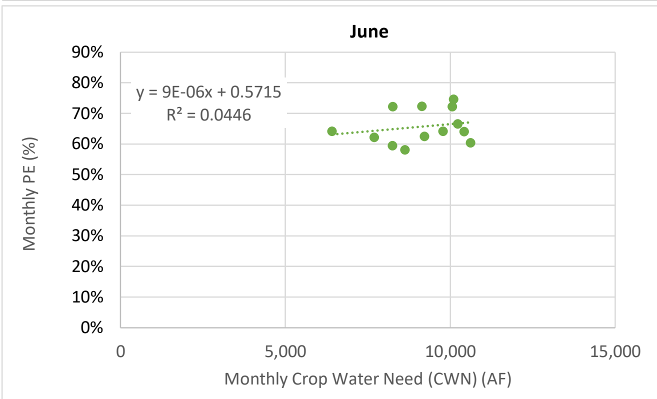


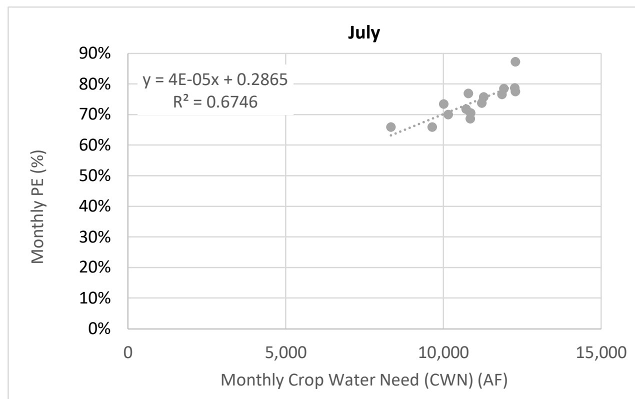
Notes:
Note different scales.
(1) Annual Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area (IDWR spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx")
(2) Annual Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (see IDWR spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx")
(3) Annual PE (colored dots) computed as the annual CWN (1) divided by the annu Adjusted Diversion (2).

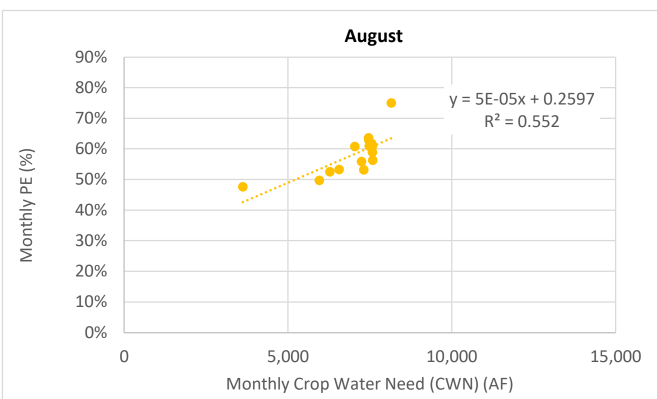
Figure 3-13
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
A&B
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

