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DEPARTMENT OF
WATER RESOURCES

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Attorneys for Bonneville-Jefferson Ground Water District

STATE OF IDAHO

DEPARTMENT OF WATER RESOURCES

IN THE MATTER OF THE DISTRIBUTION OF WATER TO VARIOUS WATER RIGHTS HELD BY AND 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 **BONNEVILLE-JEFFERSON'S WITNESS AND EXHIBIT LIST**

The Bonneville-Jefferson Ground Water District (hereafter "Bonneville-Jefferson"), acting for and on behalf of its respective members, through counsel, submits its *Proposed Witness and Exhibit List* pursuant to the Director's S*cheduling Order and Order Authorizing Remote Appearance at Hearing*, issued on May 2, 2023.

EXPERT WITNESS

Bonneville-Jefferson has retained Bryce Contor, Senior Hydrologists at Rocky Mountain Environmental Associates, Inc., 482 Constitution Way STE 303, Idaho Falls, ID 83402, for the purpose of offering expert testimony in the above-captioned matter at the June 6, 2023, hearing. Mr. Contor may testify as an expert regarding technical aspects of transient modeling and steady state modeling; the implementation of and changes to Enhanced Snake River Plain Aquifer (ESPAM); possible application of source water fraction methods in the methodology order; and the use of transient and steady-state modeling in applications of the Fifth Methodology Order. A complete statement of the expert opinions Mr. Contor may express at trial as well as the basis and reasons for his opinions are contained in his Expert Report attached to this document as Exhibit "A."

Data and other information Mr. Contor considered in forming his opinions as well as the exhibits he intends to use as a summary or in support of his opinions are referenced in his Expert Report, identified in the Exhibit List below, and are available at the Dropbox link provided to the parties.

Mr. Contor's qualifications as an expert witness in this matter, including a list of all publications authored by him in the preceding ten (10) years are contained in his Curriculum Vitae attached to this document as Exhibit "B."

A schedule of the compensation to be paid to Mr. Contor for his work and testimony in this matter is attached to this document as Exhibit "C."

A list of cases in which Mr. Contor has testified as an expert at trial or by deposition is contained in his Curriculum Vitae previously referred to as Exhibit B.

Bonneville-Jefferson reserves the right to amend or supplement this disclosure in the event the June 6, 2023, hearing date is continued.

LAY WITNESSES

Bonneville-Jefferson reserves the right to call or re-call any witness identified by any party in the above-caption matter. Bonneville-Jefferson identifies the following lay witnesses that it may call at trial:

Jay Barlogi
Manager of Twin Falls Canal Company
357 6th Ave W
Twin Falls, ID 83301

Bonneville-Jefferson reserves the right to examine or cross-examine Mr. Barlogi regarding any material identified by a party in the above-captioned matter.

Bonneville-Jefferson may call Mr. Barlogi to testify regarding the aspects of his job as the Manager of the Twin Falls Canal Company. As manager of one of the Surface Water Companies making the water delivery call against Bonneville-Jefferson and other ground water users, Mr. Barlogi has information relevant to the water call, generally, and the implementation of the Director's current and previous methodology orders. He also has information relevant to any demand shortfall his company has experienced. Further, he can speak to information his company provides the Idaho Department of Water Resources each year prior to the calculation of any demand shortfall in this water delivery call. Jay can specifically discuss the irrigated acreage and crop water needs for his company and the efficiency of his system in meeting water delivery demands. He may testify regarding diversions, measurement, and application of surface water that is the subject of the instant water delivery call. Mr. Barlogi has also participated extensively in the 2015 IGWA/SWC Settlement Agreement and can testify to matters pertaining to that agreement.

Bonneville-Jefferson reserves the right to amend or supplement this list in the event the June 6, 2023, hearing date is continued.

EXHIBIT LIST

Following are a list of exhibits Bonneville-Jefferson intends to present at trial:

Ex. No.	Ex. Name
500	Expert Report Regarding Selected Technical Aspects of the Fifth Amended Final Order Regarding Methodology for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover, Bryce Contor
501	Fifth Amended Methodology Order
502	Snake River Plain Aquifer Model Scenario, 2006
503	Curtailment Charts
504	Staff memorandum in response to expert reports submitted for Rangen Delivery Call (In the Matter of Distribution for Water to Water Right Nos. 36-02551 and 36-07694), 2013
505	Description of the IDWR/UI Snake River Plain Aquifer Model (SRPAM), 1999
506	Enhance Snake Plain Aquifer Model Final Report, 2006
507	Etransfer 3.2 image
508	Etransfer 3.4 image
509	ESPAM 2.1 Tool
510	ESPAM 2.1 Final Report, 2013
511	Table 1 Settlement 2000-22
512	Model Calibrations 2022
513	ESHMC-White-Paper, 2007
514	Eastern Idaho Water Rights Coalition Letter, 2012
515	Determination of Source of Irrigation Water for Calibration of Eastern Snake Plain Aquifer Model Version 2, 2008
516	Deposition Transcript of Jennifer Sukow, 2023
517	Fourth Amended Methodology Order
518	April 2023 As-Applied Order
519	E22 SSRF image
520	IDWR contribution to the uncertainty white paper, 2012
521	Technical Report on ESPAM 2.0 Modeling Issues, 2012
522	Idaho Code § 42-233b
523	Ground Water Banking in Aquifers that Interact with Surface Water: Aquifer Response Functions and Double-Entry Accounting, 2009 Article
524	Deposition of Jay Barlogi, 2023
525	First Deposition of Matt Anders
526	Second Deposition of Matt Anders

Bonneville-Jefferson reserves the right to amend or supplement this list in the event the June 6, 2023, hearing date is continued.

DATED: May 30, 2023

OLSEN TAGGART PLLC

/s/ *Skyler C. Johns*
SKYLER C. JOHNS

CERTIFICATE OF SERVICE

I hereby certify that on this 30th day of May 2023, I served the foregoing document on the persons below via email as indicated:

/s/ Skyler C. Johns
Attorney for Bonneville-Jefferson

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Expert Report Regarding Selected Technical Aspects of the *Fifth Amended Final Order Regarding Methodology for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover*

May 31, 2023
Bryce A. Contor
Principal Hydrologist
Rocky Mountain Environmental Associates, Inc.

Introduction

To aid in an administrative hearing concerning the *Fifth Amended Final Order Regarding Methodology for Determining Material Injury to Reasonable In-Season Demand and Reasonable Carryover* (Fifth Order), Rocky Mountain Environmental Associates Inc. (RMEA) provides this expert report regarding technical topics. This is not an exhaustive report, but is confined to the following technical issues:

- Technical arguments used by the Idaho Department of Water Resources (IDWR) to justify the use of transient modeling as opposed to stead state modeling;
- Purposes of the Enhanced Snake River Plain Aquifer Model (ESPAM) and technical opinions regarding its use;
- Possible application of source water fraction methods to parse out supplemental water use by the Surface Water Coalition;
- Logical consistency in the use of transient and steady-state modeling.

In this report, all references to Finding(s) of Fact or Conclusion(s) of law are to the Fifth Order unless explicitly stated otherwise.

Technical Arguments for use of Transient Modeling

Perhaps the most influential change in the Fifth Order is the change from steady-state modeling to transient-state modeling in determining a priority date for curtailment. The Fifth Order provides the following technical rationale for the change to transient modeling:

1. Page 2, last paragraph of the "Background" section states, *"the Department now has multiple years of experience with the methodology to better understand the impact of applying steady-state modeling versus transient modeling…."*
2. Also on page 2, the Fifth Order states *"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 [of ESPAM] was calibrated using monthly stress periods and half-month time steps, a refinement that facilitates in-season transient modeling…"*
3. Finding of Fact #83 quotes the Merriam-Webster dictionary for a plain-language meaning of the term "steady state," then asserts that *"A steady-state ESPAM simulation can only model [effects]… resulting from continuous curtailments of an identical magnitude and location until the effects of curtailment are fully realized."* Finding of Fact #84 states: *"For the benefits of curtailment predicted by steady-state analysis to be realized by the river, the curtailment must occur continuously until steady-state is achieved."*

Each of these stated rationales is discussed in turn, followed by a general conclusion.

Multiple Years of Experience

Concerning the stated reason that "*the Department now has multiple years of experience with the methodology to better understand the impact of applying steady-state modeling versus transient modeling,"* the <u>Snake River Plain Aquifer Model Scenario: Hydrologic Effects of Curtailment of Ground-water Pumping Using Snake Plain Aquifer Model Version 1.1 "Curtailment Scenario</u>" (Scenario) presented to IDWR in 2006 all of the implications of steady-state modeling vs transient described in the Fifth Order, that are correct. No data or modeling advances since 2006 have qualitatively changed the results of the Scenario. In the following excerpts, quotes from the Scenario are in italics, with square brackets *[ ]* showing clarifications that are compatible with the original text and analysis. Non-italic type not set off with brackets is commentary added with this report:

> *Page3: "It is important to recognize that even after curtailment of ground-water rights, there is a residual impact to river reaches due to previous years of ground-water pumping. The magnitude and timing of this residual impact can also be evaluated using these scenario simulations.*
>
> *Page 3: "The specific objectives [of the Scenario] are to:*
>
> > *1) Determine the magnitude of increase in spring discharges and river gains over time for each sub-reach of the Snake River.*
> > *2) Determine the seasonal magnitude of the expected increases.*
> > *3) Determine the predicted impacts to aquifer water levels."*
>
> *Page 3 and page 4: "Initially, ground-water pumping removes water from aquifer storage, causing a localized cone of depression. As pumping continues, the effects propagate until a hydraulically connected boundary is reached. A recharge boundary will act as a source for the water being removed via ground-water pumping. Changes in*

aquifer water levels will impact the amount of water being recharged or discharged from a hydraulically connected recharge or discharge boundary. For example, in a hydraulically connected river reach, the relationship between river stage and aquifer water level will determine the amount of water moving between the aquifer and the river. For a gaining river reach, a decrease in aquifer water level will result in a decrease in the rate of ground-water discharge to the river....

As time passes and the collective impacts of ground-water pumping on the eastern Snake River Plain propagate throughout the aquifer system, less of the removed water is coming out of aquifer storage and more is coming from the river, either in the form of reduced spring discharges, decreased aquifer discharges to the river, or increased losses from the river. Ultimately, however, all of the ground water pumped and consumptively used for irrigation will come from the Snake River. It is difficult to quantify the volume and timing of these impacts to the river reaches. A numerical ground-water model is the best available tool for such an estimation."

Page 5 and 6: "The numerical superposition version of the ESPA model [used in the Scenario] is very similar to the fully populated ESPA model with all recharge and discharge terms removed and with a zero initial gradient. The numerical superposition model uses the concepts of superposition as detailed in Reilly and others (1987). The fundamental basis of superposition theory is that, for a strictly linear system, a complex problem can be decomposed into more simple sub-problems. The sum of the solutions of the sub-problems will be the same as the solution to the whole, more complex problem....

Confined aquifer model representations are strictly linear; unconfined aquifer model representations are non- linear due to the fact that aquifer transmissivity changes as aquifer water levels change. In the eastern Snake River Plain aquifer, the changes in water levels are very small relative to the total saturated thickness, so these nonlinearities are considered negligible. A comparison of the confined version of the ESPA model versus the unconfined version has been done by IWRRI and is published in ESPAM Design Document DDM-019, <u>Comparison of Unconfined and Confined Aquifer Representation</u>. Similarly, a comparison of model results using the fully populated model versus the numerical superposition model has been done by IWRRI and will also be documented in a report. The results of these evaluations support the conclusion that the non- linearities of the ESPAM are negligible. These results have been presented to the ESHMC [Eastern Snake Hydrologic Modeling Committee]....

The results from this [superposition] simulation represent the impacts from the particular aquifer stress being evaluated in isolation of all other recharge and discharge."

Page 6: "Evaluation of the impacts of curtailment of ground-water pumping was greatly facilitated by using the numerical superposition model. The numerical superposition model is not restricted to the 22-year period of the fully populated model and the effects of curtailment can be evaluated in isolation of all other recharge and discharge, yielding an estimate of expected <u>changes</u> in river gains and spring discharges due to curtailment. Evaluations of the results of these scenarios using numerical superposition can be used *to estimate expected future impacts to river gains due to curtailment and the residual impacts to river gains from ground-water pumping after ground-water curtailment. Using superposition allows analysis of the future impacts of a specified stress (in this case, ground-water pumping) without requiring knowledge of other future conditions such as weather"* (emphasis in original).