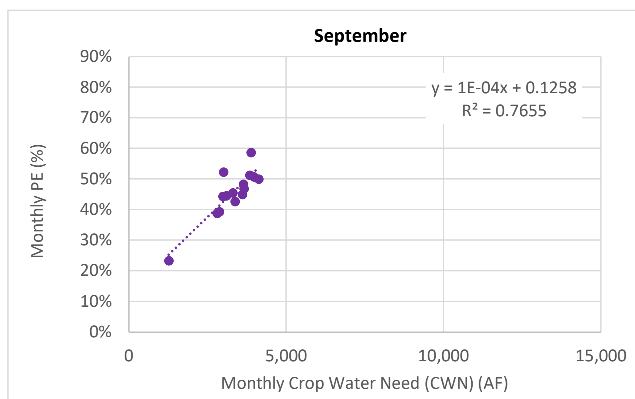


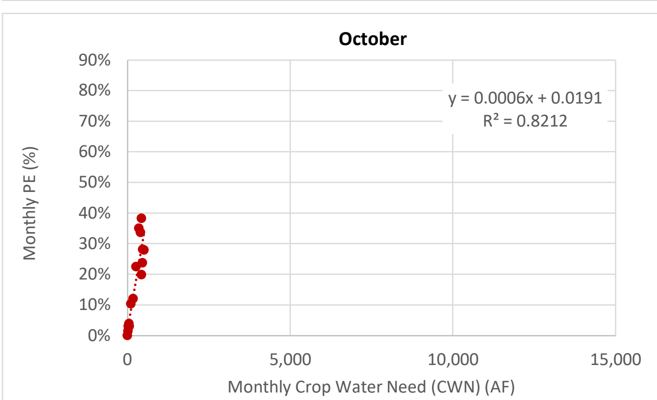






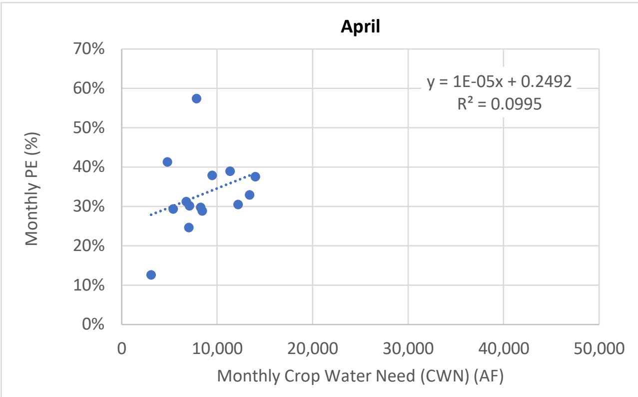


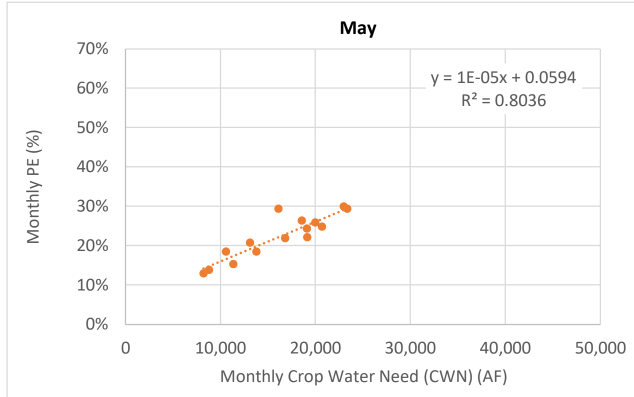


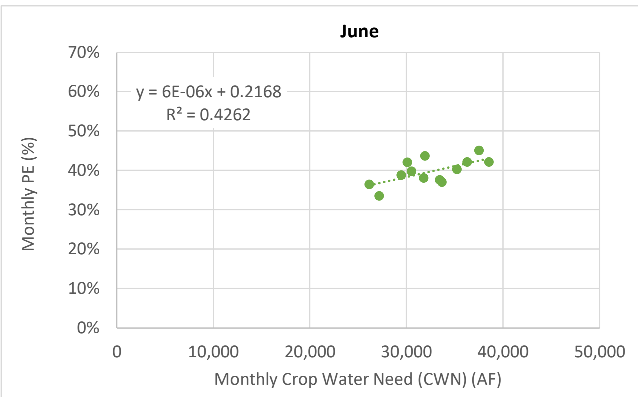


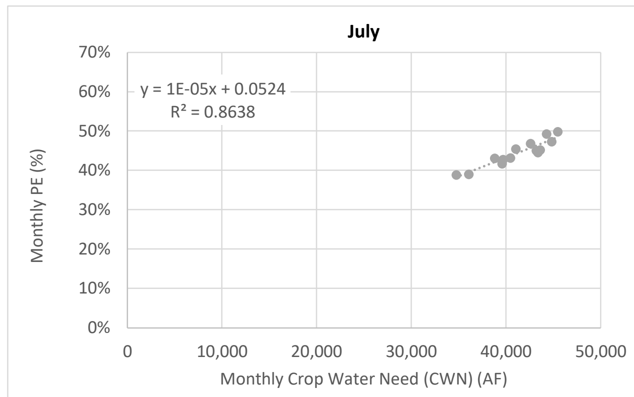
Notes:
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

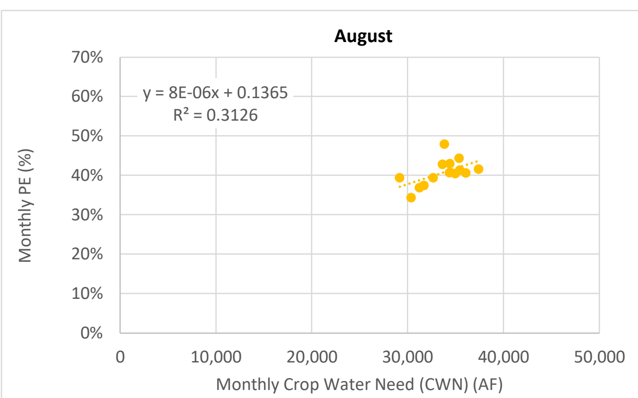
Figure 3-14
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
AFRD2
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

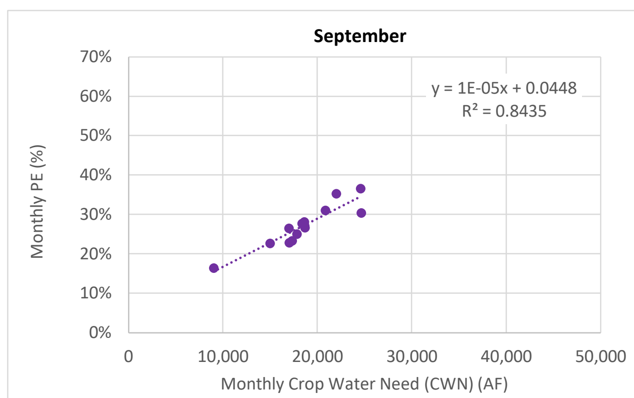


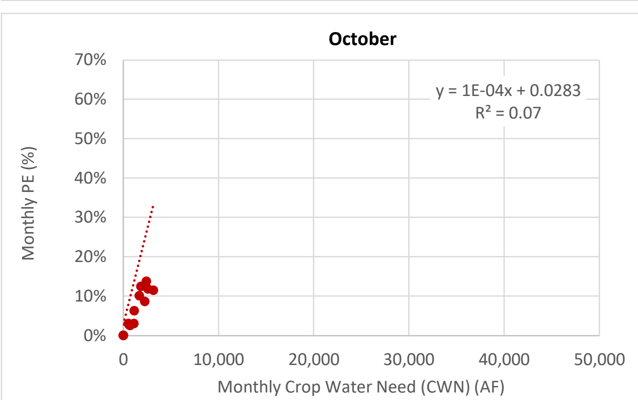






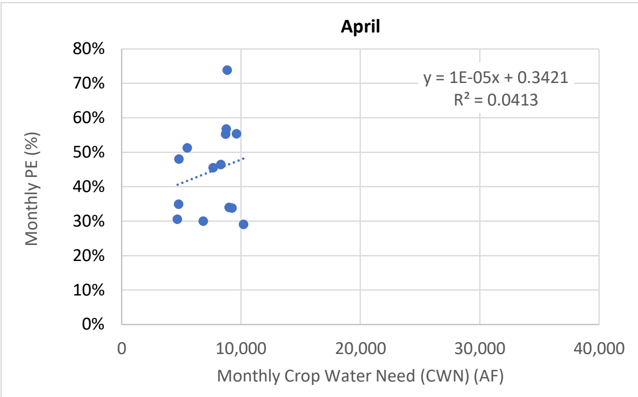


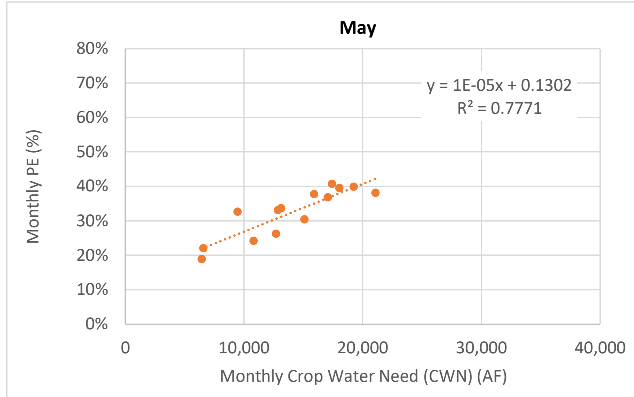


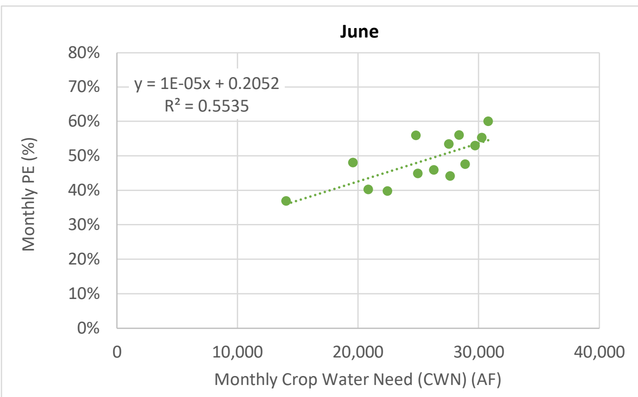


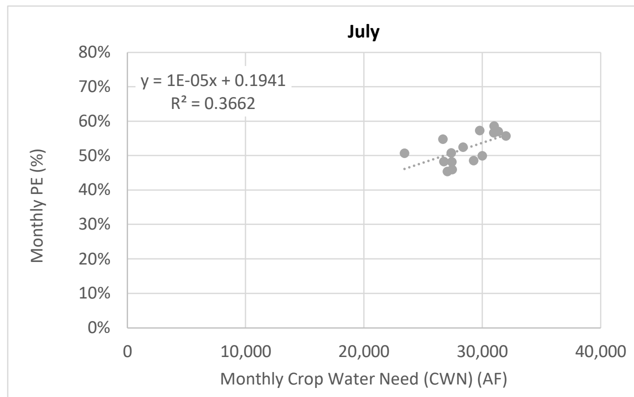
Notes:
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_ used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

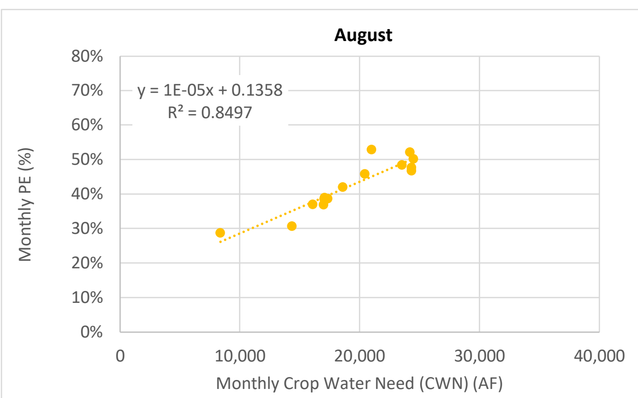
Figure 3-15
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
BID
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

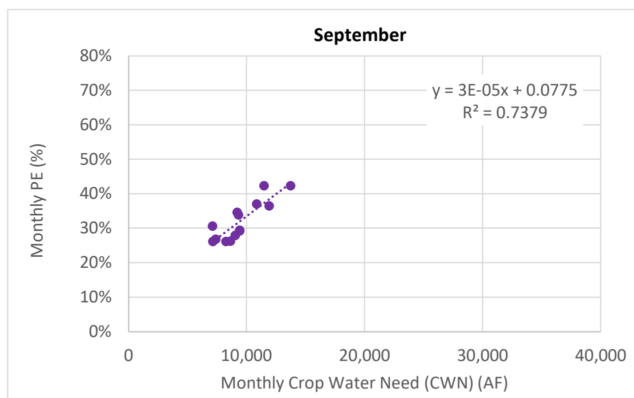


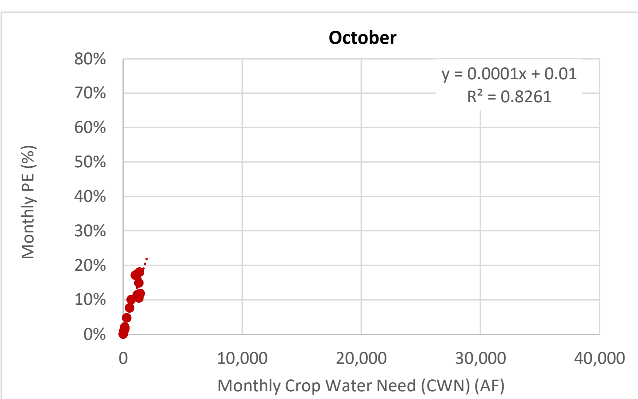












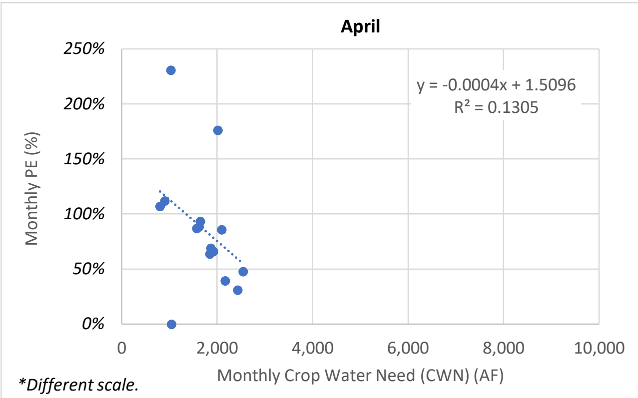
Notes:

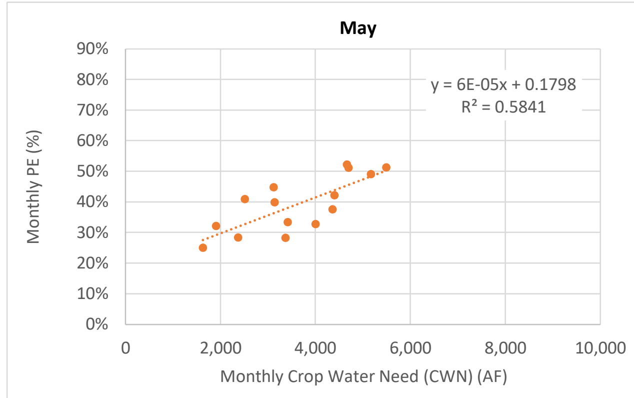
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_ used for order.xlsx").