Page 7: "For the long-term curtailment assessment, the annual averages of precipitation and evapotranspiration were used. For the seasonal curtailment assessment, summer and winter (corresponding to irrigation season and non- irrigation season) averages were used."

Page 8: "Additionally, Table 1 lists the time for each reach to come within 10% of the steady state value. For example, in Table 1, curtailment of all ground water is predicted to cause a 298 cfs accrual in the Devil's Washbowl to Buhl reach. Transient simulation results indicate that it would take approximately 59 years for the recovery to reach 90% of the steady state value. Similarly, curtailment of ground water junior to January 1, 1973 is predicted to cause an 88 cfs recovery in the same reach. Ninety percent of this recovery would be realized in 51 years."

Page 9: "Table 2 summarizes the predicted reach accrual after one year of curtailment for each reach for each cutoff date." Unfortunately, the units of Table 1 are "cfs" and the units of Table 2 are "acre feet," so it would take some calculation to perceive the difference between the first-year results and the total result.

Page 10: "Figures 18 through 28 show the seasonal predictions of reach accruals for the 11 reaches of the Snake River for each of the five cutoff priority dates....

Many of the reaches... show a winter decline almost back to the river reach gain levels of the previous year. Some of the reaches, however, show a smaller decline relative to the predicted accruals. This would indicate that the curtailed areas are more distant from the reach and that the accruals are taking longer to get to the reach...." Figure 18 also shows single-year results for two of the cutoff dates.

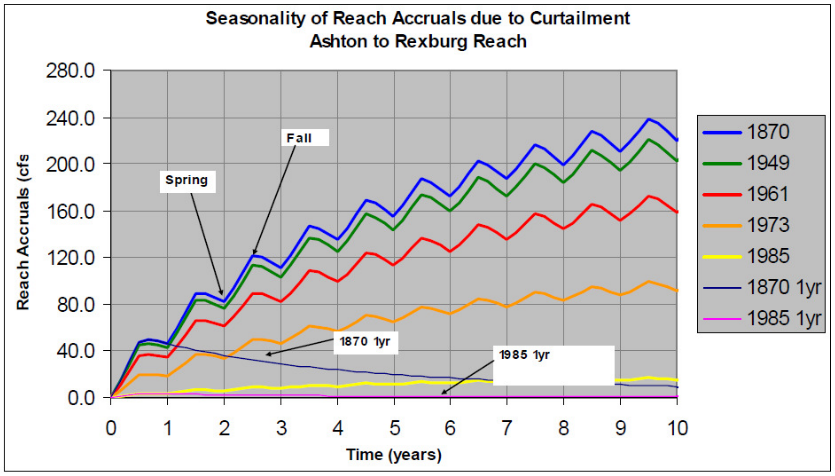

Figure 18. Seasonality of Reach Accruals due to Curtailment of Ground-Water Pumping for Ashton-Rexburg Reach (generated using ESPAM v1.1).

Figure R1: Figure 18 reproduced from Scenario.

Page 11: "Just as curtailment of ground-water pumping will cause increases in river gains, curtailment will also cause a recovery of aquifer water levels. Figures 29 through 34 show predicted changes in water levels at six locations throughout the plain due to curtailment of all ground-water pumping." Page 11 also states *"The magnitude of the rise is driven by how proximal the curtailed ground-water irrigated lands are to the river reach under evaluation."* This is incorrect and should read <u>"how proximal... to the location where water-level changes were considered."</u>

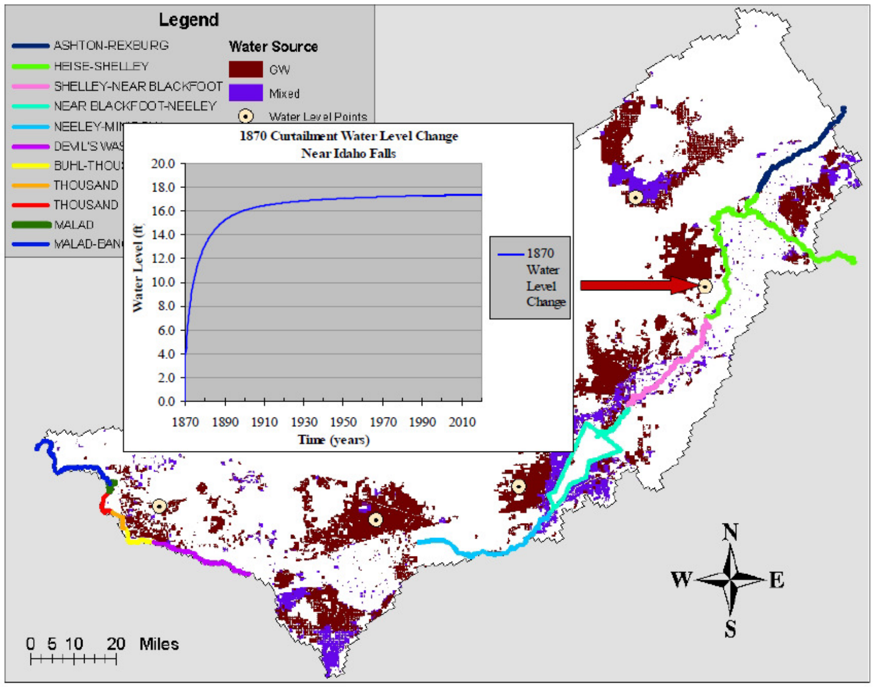

Figure 30. Predicted change in ground water level near Idaho Falls due to curtailment of ground water pumping junior to 1870 (generated using ESPAM v1.1).

Figure R2: Figure 30 reproduced from Scenario.

> *Page 11: "For the temporary, 1-year simulation, maximum realizable accruals are relatively small but the benefits last for several years."*

These excerpts show the state of knowledge that has been available to IDWR since 2006. It could be argued that a 2006 report is so old that no IDWR personnel who were familiar with it were involved with technical input to the Fifth Order. However, a 2013 staff memo from Jennifer Sukow to Gary Spackman indicates that in 2012 Sukow repeated the curtailment scenario exercise using both ESPAM2.0 and ESPAM2.1. It is clear that in 2012 Sukow was aware of the 2006 work, and that Spackman had an opportunity to be aware of it at least as early as 2013. Both still are employed at IDWR and could have applied this knowledge at any time in approximately the last decade.

Modeling Time Scale

The second stated reason is that 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 [of ESPAM] was calibrated using monthly stress periods and half-month time steps, a refinement that facilitates in-season transient modeling…."* A stress period in modeling parlance is a representation of a period of time during which model inputs (recharge and discharge data, and calibration targets) are held constant. Table 1 in this report shows the date of release and stress period lengths used in the various versions of the model discussed above. The timing of events shown in Table R1 is different than intimated by the statement in the Fifth Order.

Table R1. Model Versions, Report Dates, and Stress-Period Lengths

Model	Report Year	Stress-Period Length
SRPAM	1999	15.2 days
ESPAM1.0	(no report)	6 months
ESPAM1.1	2006	6 months
ESPAM2.0	(no report)	1 month
ESPAM2.1	2013	1 month
ESPAM2.2	2021	1 month

In addition to the fact that ESPAM modeling with one-month stress periods precedes the 2016 Fourth Methodology order by three years, the notion that earlier versions did not facilitate *"in-season transient modeling"* should be considered in light of the following:

- The 1999 SRPAM stress period was shorter even than the ESPAM2.2 stress period.
- The 2005 – 2006 ESPAM1.0 and ESPAM1.1 stress periods were approximately the length of an irrigation season and were assigned to winter and summer months in a fashion that facilitates evaluation of effects upon surface-water irrigation supplies.
- As illustrated by the Scenario, the ESPAM1.0 and ESPAM1.1 models not only were explicitly designed to represent seasonal effects of activities, they were used for that purpose at least as early as 2006.
- It is not necessary for the stress-period length in model application to match the stress-period length in calibration, as demonstrated by all versions of the IDWR transfer tool (ETRAN).

It is acknowledged that generally it is not considered good modeling practice to apply the model with shorter stress periods than used in calibration, though this guideline was not adhered to in the first single-cell versions of IDWR's transfer tool.

Time constraints precluded more robust analysis, and precluded analysis using ESPAM2.2. However, a limited analysis was conducted using a monthly version and a trimester version of ESPAM2.1, at three of the points shown in Figure R3. These points were not selected to be representative but rather to fully explore differences across the aquifer.

The monthly version of ESPAM2.1 is referred to as "RSP_E2_1." It is a proprietary tool developed by Rocky Mountain Environmental Associates that uses a mathematical modeling procedure called *convolution* to apply a table of input stresses to a large database (approximately two gigabytes) of transient response functions that provide responses from each of approximately 11,000 model cells to each of approximately 60 modeled spring and river reaches. The trimester version is IDWR's "ETRAN3.3" transfer tool.

For each point, the model was applied three times; once with ETRAN3.3, and twice with RSP_E2_1. Results are illustrated in Figure R4 through Figure R6. Only the first two years of results are shown, and only for the Near Blackfoot to Minidoka reach. All three applications represented a curtailment event that would produce 100 acre feet of reduction at the modeled point. For the results labeled "Trimester," the 100 acre feet were applied uniformly across one four-month trimester, and results modeled on a trimester stress period. For results labeled "Monthly 1," the 100 acre feet were applied uniformly across the first four months, so the application of effect was identical to the "Trimester" rendition. However, the modeling used one-month stress periods. The "Monthly 2" results also reflect 100 acre feet of relief modeled using one-month stress periods, but the relief was applied variably across six months in an effort to simulate the approximate timing of relief from an actual curtailment event.

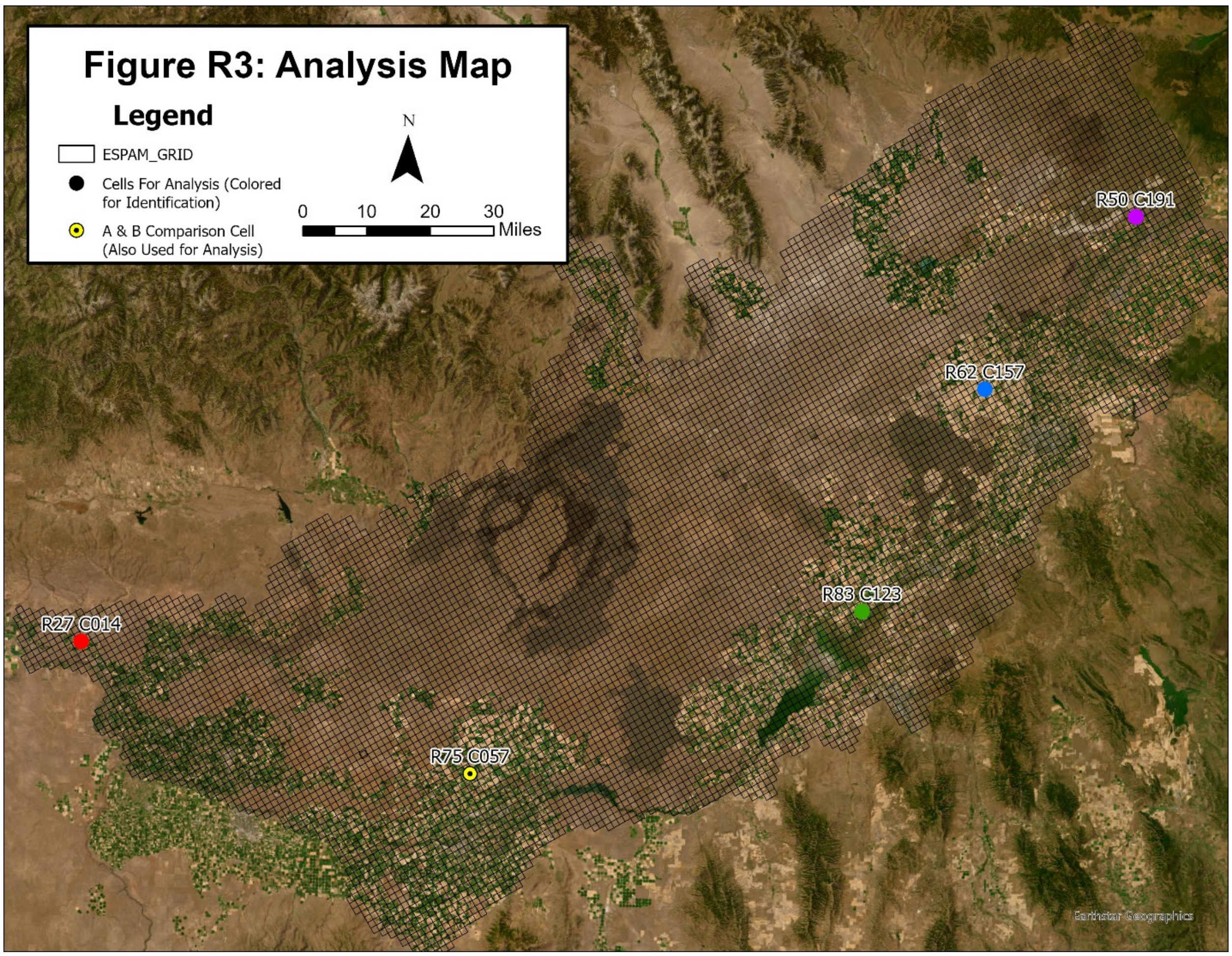

Figure R3.

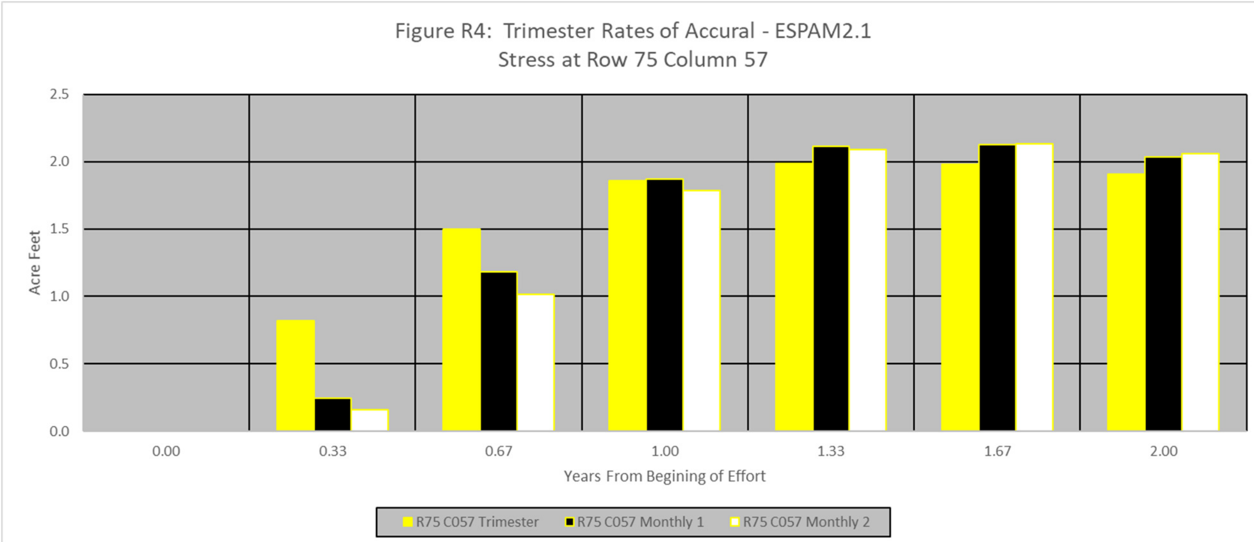

Figure R4.

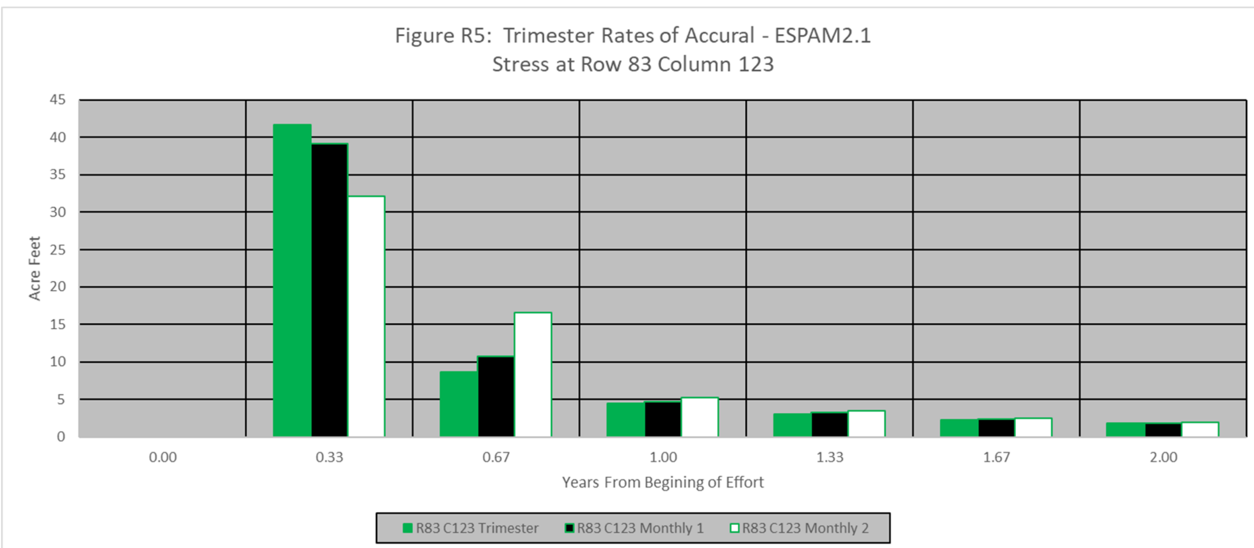

Figure R5.

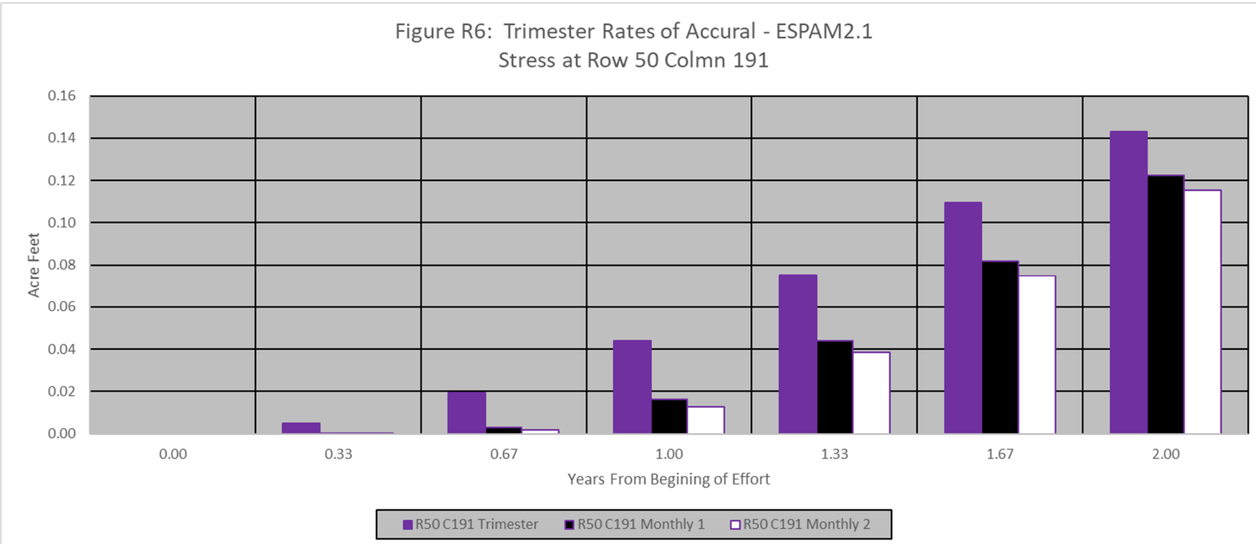

Figure R6.

Conclusions from this limited exercise are as follows:

- Within the first two years, results are qualitatively similar but not quantitatively identical.
- The differences resulting from stress-period length and temporal description of the effect of curtailment subjectively appear to be smaller than the differences between successive versions of the model, as discussed later in this report.
- The largest discrepancies, in terms of percent difference between model outputs, were observed in the point that showed the smallest overall response to the Near Blackfoot to Minidoka reach. Time constraints precluded exploration of whether this is a general result.

The results may be somewhat misleading; the model can be set to produce results as of the beginning of a stress period, or as of the end. Time constraints did not allow exploration of whether the RSP_E2_1 and ETRAN3.3 were consistent in this setting. If they were not, the discrepancies may be smaller than the figures suggest. Nevertheless, the overall conclusion is that monthly stress periods are somewhat different, and perhaps "better," than longer stress periods, but that four month stress periods and by extension probably six month stress periods can be used for evaluation on the time frame of individual irrigation seasons, as intended and practiced with ESPAM models prior to 2013.

The Nature of Steady-state Modeling

The third stated technical reason to adopt transient modeling is that *"A steady-state ESPAM simulation can only model [effects]… resulting from continuous curtailments of an identical magnitude and location until the effects of curtailment are fully realized."* It is true that permanent curtailment *could* be a presumption of steady-state analysis, and this could be the presumption that was made in constructing the Scenario in terms of cubic feet per second, as suggested by the following quote:

> *Page 8: "The steady state analysis presumes the unlikely case that pumping has been permanently curtailed."*

If this was meant to apply generally to steady state modeling, it is incorrect, though it may be a reasonable explanation for a model run whose input and output values were contemplated in terms of flow rate (cfs). If the input and output values were contemplated in terms of acre feet (as is done in assigning a curtailment date), a more correct statement would have been that <u>"Steady state analysis estimates only where the effects of curtailment will accrue and provides no information on the timing of curtailment or accrual."</u> The most striking example of this fact is that steady-state modeling has been used to calculate curtailment date under all prior methodology orders, and is used in the Fifth Order to partition mitigation responsibility.

Despite the incorrect, or at best unfortunate, wording in the Scenario, its results did show that at long time periods, transient modeling very closely approximates time-agnostic steady-state modeling:

> *Page 9: "Figures 7 through 17 show the predicted reach accruals over a long period of time for each modeled reach, for each cutoff date..... Each figure also shows the steady state value for predicted accruals for each of the cutoff dates."*

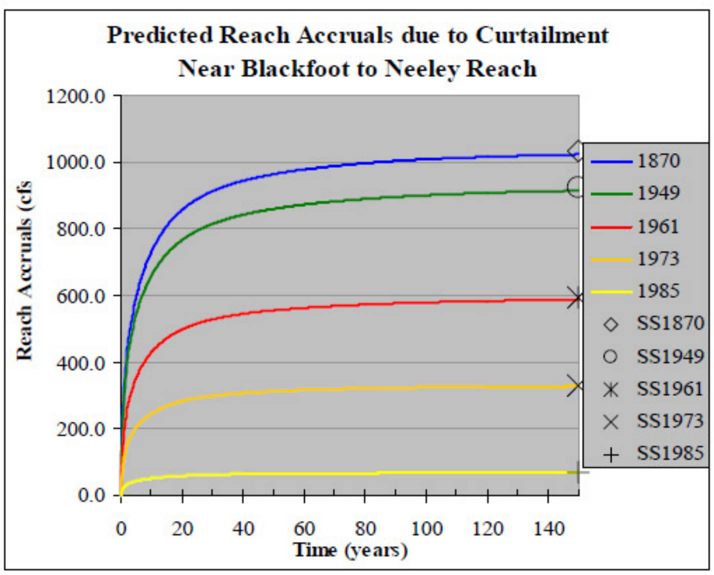

Figure 10. Predicted Reach Accruals due to Curtailment of Ground-Water Pumping for Near Blackfoot-Neeley Reach (generated using ESPAM v1.1).

Figure R7: Figure 10 reproduced from Scenario.

Intuitively, and as explained in the Scenario in 2006, if the modeling period is sufficiently long relative to the duration of the event and the proximity of it to springs and rivers, transient results will begin to approach steady-state results and would equal them if the transient simulation could be run to infinite time.