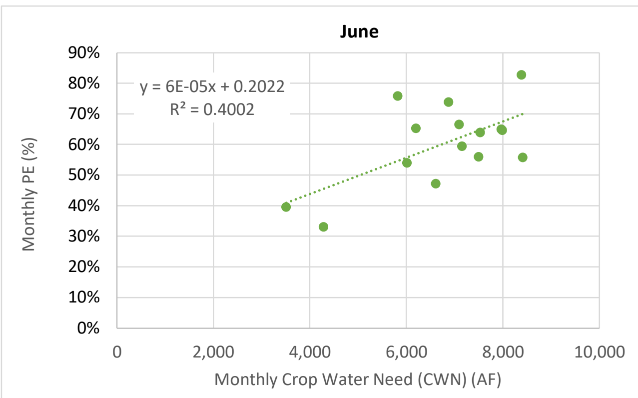
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

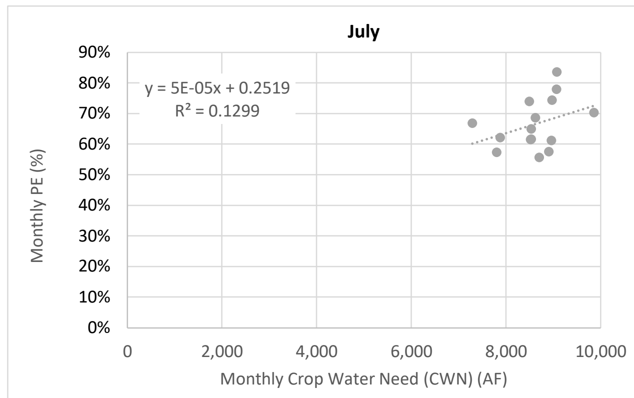
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

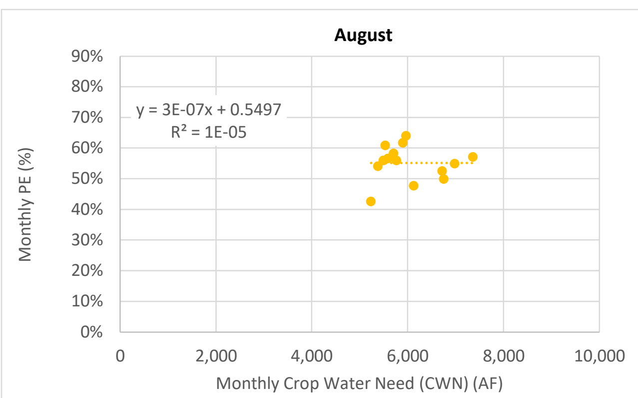
Figure 3-16
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
Milner
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

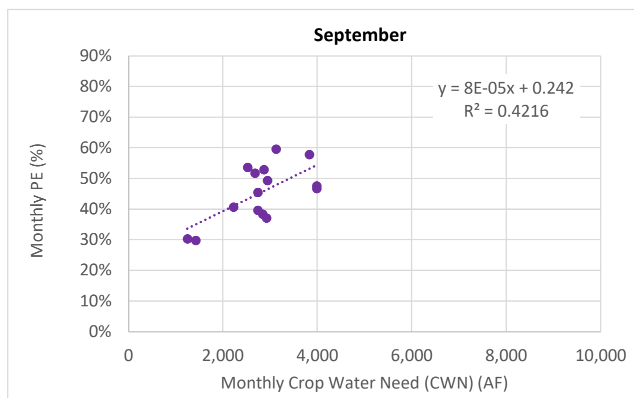


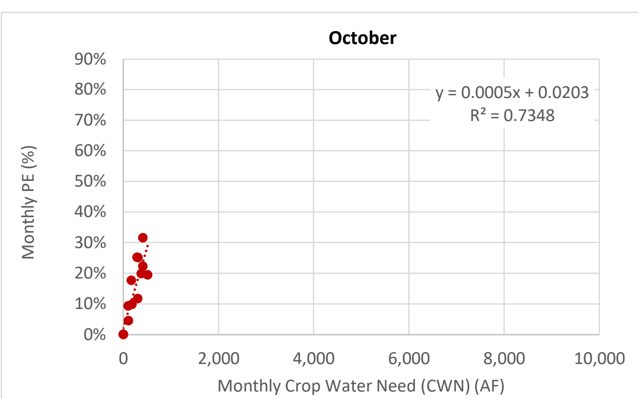












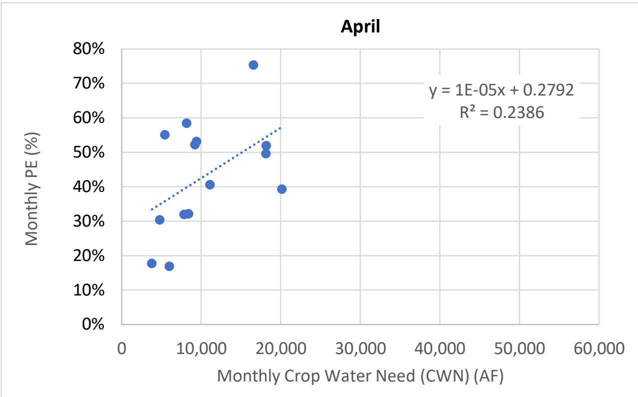
Notes:

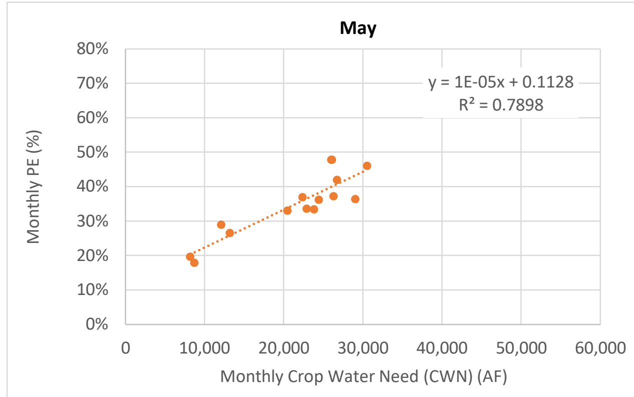
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

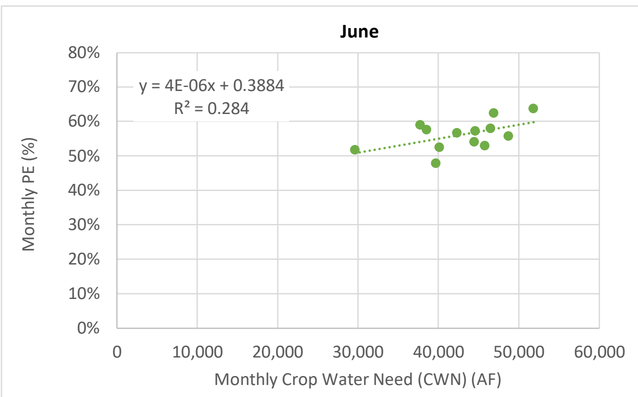
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

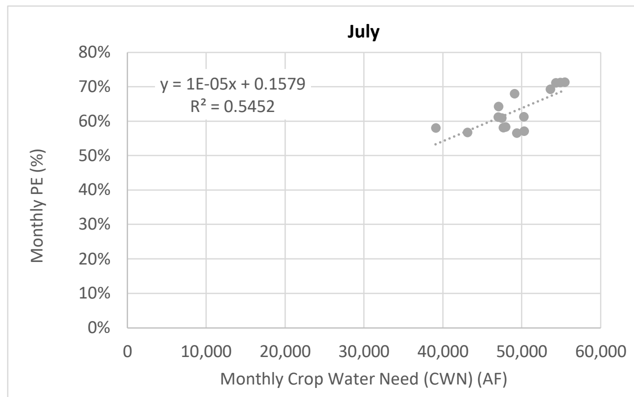
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

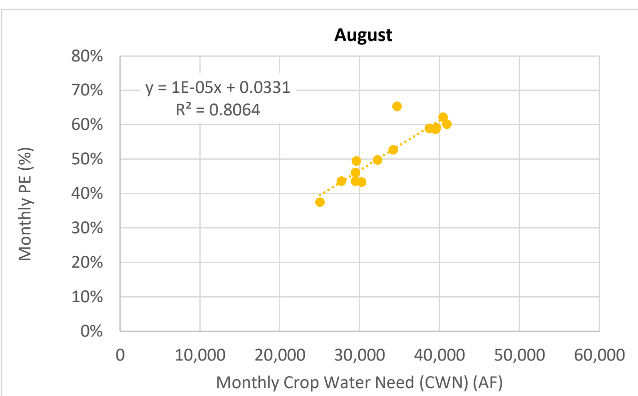
Figure 3-17
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
Minidoka
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