A technically-correct Finding of Fact #83 could read:

> *Merriam-Webster's Dictionary defines steady-state as "a state or condition of a system or process … that does not change in time." Steady state, Merriam-Webster.com, https://www.merriam-webster.com/dictionary/steady-state (April 19, 2023). A steady-state ESPAM simulation based on input values of acre feet of curtailment can only ~~model increases in aquifer discharge~~ indicate total acre feet of accrual to modeled reaches of the Snake River and tributary springs resulting ~~from continuous curtailments of an identical magnitude and location until the impacts~~ after the effects of curtailment ~~are~~ have fully been realized. For example, a steady-state analysis of the curtailment of 1,000 acre feet would indicate where the 1,000 acre feet of accrual eventually would be expressed, but would not describe the timing of arrival of accruals. ~~acres, assumes that irrigation of the same 1,000 acres is curtailed every year at the same rate of consumptive use, until the impacts of that curtailment reach a steady state, or no longer change from year to year~~.*

A technically-correct Finding of Fact #84 could read in part:

> *Steady-state analysis does not calculate the time to reach steady-state conditions nor describe the seasonal timing of the impacts, but only estimates the spatial distribution of accruals. To estimate the timing of accruals, transient modeling must be employed. ~~For the benefits of curtailment predicted by steady-state analysis to be realized by the river, the curtailment must occur continuously until steady-state is achieved. The assumption of continuous curtailment does not reflect reality in the SWC Delivery Call~~* [SWC refers to the Surface Water Coalition].

Conclusions Regarding Technical Justification for Adopting Transient Modeling

It is my professional opinion that the Fifth Order's technical arguments for adoption of transient modeling are not factually sound:

- IDWR has had access to the current understanding of the general implications of transient vs. steady-state modeling since at least 1999, and access to the specific implications of a curtailment context since 2006;
- The 1999 SRPAM model had stress periods even shorter than the current model;
- Though its stress periods were longer than the current model, the 2006 ESPAM1.1 model was designed and deployed to represent effects on an irrigation-season time scale;
- The 2013 ESPAM2.1 model had identical stress periods to the current ESPAM2.2 model.
- The transient version of the model can be used to represent temporary curtailment of water rights.

Since the technical rational presented is not factually correct, it is my professional opinion that the Fifth Order does not reveal the true rationale for the change from steady-state to transient. I therefore am unable to comment on the technical merit of the actual rationale.

Purposes and Use of ESPAM Modeling

The 1999 SRPAM model was stated "*to be a planning and management tool for use by both agencies [IDWR and US Bureau of Reclamation].* The subsequent ESPAM model reports have indicated the stated purpose of informing *"conjunctive management,"* a misnomer that has been used for decades in Idaho for conjunctive *administration* of groundwater and surface-water rights. Curtailment is a conjunctive-administration activity, and in all likelihood, curtailment calculations always have been a consideration of IDWR. However, the ESPAM reports have cautioned that model use should correspond to its regional nature; for instance, from the ESPAM2.2 report: "*The [model] is a regional groundwater model. For this reason, the model is best used for broad-scale predictions. The user should avoid the temptation to model localized phenomena…. This limitation exists in part because the input data used to compute the agricultural impacts are still coarse."*

In 2007 and again in 2012, many members of the Eastern Snake Plain Hydrologic Modeling Committee (ESHMC) responded to invitations to participate in drafting of "white papers," which in reality were compilations of individual statements on model use. Opinions ranged widely, from: "*It is our professional opinion that the current model has no technical credibility as a tool for water rights administration*" (2007 White Paper) to: *"[I]nformation from the model can be used to estimate the effects of curtailment of ground water pumping on aggregated river reaches."* (2007 White Paper).

An especially insightful comment elaborates on the caution regarding coarse data: *"The effects of temporal imprecision are analogous to the effects of spatial imprecision, but are compounded with concerns about the difficulty the calibrators have had in matching seasonal amplitude in some target springs. These suggest to us that while the model can be used to estimate effects on a monthly basis, it should not be used to make administrative decisions that hinge on monthly distribution of effects"* (2012 White Paper contribution from Eastern Idaho Water Rights Coalition, emphasis in original).

Implicit in using any tool for any purpose is a determination that the tool satisfies the minimum criteria for its use. Establishing criteria is a policy question, and whether criteria are met is a technical question. The Fifth Order does not describe the policy criterion for the model's ability to match month-to-month variation, nor the rationale for the criterion. However, a metric is available; the ESPAM2.2 report provides an R^2 score for each model reach, shown in the bottom right panel of the corresponding figure of calibration results. The R^2 statistic can be described as a score of the fraction of variability in a data set that are described by an algorithm and its input data. Figure 119 shows an R^2 value of 0.4232 (i.e. the model and its input data can explain approximately 42% of monthly variability) for the Near Blackfoot to Neeley reach, and Figure

120 shows an R^2 value of 0.0079 (under 1%) for the Neeley to Minidoka reach. The bottom center panel provides an indication of when in the year discrepancies generally occur; these are the months when the blue and orange lines are most disparate. In both cases, the average results are worst during the irrigation season.

It is my professional opinion that unless the criterion for the ability to match monthly values is very low, ESPAM2.2 likely should not be considered appropriate for estimating month-by-month effects for the combined Near Blackfoot to Minidoka model reach when substantial consequences depend on decisions made on its basis.

Technical work that could inform the policy decision of establishing a criterion would explore the ratio of the potential relief of curtailment to the known cost. Additional technical defensibility could be gained by holistically considering all the hydrologic implications of the fundamental differences in spatial and temporal responses between groundwater systems and surface-water systems, as discussed later in this report.

It is my professional opinion that the use of ESPAM modeling is technically defensible when ratios of relief to cost are considered in light of modeling precision and imprecision, and when policy adjusts for spatial and temporal responses. This is true for both steady-state and transient modeling analysis.

Supplemental Water Use by SWC

Finding of Fact #23 states: *"There are lands within the service areas of SWC entities that are irrigated with supplemental groundwater. Exhibit 3007. Supplemental groundwater is a factor the Director can consider in the context of a delivery call…. At this time, the information submitted or available to the Department is insufficient to determine the extent of supplemental irrigation on lands within the service areas of SWC entities."*

My professional opinion is that because this statement is not factually correct, the true rational for this decision has not been disclosed. Therefore, I cannot respond to the technical content of the actual rationale. The basis for this opinion is:

- Since the initial development of ESPAM1.0 in the early 2000s, the extent and effect of supplemental groundwater irrigation has been calculated for the parts of the SWC Service Areas that are within the ESPAM model boundary.
- The data and methods that have been used in the ESPAM model are readily available and applicable to the parts of the SWC Service Areas that are outside the ESPAM model boundary.
- As a result of measurement orders, the measurement and report of well discharge data, and the availability of these data in IDWR's Water Measurement Information System (WMIS) are much more robust than in the early 2000s when these calculations first were undertaken and the methods developed.

- IDWR has known, or could have known, since at least 2015 that these data would be important to a correct calculation of Reasonable In Season Demand. The intervening eight years would have been sufficient time to apply the existing data and methods, or to improve them, for purposes of the methodology.

Because of the existence of these methods and data, it is my professional opinion that a defensible adjustment for supplemental groundwater use within the SWC Service Areas is reasonably within reach, on a technical basis. The existence of these methods and data is documented in accompanying documents:

- Cosgrove, D.M., B.A. Contor and G.S. Johnson. 2006 Enhanced Snake Plain Aquifer Model Final Report, pages 50 – 54.
- Contor, Bryce A. and Paul L. Pelot. April, 2008. Draft 2. Determination of Source of Irrigation Water for Calibration of Eastern Snake Plain Aquifer Model Version 2.
- Idaho Department of Water Resources. 2013. Enhanced Snake Plain Aquifer Model Version 2.1 Final Report, pages 50 – 52.
- Sukow, Jennifer. 2021. Model Calibration Report Eastern Snake Plain Aquifer Model Version 2.2, pages 15 – 17.

In addition, substantially more acre feet of diversion are required to support a surface-water irrigated acre than a groundwater-irrigated acre because the curtailment requirement is multiplied by the following:

- An acre of groundwater irrigation requires fewer acre feet of gross diversion than does an acre of surface-water irrigation supplied by a long canal.
- For most groundwater-irrigated lands, more accrual from curtailment arrives at non-target reaches than arrives at the Near Blackfoot to Minidoka Reach
- The curtailment requirement again is multiplied by the fact that more accruals from curtailment occur in future years than in the year of need.

Thus, it is my professional opinion that neglecting a single acre of supplemental irrigation within the SWC Service Area results in needless curtailment of many groundwater-irrigated acres. Therefore, strictly on a technical basis, the refinement of quantifying the effect of supplemental irrigation within the Surface Water Coalition service area could provide substantial relief to a broad constituency of Idaho water users.

Logical Consistency

This section of the report addresses logical consistency in application of modeling, from a technical viewpoint. It also lays groundwork for an attempt to address a hearing officer's complaint from a number of years ago that expert reports tend to focus on what *cannot* be done, without providing a hearing officer any input on what could be done from a technical standpoint. In response to that complaint, this report concludes with a conceptual discussion of a technical approach that is logically consistent and coherent, that could be considered as foundation for policy deliberations.

Accruals beyond the Irrigation Season

Finding of Fact #86 indicates that: *"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,"* indicating that the bulk of accruals from curtailment do not arrive during the time period of indicated shortfall. Time constraints prevented confirmation of the numerical values, but conceptually this matches my understanding. However, the actual response time is independent of modeling and is governed by the physical properties of the aquifer/river system. While 9% to 15% probably is a reasonable estimate, whatever the true value is, it applies identically to any curtailment regardless of whether it was calculated using steady-state or transient modeling. The only difference is that the transient modeling produces an estimate of the delay in accrual.

The delay in accrual depends on the spatial relationship of the well curtailed and the reach for which accruals are desired. The spatial distribution of the delayed response from curtailment is illustrated using evaluation of the sample points illustrated in Figure R3, presented earlier. Spatial distribution is illustrated using results from the ETRAN3.4 Transfer Tool realization of the transient ESPAM2.2 model.

Time constraints precluded duplicating the five-month May 1 to September 30 period considered important in Finding of Fact #86. However, the ETRAN3.4 Transfer Tool four-month period is not too different, and allows conceptual discussion of the results shown in Figure R8 through Figure R13. Though the transfer tool assigns its summer trimester to July, August, September, and October, from my involvement in the development of the original transfer tool I know that this assignment is arbitrary and that it is valid to consider that the figures illustrate the results of a four-month curtailment beginning in May.

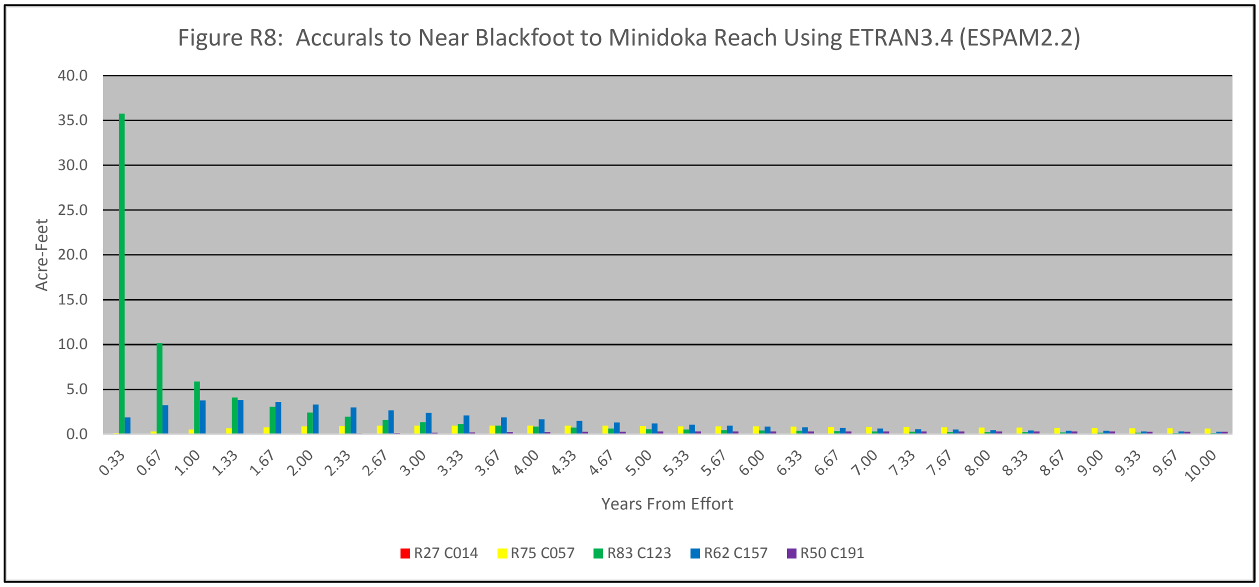

Figure R8.