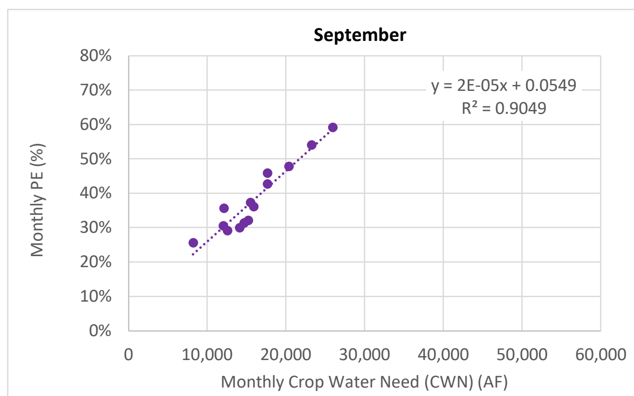


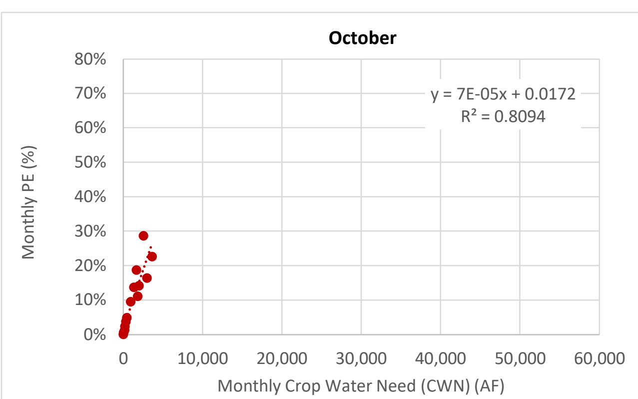






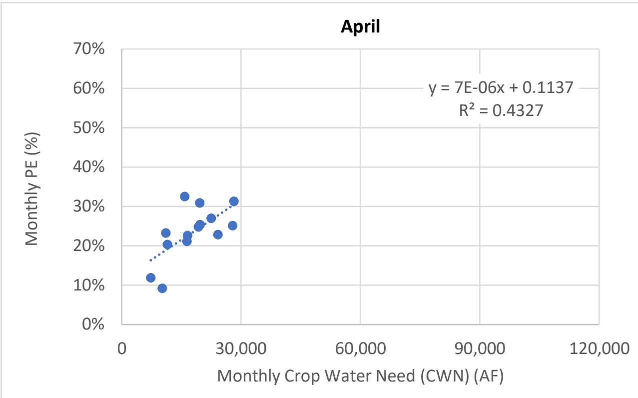


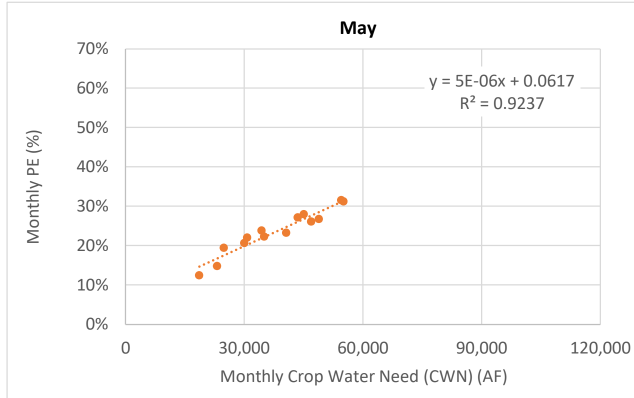


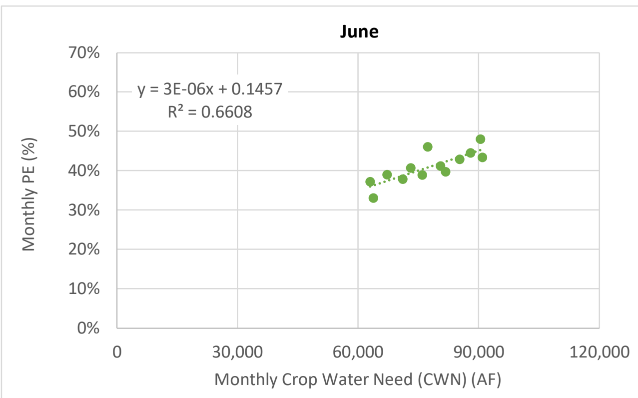


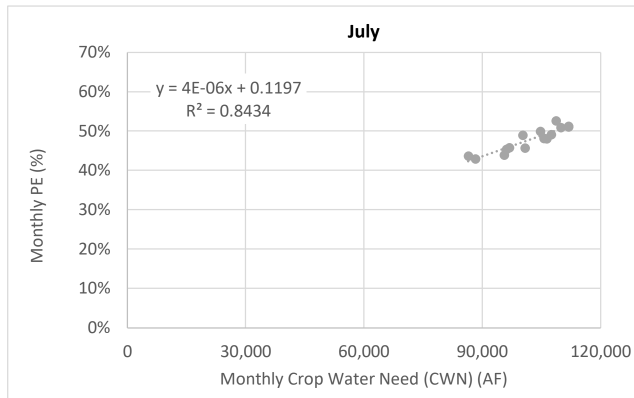
Notes:
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

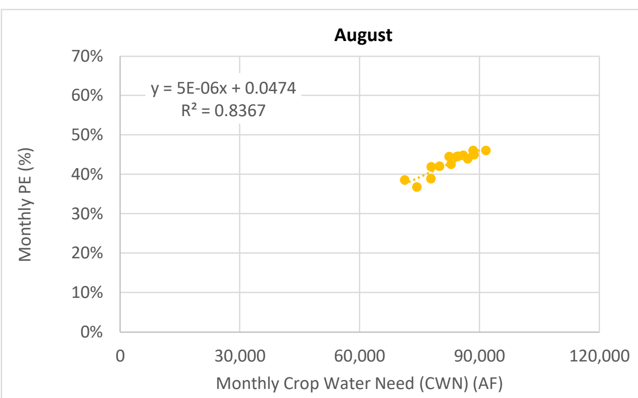
Figure 3-18
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
NSCC
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)

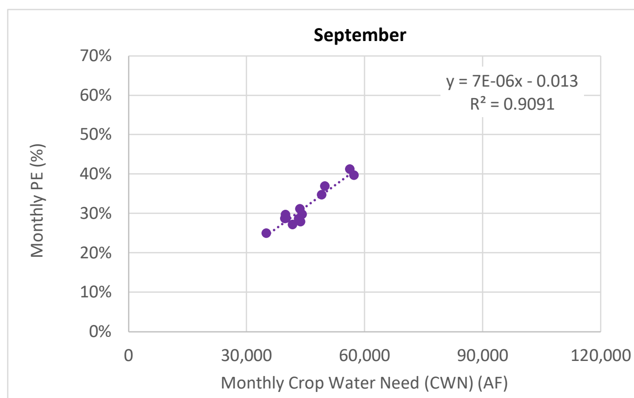


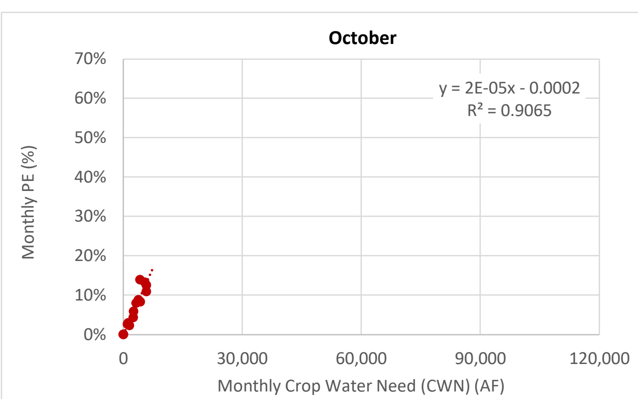






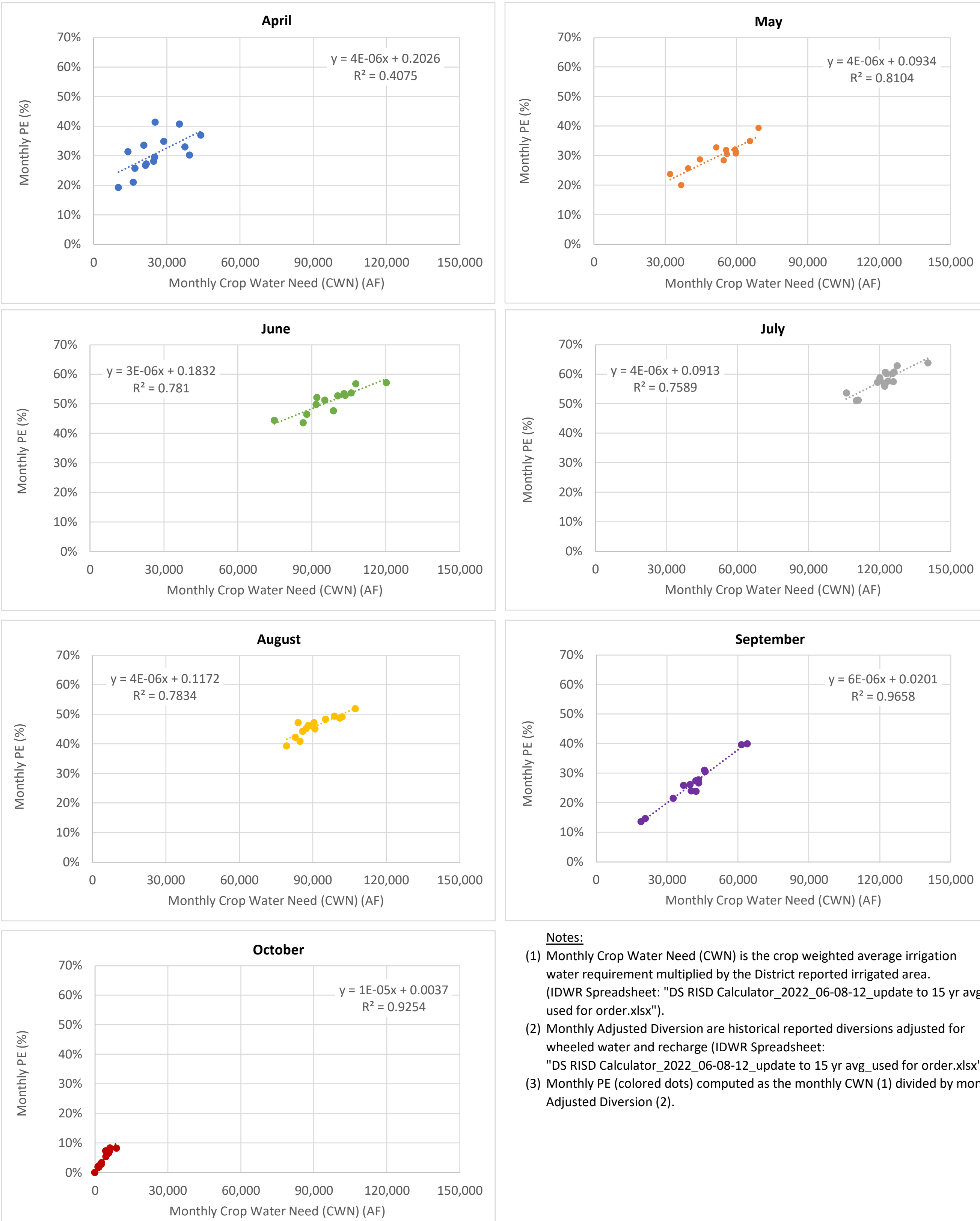






Notes:
(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_ used for order.xlsx").
(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").
(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

Figure 3-19
Monthly Project Efficiency v. Monthly Crop Water Need (CWN)
TFCC
2007 - 2021 (AF)
Exclude PE Outlier Months (> +/- 2 Std Dev)



Notes:

(1) Monthly Crop Water Need (CWN) is the crop weighted average irrigation water requirement multiplied by the District reported irrigated area. (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

(2) Monthly Adjusted Diversion are historical reported diversions adjusted for wheeled water and recharge (IDWR Spreadsheet: "DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx").

(3) Monthly PE (colored dots) computed as the monthly CWN (1) divided by montl Adjusted Diversion (2).

TABLES

Table 2-1
Annual Diversions
Surface Water Coalition Members
(AF)

	Year	A&B	AFRD2	BID	Milner	Minidoka	NSCC	TFCC	Total
	2000	62,623	512,980	268,653	66,583	400,544	1,119,218	1,160,451	3,591,053
	2001	63,229	415,977	225,398	53,572	369,320	979,689	1,012,202	3,119,388
	2002	59,354	400,654	229,261	60,327	349,680	926,219	1,009,092	3,034,586
	2003	59,479	397,573	249,562	56,966	353,245	929,453	1,046,624	3,092,903
	2004	49,708	299,371	254,082	35,674	340,958	924,324	1,001,779	2,905,896
	2005	46,929	401,735	219,600	38,948	307,628	900,339	918,011	2,833,190
	2006	57,493	410,376	247,849	41,672	352,269	963,208	995,822	3,068,689
	2007	60,227	429,040	259,495	52,342	375,519	1,015,260	1,048,965	3,240,849
	2008	59,493	421,083	254,105	50,994	373,499	967,543	1,094,941	3,221,658
	2009	57,344	453,757	236,983	55,713	343,520	1,007,862	1,043,006	3,198,185
	2010	53,528	431,376	231,542	45,471	319,837	995,820	1,029,645	3,107,219
	2011	53,788	427,228	219,855	46,932	319,744	963,049	1,054,435	3,085,031
	2012	63,550	454,143	248,557	49,038	387,998	1,018,145	1,089,269	3,310,699
	2013	62,016	400,729	248,424	52,561	364,124	1,021,024	1,058,154	3,207,032
	2014	60,392	459,017	233,728	49,961	368,685	1,021,605	1,114,409	3,307,796
	2015	62,975	442,896	253,107	55,153	368,773	1,021,958	1,102,412	3,307,275
	2016	60,409	438,224	250,702	56,550	349,779	978,658	1,045,567	3,179,888
	2017	60,713	391,658	239,685	62,371	335,922	987,102	1,053,742	3,131,193
	2018	64,192	453,890	262,211	58,417	354,851	1,026,661	1,121,717	3,341,939
	2019	56,115	436,533	254,189	52,326	327,963	1,032,687	1,075,987	3,235,802
	2020	65,828	493,153	282,949	67,227	373,531	1,048,708	1,206,401	3,537,797
	2021	69,035	444,126	265,141	64,748	354,595	1,069,340	1,083,514	3,350,499
	2022	63,848	405,410	235,119	49,787	311,795	941,270	950,024	2,957,253
	Averages								
(1)	2000-2021	59,474	427,978	247,049	53,343	354,181	996,267	1,062,098	3,200,389
(2)	2000-2022	59,664	426,997	246,530	53,188	352,338	993,876	1,057,225	3,189,818
(1)	2000-2014	57,944	421,003	241,806	50,450	355,105	983,517	1,045,120	3,154,945
(1)	2015-2021	62,752	442,926	258,283	59,542	352,202	1,023,588	1,098,477	3,297,770
(3)	06/08/12	60,179	428,534	250,170	47,234	371,255	982,965	1,060,011	3,200,349
(4)	06/08/12 (Old)	59,993	427,672	251,531	47,135	369,492	978,888	1,060,011	3,194,722
	Old 06/08/12 Average (Fourth Methodology Order) Minus 2000-2021 and 2000-2022 Averages								
	2000-2021	519	-306	4,482	-6,208	15,311	-17,379	-2,087	-5,668
	2000-2022	329	675	5,001	-6,053	17,154	-14,988	2,786	4,904
	Revised 06/08/12 Average Minus 2000-2021 and 2000-2022 Averages								
	2000-2021	705	556	3,121	-6,109	17,074	-13,302	-2,087	-41
	2000-2022	515	1,537	3,640	-5,954	18,917	-10,910	2,786	10,530

Notes:

(1) Annual diversions from 2000 - 2021 from spreadsheet provided by Mat Anders at his deposition on May 12, 2023: "BLYReview_2022_v1 used for TWG_used for order.xlsx".