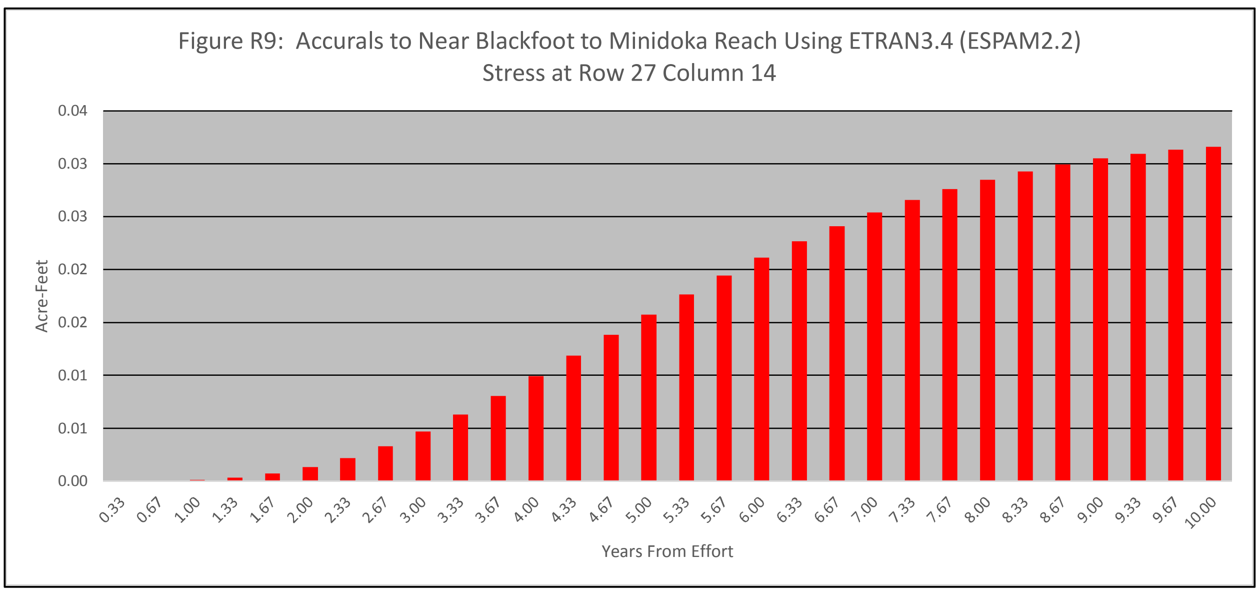

Figure R9.

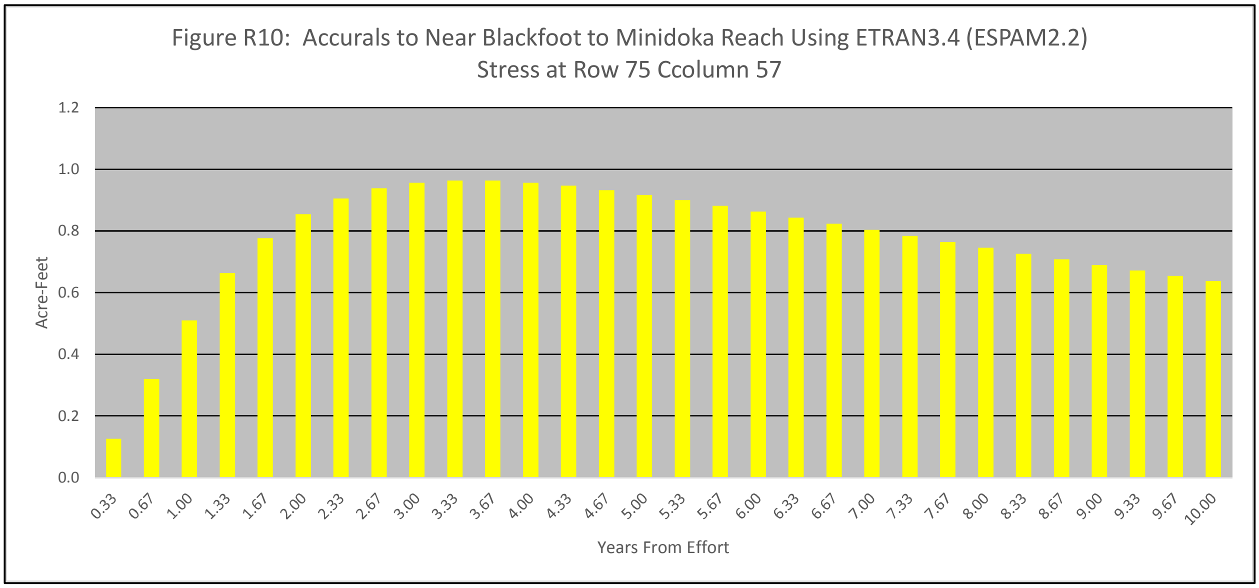

Figure R10.

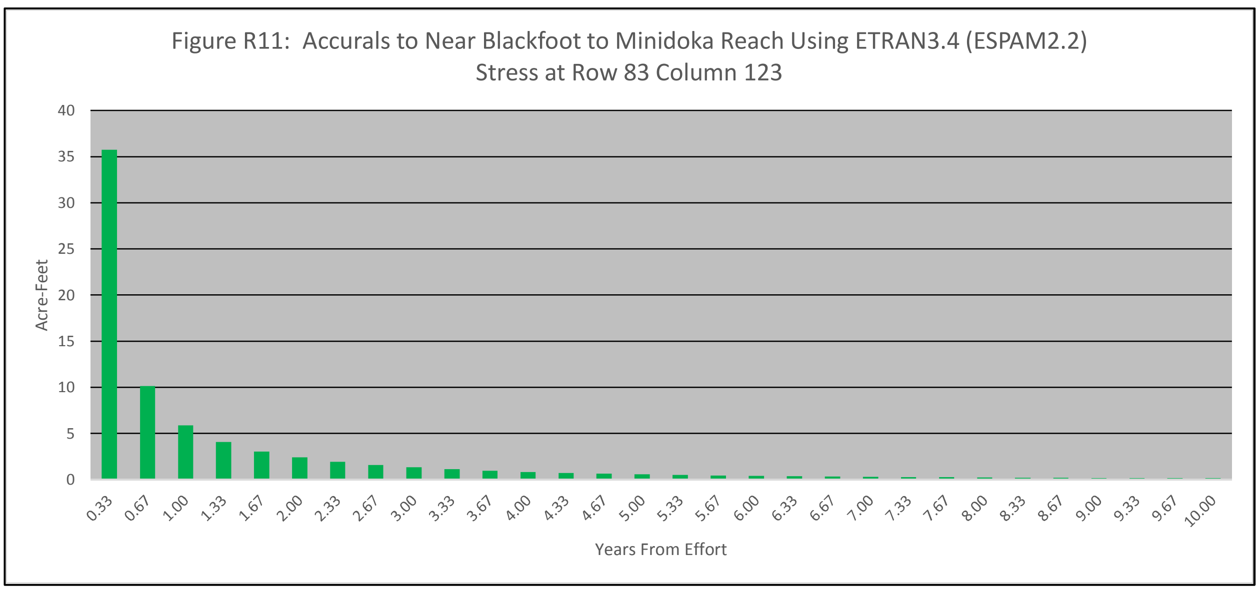

Figure R11.

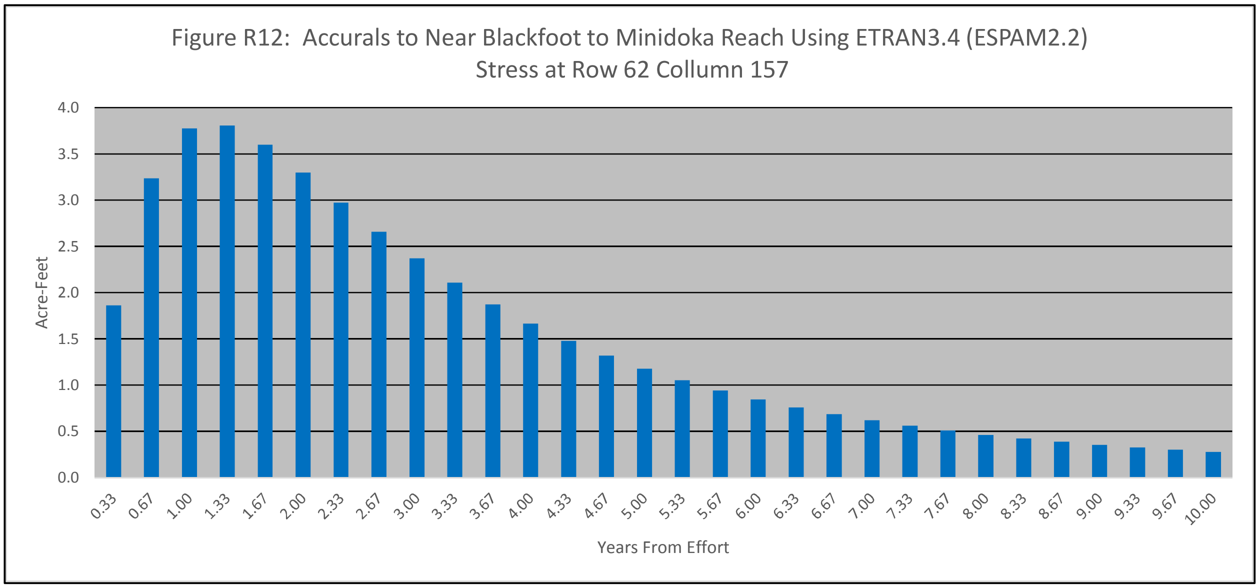

Figure R12.

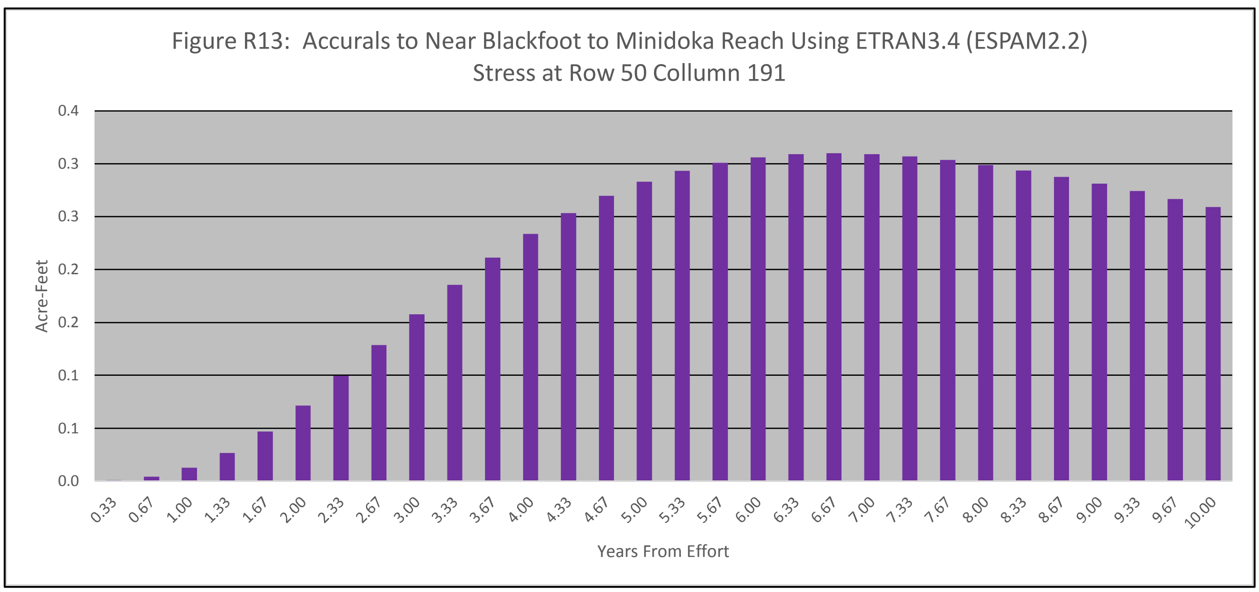

Figure R13.

Qualitatively, these figures can be summed up with the statement that: "Accruals from curtailment predominantly arrive in years later than the curtailment event, except for curtailment that occurs very near the river in the Near Blackfoot to Minidoka reach."

In deposition testimony in May, 2023, Jennifer Sukow of IDWR indicated her opinion that model-indicated future accruals to irrigation-season reach gains could be applied to offset future calculated shortfalls. This is logically consistent with the physical nature of propagation of effects, and with the modeling. However, because this carry-forward does not appear to be specified in the Fifth Order it is not clear whether such a carry-forward would be authorized. Additionally, earlier orders' Step 10, using transient modeling in relationship to reasonable carryover, was remanded by the court (Fourth Methodology Order page 3). Time constraints preclude exploration of the arguments and rationale behind this remand, and without this understanding, it is difficult to assess whether Sukow's proposed carry-forward would survive judicial review. Regardless, even if the Fifth Order does would allow it, and even if it would survive judicial review, its omission from the Fifth Order leaves it as a mechanism that cannot be relied upon.

Sukow also indicated that the effect of curtailment on future carryover calculations would be implicit in the data relied upon. Though time constraints preclude a robust analysis, it appears that the assumption of the methodology calculations is that the data represent a single snapshot of time within a dynamic equilibrium. If this is true, then for Sukow's argument to be logically consistent, the implicit effect of prior curtailment on the well that is used in calculations would be expected to be dynamically stable, meaning that water level in said well would be relatively consistent over time. However, this is not the case following a one-time curtailment event, and the departure of the assumption from reality depends on the temporal and spatial distance of the curtailment event from the well, and also on its magnitude. Considering that modeled reach gains are a manifestation of aquifer heads in model river cells, the temporal aspects of effects on the well can be qualitatively compared to the model results summarized in Figure R8 through R13.

In Figure R11, early accruals are greater than subsequent accruals. This scenario reflects a curtailment that occurred relatively near the well, much as cell R83 C123 is relatively near the Near Blackfoot to Minidoka reach. Sukow's implicit assumption would overestimate accruals during the second year after curtailment. Overestimates, such as this one, hurt the SWC by providing less during the second year than the model would suggest. Conversely, Figures R9, R10, and R13 show scenarios for locations more distant, where subsequent accruals exceed the initial accruals. In this case, Sukow's implicit assumption would underestimate accruals during the second year after curtailment, harming potentially-curtailed water users by requiring more curtailment than is necessary to meet the need of a call. A solution would be to explicitly model and account for all future accruals, much as Sukow proposed for in-season demand calculations.

Accruals to Non-Target Reaches

The Fifth Order does not discuss the fact that curtailment would result in greater accruals to non-target reaches than it would to the Near Blackfoot to Minidoka Reach. Time constraints did not allow exploration of ESPAM2.2 results, but they would be qualitatively similar to the ESPAM1.1 results from Table 1 of the Scenario, reproduced here.

Table 1. Predicted steady state reach accruals for each curtailment period (using ESPAM v1.1).

Cutoff Date	All Pumping		Post January 1, 1949		Post January 1, 1961		Post January 1, 1973		Post January 1, 1985	
Reach Name	Steady State Gain (cfs)	Time (yrs) to realize 90% of gain	Steady State Gain (cfs)	Time (yrs) to realize 90% of gain	Steady State Gain (cfs)	Time (yrs) to realize 90% of gain	Steady State Gain (cfs)	Time (yrs) to realize 90% of gain	Steady State Gain (cfs)	Time (yrs) to realize 90% of gain
Ashton to Rexburg	316	20	290	20	222	19	128	19	22	19
Heise to Shelley	211	18	195	18	141	17	78	17	15	17
Sum of Reaches Above Shelley	**526**		**484**		**363**		**206**		**37**	
Shelley to Near Blackfoot	406	30	368	30	240	28	132	25	26	28
Near Blackfoot to Neeley	1035	35	925	36	593	33	331	29	69	32
Neeley to Minidoka	158	62	134	65	84	61	46	55	10	60
Sum of Reaches Shelley to Milner	**1598**		**1427**		**917**		**509**		**105**	
Devil's Washbowl to Buhl	298	59	257	61	160	57	88	51	18	60
Buhl to Thousand Springs	137	49	122	50	81	43	47	37	8.0	51
Thousand Springs	89	48	79	48	54	42	31	35	5.6	47
Thousand Springs to Malad	10	45	9	46	6.4	38	3.7	32	0.74	42
Malad	77	50	68	51	47	43	29	35	5.5	44
Malad to Bancroft	5.8	38	5.2	38	3.8	34	2.4	31	0.59	36
Sum of Thousand Springs Reaches	**617**		**541**		**352**		**201**		**38**	
Total (cfs)	**2741**		**2453**		**1633**		**916**		**180**	
Total (acre-feet/year)	**1,984,659**		**1,775,637**		**1,182,086**		**663,362**		**130,506**	

Figure R14: Table 1 reproduced from Scenario.

Extracting the Near Blackfoot to Neeley and Neeley to Minidoka results, and comparing them to the total results, indicates the relationships show in Table R2.

Table R2: Summary of ESPAM1.1 results from Scenario

	Near Blackfoot to Neeley Accrual (cfs)	**Neeley to Minidoka Accrual (cfs)**	**Near Blackfoot to Minidoka Accrual (cfs)**	**Total Accrual (cfs)**	**Percentage of Accrual to Near Blackfoot to Minidoka**
All Pumping	1,035	158	1,193	2,741	44%
Junior to January 1, 1949	925	134	1,059	2,453	43%
Junior to January 1, 1961	593	84	677	1,633	41%
Junior to January 1, 1973	331	46	377	916	41%
Junior to January 1, 1985	69	10	79	180	44%

Depending on viewpoint, the fact that more than half the accruals from curtailment arrive at non-target reaches is either a windfall or is collateral damage. Regardless, the Fifth Order is silent on the fact of the accrual and on the technical ability to assess and report its timing and magnitude for potential application to needs that might arise in non-target reaches, such as the small amounts of additional accrual that sometimes are needed to facilitate a Point of Diversion transfer of a groundwater right.

Consistency between Calculation of Priority Date and Partition of Responsibility

In deposition testimony in May, 2023, Jennifer Sukow indicated that the partition of responsibility for mitigation in lieu of curtailment is done on a steady-state basis on the rationale that all users bear responsibility for cumulative effects of past pumping that have been propagating toward the reach for decades. Whether this is valid rationale is a policy question beyond the scope of this report, but use of steady-state modeling is consistent with the rationale.

Use of steady-state partitioning of responsibility would be logically consistent with steady-state calculation of curtailment date, as would the use of transient partitioning be consistent with transient calculation of curtailment. The linkages are a result of the concept that mitigation in lieu of curtailment is both defined and constrained by the alternate relief that curtailment would provide.

Time constraints preclude analysis using correct spatial distributions of irrigated lands and consumptive use, but the concept can be explored hypothetically. If each of the five points illustrated in Figure R3 represented an equal number of acre feet of consumptive use from groundwater, the assignment of responsibility could be made based on model-indicated contributions to the Near Blackfoot to Minidoka reach. Using the IDWR-generated steady-state models reflected in accompanying file "E2_SSRF.csv," the steady-state assignment to Row 27 Column 14 would be 1.8% of the total obligation. The four-month contribution of curtailment at that location is represented in Figure R9. Conversely, calculating percentages to three significant figures, the four-month transient contribution of curtailment at that location using ETRAN3.4 is 0.000%. This does not mean that there is *no* benefit, but that if mitigation in lieu of curtailment were to be defined and constrained by the accruals estimated per a transient curtailment, the technically-correct mitigation would be substantially less than the steady-state partition of responsibility.

It is my professional opinion that partitioning responsibility using a different modeling framework than was used to calculate curtailment can result in some users being held responsible for more mitigation than the relief that their curtailment would have provided.

Consistency between Precision and Burden

Conclusion of Law #21 articulates understanding of the fundamental difference between groundwater hydrology and surface-water hydrology, yet the unenviable burden of IDWR is to administer the connected resources conjunctively. To frame and provide context to the technical discussion of consistency between precision and burden, the following rhetorical questions are posed for surface-water Points of Diversion:

- Would prior appropriation require curtailment of junior whose Point of Diversion was adjacent to the senior Point of Diversion, given that curtailment of the junior could make water immediately available to the senior?
- Would prior appropriation require curtailment of a junior whose Point of Diversion was on a stream not tributary to the senior's source?

In essence, there is a continuum comprised of the ratio between the relief afforded the senior and the cost to the junior. In a surface-water context, results tend to fall on one end of the continuum or the other. In the first hypothetical, the ratio of benefit to burden is one to one. In the second, it is zero.

Some groundwater scenarios fall on the "zero" end of the spectrum; curtailment of a well in Rathdrum likely would not provide relief to the Surface Water Coalition. A few fall close to the "full and immediate relief" end of the spectrum; for instance, modeling indicates that curtailment at the location represented by Figure R11 would produce 35% accrual to Near Blackfoot to Minidoka within four months, and 45% within eight months.

The legal meaning of the Conclusions of Law #4, #5 and #6 is beyond the scope of this report but a plain-language reading suggests that priority is not the only factor to consider. The Rathdrum example indicates that a continuum exists for groundwater, as it does for surface water. Conclusion of Law #7 indicates that IDWR requires knowledge of *"how, when, where and <u>to what extent</u> the diversion and use of water from one source impacts the water flows in... other sources"* (emphasis added). If knowledge of something is required, the implication is that the knowledge must be utilized in making some decision. Under that assumption, *where* the cutoff is located is a policy decision, and once the decision is made, technical work can quantify where efforts fall in relation to it.

Conclusion of Law #21 states:

> *"Rule 43 of the CM Rules mandates that when the Director evaluates a mitigation plan, the mitigation plan must ensure that water is delivered to holders of senior priority surface water rights in both the quantity and at the time and place required by the senior. In considering a proposed mitigation plan pursuant to Rule 43, the Director must evaluate:*
>
>> ***b.** Whether the mitigation plan will provide replacement water, <u>at the time and place required by the senior-priority water right,</u> sufficient to offset the depletive effect of ground water withdrawal on the water available in the surface or ground water source <u>at such time and place as necessary</u> to satisfy the rights of diversion from the surface or ground water source. Consideration will be given to the history and seasonal availability of water for diversion so as not to require replacement water at times when the surface right historically has not received a full supply, such as during annual low-flow periods and extended drought periods.*
>> ***c.** Whether the mitigation plan provides replacement water supplies or other appropriate compensation to the senior-priority water right <u>when needed during</u>*

a time of shortage even if the effect of pumping is spread over many years and will continue for years after pumping is curtailed. A mitigation plan may allow for multi-season accounting of ground water withdrawals and provide for replacement water to take advantage of variability in seasonal water supply. The mitigation plan must include contingency provisions to assure protection of the senior-priority right in the event the mitigation water source becomes unavailable (emphasis in Fifth Order).

Time constraints, the scope of this report and the expertise of the author preclude full exploration of the implications of this excerpt, in context of the full Conjunctive Management rules. The importance here is the explicit recognition of fundamental difference between time frames of surface-water processes and the effects of groundwater activities upon surface-water processes.

Within the context of both the magnitude of expected relief and the requirement that relief be timely, an added complexity of groundwater is that the linkages are not always apparent, nor are the methods to discern them infallible. An additional policy decision that could be articulated would be a specification of if or how precision of the knowledge of the degree of hydrologic connection might inform the policy decision of where the cutoff point is on the continuum between ratios of zero and one-to-one. If that decision were to be undertaken, it could be informed by technical knowledge of the precision of the model. IDWR's contribution to the 2012 white paper discussed above could be a starting point for analysis of the precision of the model, and such analyses may already have been performed. Qualitative insight into the relative quality of the model can be gleaned from comparisons of successive models, each in their time deemed to be the best available science.

Figure R17 shows a map of points that were used for such a qualitative view of ESPAM2.0, with graphical output provided in Figure R18. Figure R18 attempts to inform both quantity and timing issues. The top three panels, with blue-colored bars, show the fraction of accruals from the three points that the models indicate would be captured by a particular reach. The bottom panels, with red-colored bars, represent the differences in modeled timing of accrual. The metric is the number of months for the model to indicate that half of the captured accruals have arrived at the reach of interest.