(2) Annual diversions for 2022 from IDWR Spreasdheet: "DS RISD Calculator_2023_05_03.xlsx"

(3) Calculated average of 2006, 2008, and 2012 using data in table.

(4) 06/08/12 Average from Fourth Amended Methodology Order (April 2016).

Table 3-1

Summary of Annual Reasonable In-Season Demands and Shortages

TFCC

2007 - 2021 (AF)

	(1)	(1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Annual RISD			November 1 RISD Shortfall		
Year	CWN	Historical Adjusted Diversion	Nov. 1 Forecast Supply	CWN/ Methodology Order 5 PE	CWN/ Regression & Avg PE	CWN/ Regression & 75% PE	Methodology Order 5 PE	Regression & Avg PE	Regression & 75% PE
2007	443,275	1,048,965	1,030,224	1,127,782	1,073,397	1,035,277	97,558	43,173	5,053
2008	416,362	1,094,941	1,170,179	1,056,414	1,057,689	1,005,709	0	0	0
2009	352,119	1,043,006	1,141,701	947,397	940,865	896,483	0	0	0
2010	378,349	1,029,645	1,064,441	961,189	961,189	906,143	0	0	0
2011	393,611	1,054,435	1,215,802	972,593	981,358	938,090	0	0	0
2012	457,841	1,089,269	1,173,413	1,153,456	1,104,500	1,075,324	0	0	0
2013	431,633	1,058,154	1,128,023	1,084,050	1,014,099	984,820	0	0	0
2014	365,130	1,114,409	1,258,773	932,688	910,543	872,296	0	0	0
2015	409,472	1,102,412	969,761	1,035,362	1,014,356	967,927	65,601	44,595	0
2016	415,928	1,045,567	1,031,291	1,018,220	996,747	957,887	0	0	0
2017	435,307	1,053,742	1,212,718	1,096,031	1,071,959	1,035,776	0	0	0
2018	462,889	1,121,717	1,193,720	1,178,165	1,060,523	1,031,778	0	0	0
2019	396,648	1,075,987	1,176,197	991,190	965,223	931,602	0	0	0
2020	465,580	1,206,401	1,281,322	1,214,351	1,100,743	1,063,109	0	0	0
2021	478,907	1,084,609	1,063,647	1,242,713	1,195,067	1,138,478	179,066	131,420	74,831

Notes:

(1) Monthly Crop Water Need (CWN), monthly Historical Adjusted Diversion, and November 1 Forecast Supply volumes from IDWR spreadsheet: *DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx* .

(2) Monthly CWN divided by monthly average PE from 5th Amended Methodology Order (IDWR method).

(3) Monthly CWN divided by monthly PE computed using regression equation if $R^2 > 0.5$ (min efficiency = historical average; Oct PE = Sep PE).

(4) Monthly CWN divided by monthly PE computed using regression equation if $R^2 > 0.5$ (min efficiency = 75th percentile PE from historical data; and Oct PE = Sep PE).

In (2)-(4), per the IDWR Methodology, the April and October minimum and maximum limits are applied and outliers +/- two standard deviations are removed for purposes of computing the PE.

(5) Maximum [(2) - Nov. 1 Forecast Supply, 0].

(6) Maximum [(3) - Nov. 1 Forecast Supply, 0].

(7) Maximum [(4) - Nov. 1 Forecast Supply, 0].

Table 3-2

Summary of Annual Reasonable In-Season Demands and Shortages

AFRD2

2007 - 2021 (AF)

Year	(1) CWN	(1) Historical Adjusted Diversion	(1) Nov. 1 Forecast Supply	(2) Annual RISD: CWN/ Methodology Order 5 PE	(3) Annual RISD: CWN/ Regression & Avg PE	(4) Annual RISD: CWN/ Regression & 75% PE	(5) November 1 RISD Shortfall: Methodology Order 5 PE	(6) November 1 RISD Shortfall: Regression & Avg PE	(7) November 1 RISD Shortfall: Regression & 75% PE
2007	160,584	429,040	437,004	463,777	431,895	417,823	26,773	0	0
2008	150,892	421,083	525,302	435,515	423,846	401,770	0	0	0
2009	129,641	453,757	623,736	390,936	375,244	361,230	0	0	0
2010	140,084	431,376	539,947	397,330	391,574	369,223	0	0	0
2011	144,619	427,228	701,749	410,255	399,657	378,691	0	0	0
2012	166,340	454,143	490,168	483,272	452,317	441,601	0	0	0
2013	156,747	400,729	412,067	450,789	421,329	404,622	38,723	9,262	0
2014	132,568	459,017	551,279	393,507	366,471	355,017	0	0	0
2015	140,505	442,896	392,208	395,557	390,220	361,712	3,349	0	0
2016	139,802	438,224	488,209	379,802	379,802	352,307	0	0	0
2017	147,288	391,658	608,214	425,202	420,602	391,734	0	0	0
2018	156,633	453,890	579,089	439,069	409,156	389,840	0	0	0
2019	133,905	436,533	539,070	379,019	372,850	349,675	0	0	0
2020	156,003	493,153	591,776	461,089	428,276	403,450	0	0	0
2021	159,868	444,126	454,968	459,813	438,704	419,380	4,845	0	0

Notes:

(1) Monthly Crop Water Need (CWN), monthly Historical Adjusted Diversion, and November 1 Forecast Supply volumes from IDWR spreadsheet: *DS RISD Calculator_2022_06-08-12_update to 15 yr avg_used for order.xlsx* .

(2) Monthly CWN divided by monthly average PE from 5th Amended Methodology Order (IDWR method).

(3) Monthly CWN divided by monthly PE computed using regression equation if R^2 > 0.5 (min efficiency = historical average; Oct PE = Sep PE).

(4) Monthly CWN divided by monthly PE computed using regression equation if R^2 > 0.5 (min efficiency = 75th percentile PE from historical data; and Oct PE = Sep PE).

In (2)-(4), per the IDWR Methodology, the April and October minimum and maximum limits are applied and outliers +/- two standard deviations are removed for purposes of computing the PE.

(5) Maximum [(2) - Nov. 1 Forecast Supply, 0].

(6) Maximum [(3) - Nov. 1 Forecast Supply, 0].

(7) Maximum [(4) - Nov. 1 Forecast Supply, 0].