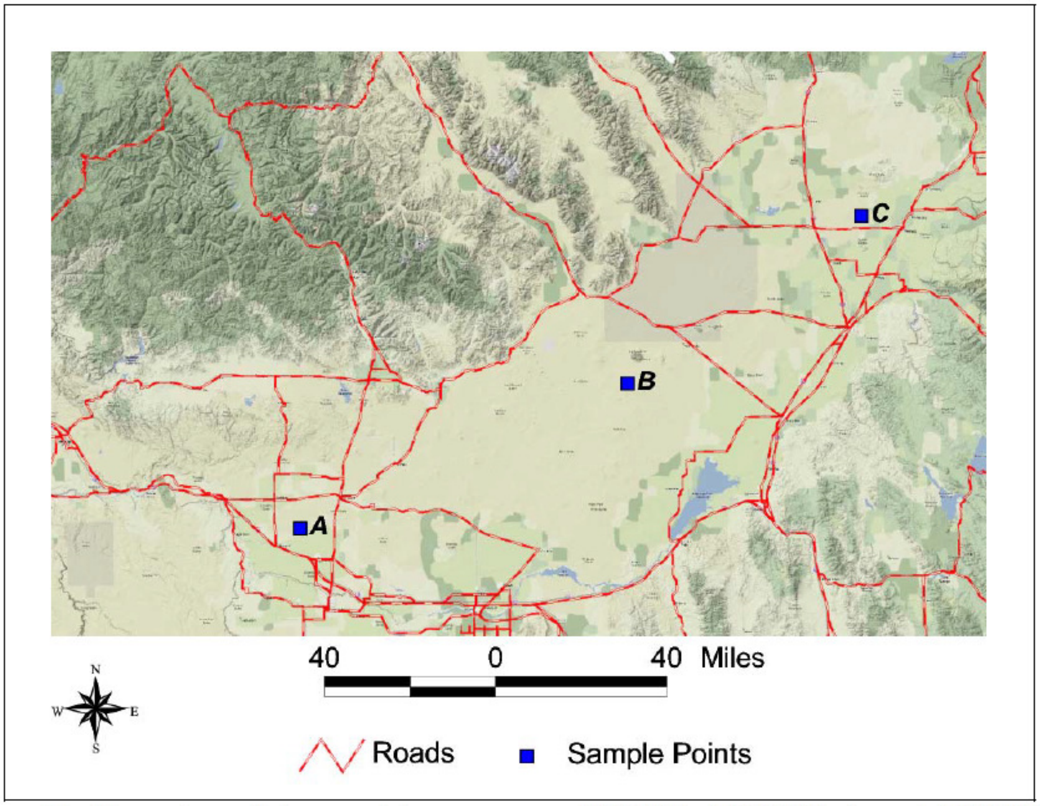

Figure 7. Sample points used to compare SRPAM, ESPAM1.1 and ESPAM2.0.

Figure R17: Figure 7 reproduced from Technical Report on ESPAM2.0 Modeling Issues

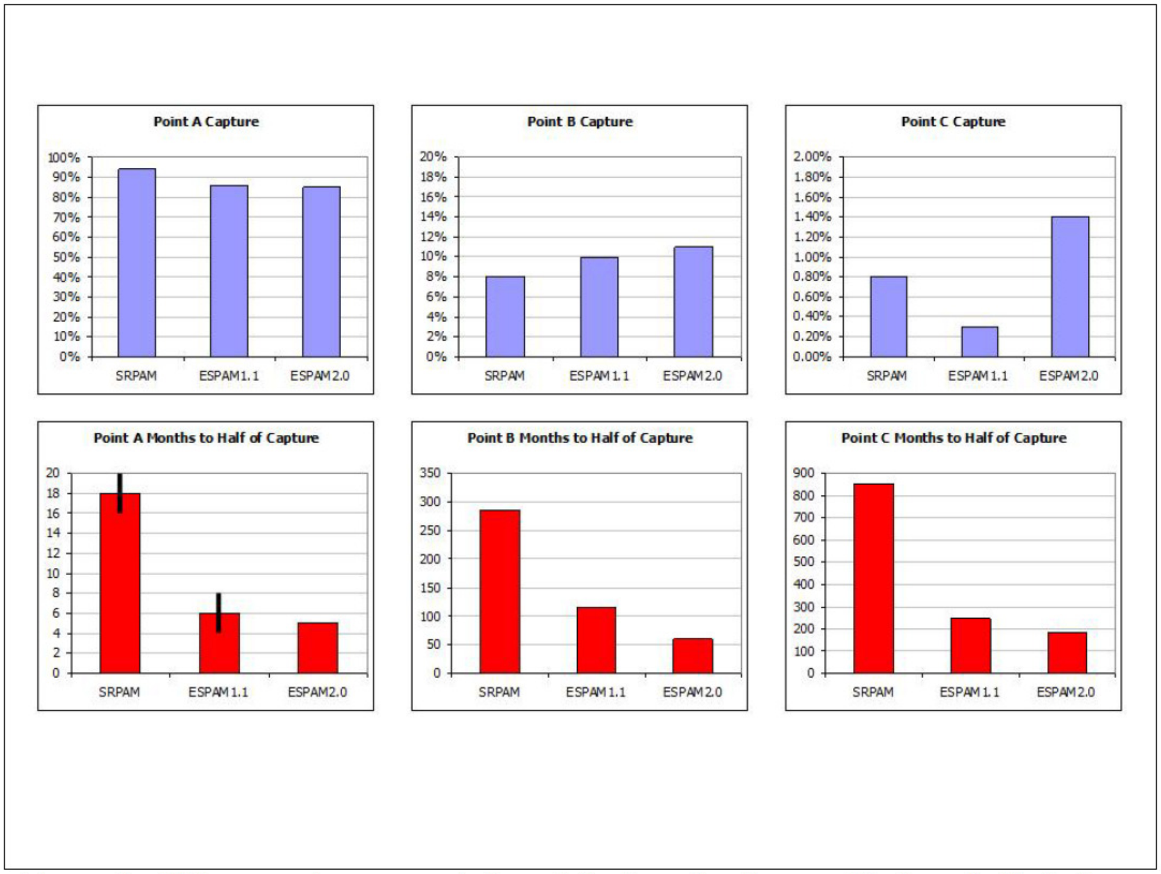

Figure 8. Differences in representation of Capture Fraction and timing of effect, from applying three Calibrated models to the points shown in Figure 7.

Figure R18: Figure 8 reproduced from Technical Report on ESPAM2.0 Modeling Issues.

Time constraints preclude comparison of ESPAM2.0 with ESPAM2.1, but Figure R19, Figure R20 and Figure R21 allow qualitative assessment of the differences between ESPAM2.1 as realized in the ETRAN3.3 Transfer Tool, and ESPAM2.2 as realized in the ETRAN3.4 transfer tool. Table R3 summarizes qualitative comparisons of the two models for these three points. The points intentionally are of disparate character and are not intended to be representative of the plain as a whole.

Table R3. Qualitative Comparison of ESPAM2.1 and ESPAM2.2 via Figures R19, R20 and R21

Point	**General Location**	**ESPAM2.1 Years to Peak**	**ESPAM2.2 Years to Peak**	**Subjective Comparison of 10-year Sum of Accruals**
R75 C57	A&B Irrigation District	1.67	3.67	ESPAM2.1 slightly higher
R83 C123	Very close to Near Blackfoot to Neeley	0.33	0.33	Very similar
R50 C191	Near Henry's Fork	5.00	6.67	Very similar

These results underscore Eastern Idaho Water Right Coalition's 2012 observation that:

> All of these uncertainties are a function of the spatial scale at which answers are sought. If the question is asked: "How much pumping at location X will propagate to river and spring reaches?" the answer can be determined with very little uncertainty, and independently of the limitations described above.
>
> If refined estimates of above-Miiner vs. below-Milner effects are required, the uncertainty depends on the location of the well. For wells distant from Milner, none of these conceptual simplifications are likely to materially affect the answer. For wells near to Milner, all of these affect the results and a different set of assumptions would be expected to produce a markedly different result.
>
> Similarly, refining the question to include some understanding of the timing of effect begins to introduce additional uncertainty. The answer to "How much will propagate in time period Y" is less certain than "How much will eventually propagate," and results are sensitive to changes in conceptual simplifications.

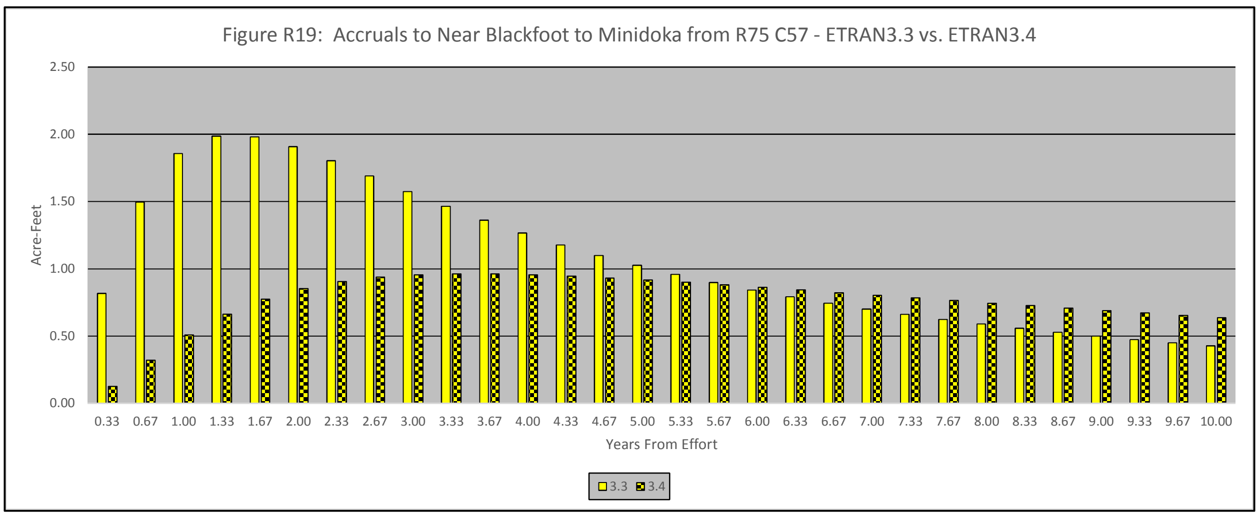

Figure R19.

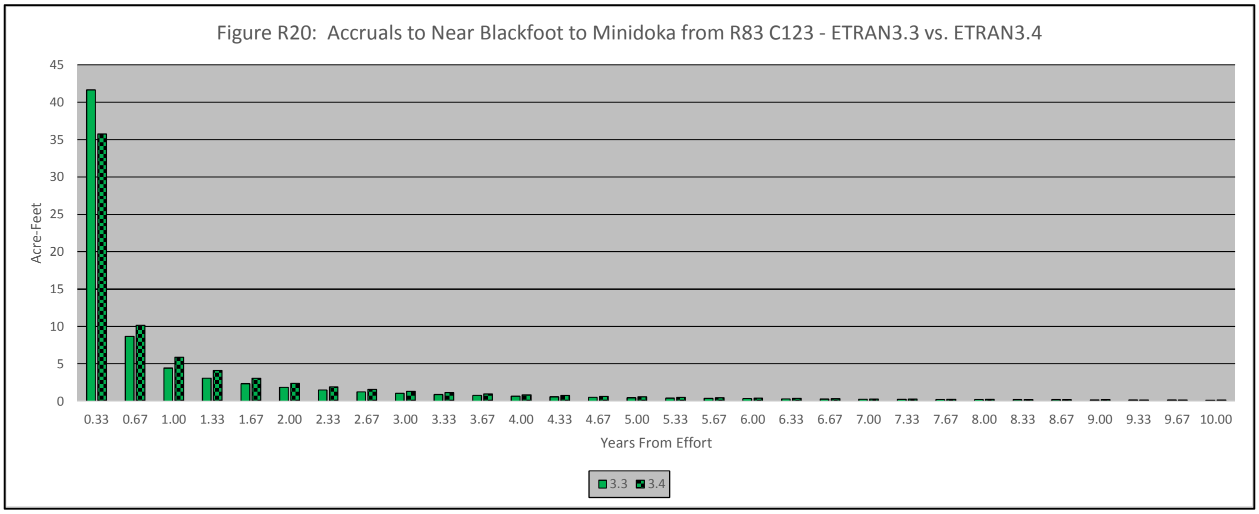

Figure R20.

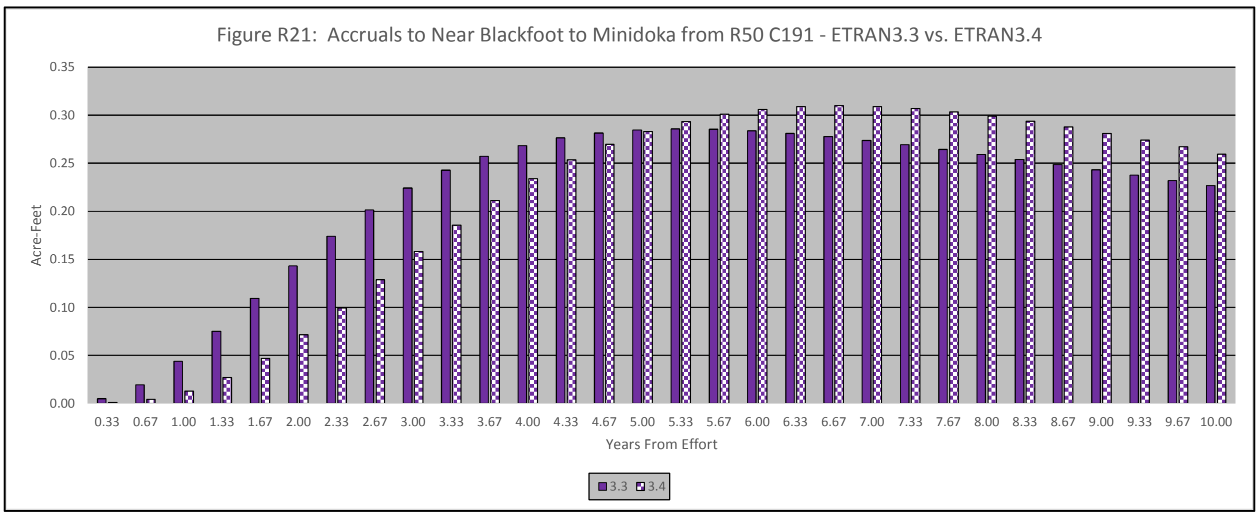

Figure R21.

A thoughtful reader might ask a policy question such as: "Is it fair to the SWC to use the model to estimate timing of accruals in the trimester of curtailment, when the two most recent best-available-science models differ by approximately a factor of six?" Technical analysis could inform policy deliberations about such a question.

Discussion of Technically-consistent Options

As indicated earlier, this report attempts to remedy a shortcoming identified by the hearing officer in another case, that expert reports offer no solutions. While implementation of a solution is a policy decision, technical work can help frame the understanding of what is possible, and what the implications of alternatives might be.

Alignment of Modeling Time Frame with Policy. In deposition in May 2023, Jennifer Sukow stated that she was *"told by Allan Wylie that [former Director] Karl Dreher did not want to use a transient analysis, because he did not like the additional volume of water that would accrue to the reach in future years."* This may have been how the decision was communicated, but it is likely that rather than not "liking" the result, the former Director deliberately selected steady-state analysis as a policy response to some of the temporal issues that have been explored above. However, applying the steady-state values only in years of shortfall still was technically inconsistent with the temporal delay in accrual. The Fifth Order methodology attempts to address that inconsistency but brings others, discussed above. The current methodology produces results such as seen in 2023, with curtailment of most groundwater irrigation threatened in a season of abundant snowpack and local flooding in some areas.

Visual inspection of Figure R16 suggests a cyclical pattern with a period of a few years. Robust time series analysis likely could quantify the periodicity. The periodicity likely could be partitioned into components of different periodicity, such as natural flow, return flows from surface-water irrigation, and groundwater contribution. Both time-series analysis and water-budget analysis could contribute to this understanding. Additionally, if the zeros in the hindcast were replaced by numerical values of surpluses that occurred, a statistical distribution of supply could be derived that would allow calculation of an appropriate level of conservatism to protect the SWC interests.

Similarly, as shown by Figures R8 through R13 and R19 through R20, the transient ESPAM model could be used to explore the characteristic time of response for curtailment of zones of similar hydraulic distance from the reach in question.

Combined, these two analyses could inform a curtailment scheme and a frequency of adaptive management that allowed the temporal pattern of need to be matched to the temporal response of reach gains to curtailment activities.

It is my professional opinion that a technically- and logically-coherent curtailment strategy could be constructed using either steady-state or transient analysis. The key would be to align the calculation and expectations of relief to the physical time frame of aquifer response. Something akin to Sukow's proposal for considering future accruals likely would be an important element.

Accounting for Non-Target Accruals. The key to accounting for non-target accruals is to be sure that the accounting decay of accruals, and the spatial assignment, match reality. A possible method is described in the Journal of the American Water Resources Association (Contor, 2009) that links transient *"aquifer response functions with double-entry accounting technologies"* and *"honors the hydrologic realities of groundwater / surface water interaction, the legal requirements of prior appropriation water law, and the economic requirements for equitable and efficient allocation of resources."*

Summary and Conclusions

My professional opinions regarding the Fifth Order are as follows:

- The arguments presented for transition to transient modeling are not factually correct, and therefore the true rationale has not been revealed.
    - Because I do not have access to the true rationale, I cannot assess it technically.
- Unless the criteria for accuracy and precision are very low, ESPAM2.2 is not sufficiently precise for monthly estimation of effects to the Near Blackfoot to Minidoka reach, for decisions that precipitate large financial burdens.
- The use of ESPAM modeling is technically defensible when ratios of relief to cost are considered in light of modeling precision, and when policy adjusts for spatial and temporal differences in response.
- The arguments presented against considering supplemental groundwater use within the SWC are not factually correct, and therefore I cannot technically assess the unrevealed true rationale.
- It is technically possible and reasonably achievable to assess and address supplemental groundwater use within the SWC.
- The following factors multiply the effect of ignoring supplemental groundwater use within the SWC:
    - Because of inherent characteristics of surface-water delivery systems, supplying one acre with surface water requires substantially more water than supplying an acre with groundwater.
    - Not all effects of curtailment of groundwater propagate to the Near Blackfoot to Minidoka reach, so more than one acre foot of curtailment is required to produce one acre foot of accrual.
    - When obligations are calculated on a transient basis, the temporal delay in propagation creates an additional multiplier of effort.
- Partitioning responsibility using a different modeling framework than was used to calculate curtailment can result in some users being held responsible for more mitigation than the relief that their curtailment would have provided.
- Technical methods exist to inform a coherent plan under either a transient or a steady-state paradigm.

Signature

Bryce A. Contor

Bryce A. Contor
Principal Hydrologist

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Curriculum Vitae

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Summary Statement

Mr. Contor has worked in the hydrology field since 1996, including ten years with the Idaho Water Resources Research Institute where he served as a research hydrologist, and five years with Idaho Department of Water Resources where he served as a Senior Water Resource Agent. Prior to that he farmed and served on the board of directors of a small canal company.

With the Institute, Mr. Contor served as principal investigator on hydrologic projects as diverse as preparing water budgets for large numerical aquifer models, investigating remote sensing of evapotranspiration on irrigated lands, developing tools to calculate the economic demand for irrigation water, and investigating managed recharge of aquifers. He has published in national peer-reviewed scientific journals and has authored numerous technical completion reports for the Idaho Water Resources Research Institute. At Idaho Department of Water Resource, Mr. Contor measured flow in pipelines and open channels, investigated water-right claims and made water-right recommendations in the Snake River Basin Adjudication.

Mr. Contor holds an M.S. Degree in hydrology from the University of Idaho. His hydrologic specialties include groundwater/surface-water interactions and MODFLOW aquifer modeling, water-budget analysis, pipeline and open-channel flow measurement, and statistics. GIS specialties include aerial land photography interpretation and manipulation of remote-sensing data. Economics specialties are water banking and economic demand for irrigation water. He has extensive experience with water-budget preparation and with collaboration as a member of the development team for Enhanced Snake Plain Aquifer Models (ESPAM) versions 1.0 through 2.1, and the Spokane Valley – Rathdrum Prairie Model. Contor has served as an expert witness in water-related matters.

Education

University of Idaho, Idaho Falls, Idaho, 2005, M.S., Hydrology
Brigham Young University, Provo, Utah, 1994, B.S., Agricultural Economics. Cum Laude.
Ricks College, Rexburg, Idaho, 1980, A.S., Farm Crops Management

Work Experience

Hydrologist at Rocky Mountain Environmental Associates, Inc., Idaho Falls, Idaho, 2010 to Present. Currently serving as Principal Hydrologist.

Position includes aquifer modeling, hydrologic field investigation, hydrologic analysis, GIS and expert-witness work in support of Idaho water-rights transactions, negotiations and proceedings. For approximately two years, Mr. Contor reduced his work at Rocky Mountain Environmental Associates while doing landowner-outreach and technical work for the Henry's Fork Foundation and Friends of the Teton River.

Research Hydrologist of Idaho Water Resources Research Institute, University of Idaho, Idaho Falls, Idaho, 2001-2010

Position included serving as a principle investigator on a ground water banking project in cooperation with U.S. Bureau of Reclamation, as principle investigator in water-budget preparation for aquifer modeling projects, and field investigation in support of managed aquifer recharge. The position included GIS analysis and supervision of hydrologists and data technicians. During this period Mr. Contor sub-contracted field exams for the Snake River Basin Adjudication for Idaho Department of Water Resources.

Senior Water Resource Agent, Idaho Department of Water Resources and North Water Measurement District, 1996-2001

Duties included field and office evaluation of water-right claims, including flow measurements and characterization of conveyance and diversion structures, making water-right recommendations in the Snake River Basin Adjudication, and the measurement of water discharge and power consumption of irrigation wells for documentation of ground water withdrawal volumes.

Worked in irrigated agriculture from 1980 through 1995 as irrigation supervisor, farm manager, tenant farmer, farm owner, seed-company field representative, and Idaho Department of Agriculture chemigation inspector. In the late 1980s through early 1990s served as a board member and then as secretary of a small canal company.

Experience Testifying/Giving Depositions

Circa 2005: Deposed in matters related to the calibration of Enhanced Snake Plain Aquifer Model Version 1.0 and 1.1.

Circa 2012: Deposed and testified at hearing before IDWR regarding aquifer-modeling issues related to the Rangen Aquifer Delivery Call.

2016: Testified in behalf of the plaintiff in a civil case related to filling in of an irrigation ditch.

Circa 2019: Deposed and testified at hearing before IDWR regarding creation of the Eastern Snake Plain Aquifer Ground Water Management Area.

2021: Testified in behalf of protestant at hearing before IDWR regarding change in Point of Diversion of surface-water rights.

2023: Testified in behalf of applicant at hearing before IDWR regarding change in Point of Diversion and Place of Use of surface-water rights.

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Statement regarding compensation

Bryce A. Contor serves as a Principal Hydrologist at Rocky Mountain Environmental Associates, Inc. (RMEA), in Idaho Falls, Idaho. RMEA invoices Bonneville Jefferson Ground District for Contor's services per the attached rate schedule.

2023 Labor & Equipment Rates

PROFESSIONAL RATE SCHEDULE	
Principal Engineer/Geologist/Hydrologist	$170.00 per hour
Senior Geologist/Water Right Analyst/GIS Analyst	$152.00 per hour
Geologist 3/Water Right Analyst 3/GIS Analyst 3	$135.00 per hour
Geologist 2/Water Right Analyst 2/GIS Analyst 2	$120.00 per hour
Geologist 1/ Water Right Analyst 1/GIS Analyst 1	$105.00 per hour
Geoscience Technician/GIS-Drafting/Field Assistant	$80.00 per hour
Clerical or Secretary	$65.00 per hour
Expert Witness Testimony	Base rate x 2
Laboratory Analysis	Cost plus 15%
Subcontracted Services (drilling, excavation)	Cost plus 15%
All other direct expenses	Cost plus 15%
RMEA-OWNED EQUIPMENT RENTAL	
Drone and Camera	$175.00 per day
GPS Unit	$30.00 per day
Soil Sampling and Decontamination Equipment	$30.00 per day
Photoionization Detector (PID)	$110.00 per day
Multi Gas Meter (LEL, H2S, CO)	$110.00 per day
Hand Auger Soil Sampling Kit	$45.00 per day
Electronic Water Level Meter	$55.00 per day
YSI (pH, Conductivity, DO, &Temp)	$160.00 per day
Turbidity Meter	55.00 per day
Downhole Datalogger	$110.00 per month
Portable DC Submersible Pump	$110.00 per day
Peristaltic Pump	$55.00 per day
Schoenstadt Magnetic Locator	$30.00 per day
NON-RMEA OWNED EQUIPMENT RENTAL	Cost plus 15%
TRAVEL & SHIPPING	
Mileage	$0.75 per mile
Per Diem (if applicable)	$160.00 per day
4-wheeler	$160.00 per day
Airfare or other purchased travel	Cost plus 15%
Sample Shipment (overnight via courier on ice)	$110.00 per cooler

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