RECLAMATION

Managing Water in the West

Upper Deschutes River Basin Study

Technical Memorandum

Technical Sufficiency Review

THE UPPER DESCHUTES BASIN STUDY

Water for agriculture, rivers & cities

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region

December 2018

Mission Statements

U.S. Department of the Interior

PROTECTING AMERICA'S GREAT OUTDOORS AND POWERING OUR FUTURE

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Summary

This Technical Memorandum describes the Technical Sufficiency Review (TSR) process and outcomes for the Upper Deschutes River Basin Study (Basin Study). The TSR is a required component of Reclamation's Basin Study Program as detailed in Paragraph 11 of Directives and Standards WTR 13-01 of the Reclamation Manual.

The approach for the Upper Deschutes River Basin Study TSR was developed in consultation with and approved by the Basin Study Work Group (BSWG). All work products (technical memoranda) from the Basin Study tasks were developed by study team members, then reviewed in draft form by Technical Working Groups (TWGs) which included multiple individuals with specialized expertise and/or interest in the relevant topic. Additional reviewers who were not directly involved with task completion were identified to provide comments on the TWG drafts as summarized below in Table 1.

The most significant technical elements of the Basin Study involved hydrologic analysis, water resources model development, and assessment of future climate conditions. Comments on technical memoranda detailing those study elements were provided by two qualified independent reviewers identified and agreed upon by the Basin Study funding agencies, Reclamation and the Oregon Water Resources Department (OWRD); see Table 1 below for identified reviewers and Attachments A and B for specific comments and responses. Comments received from other sources and on other elements of the study were addressed in the Basin Study report and/or relevant technical memoranda. Technical reviews completed by OWRD are summarized in Attachment C.

(*Note: The content of this document was finalized December 2018; formatting for accessibility compliance with Section 508 of the Rehabilitation Act was applied in 2019.*)

Table 1. Reviewers for Basin Study tasks and work products

Task/Work Product	Reviewer(s)
Analysis of Regulated River Flow in the Upper Deschutes Basin using Varying In-Stream and Out-of-Stream Conditions, Technical Memorandum prepared by Reclamation	• Independent Technical Reviewers: Ken Nowak, Reclamation (Technical Services Center); and Matt Ely, U.S. Geological Survey • OWRD staff • Climate Change and Modeling Technical Working Group reviews
Compilation and Analysis of Climate Change Information in the Deschutes Basin, Technical Memorandum prepared by Reclamation	• Independent Technical Reviewers: Ken Nowak, Reclamation (Technical Services Center); and Matt Ely, U.S. Geological Survey • OWRD staff • Climate Change and Modeling Technical Working Group reviews

Prineville Reservoir and Crooked River Temperature Modeling as evaluated by Portland State University, contractor to BSWG	• OWRD staff • Jen Cuhaciyan, Reclamation • BSWG Crooked River Subgroup reviews
Legal, Policy & Economics (LPE) Issues as evaluated by GSI and Summit Conservation Strategies, contractors to BSWG	• OWRD staff • Gail McGarry, Reclamation (PN Region) • BSWG LPE TWG reviews
Water Conservation Assessment as evaluated by Water Professionals Network, contractor to BSWG	• OWRD staff • Jennifer Johnson, Reclamation (PN Region) • BSWG Water Conservation TWG reviews
Assessment of Potential Enhanced or New Storage Opportunities, Technical Memorandum prepared by Reclamation	• OWRD staff • Bob Hamilton, Reclamation (PN Region) • BSWG Storage TWG reviews
Upper Deschutes Ecological Assessment, Technical Memorandum by River Design Group, contractor to BSWG	• OWRD staff • Scott Hoefer, Reclamation (PN Region) • BSWG Ecological Assessment TWG reviews
Whychus Creek and Middle Deschutes River Temperature Assessments, Technical Memorandum by Upper Deschutes Watershed Council, contractor to BSWG	• OWRD staff • Clyde Lay, Reclamation (PN Region) • BSWG reviews

Attachment A – Technical Sufficiency Reviews of Technical Memorandum: Analysis of Regulated River Flow in the Upper Deschutes Basin using Varying In-Stream and Out-of-Stream Conditions

Comment Number	Reviewer	Location	Comment	Response
1	Ken Nowak (Technical Sufficiency Reviewer)	Section 1.1	Be explicit on what this is… I'm not 100% sure	Reworded for clarity
2	Ken Nowak (Technical Sufficiency Reviewer)	Section 1.1	Same here. Be clear on what you mean by this.	Reworded for clarity
3	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.0	Legend needs fixing, also shouldn't city of bend be between Tumalo creek and the Deschutes River instead of NW of Tumalo?	Fixed legend - Since it is a schematic not a map, I don't think the placement has to be geographically correct, just the order on the reach, which it is
4	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.0	Legend needs fixing - would be nice to have a list of acronyms and full names – difficult to link this graphic with locations plotted in later sections	Fixed legend - Later tables link together names and acronyms
5	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.0	Were operations and associated model logic stable enough to do this over ~25 years?	For the most part, yes, although there were some differences.
6	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.0	This statement is confusing – did operations recently change? Does this mean new model rules had to be developed recently? If so, how does this related to the 1984-2009 historical simulation discussed above? Or are these operational alternatives as part of the Basin Study?	Yes, operations have changed since the original calibration period. Added a statement to describe the changes that a further described in sections 2.2 and 2.3. They are part of the baseline model.
7	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.2	Min here also? A little confusing in context of statements that follow – which seem to suggest that flows might not be greater than 600 cfs between March 30 and sept 15?	Yes, it is a minimum of 600 in the summer. Clarified

Comment Number	Reviewer	Location	Comment	Response
8	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.3	Is this largely b/c of the recent changes associated with the Prineville legislation –i.e. things are still being worked out? Perhaps rephrase to say along the lines of as operations experience under the Prineville legislation is gained, model rules will continue to be refined, but for the purpose of the study, logic as described below is used?	Yes, updated language with your suggestion
9	Ken Nowak (Technical Sufficiency Reviewer)	Section 2.3	So, 5-day avg. inflow less than 3 cfs = “end of runoff” and therefore day of allocation?	Yes, this is similar to how the state makes the determination, though the model has to make it in "real time"
10	Ken Nowak (Technical Sufficiency Reviewer)	Section 3	Re-specify what this means here.	Added language
11	Ken Nowak (Technical Sufficiency Reviewer)	Section 3	Feasibility of what?	Took out feasibility - confusing
12	Ken Nowak (Technical Sufficiency Reviewer)	Section 3	Proposed by who? Wouldn’t the BSWG be the ones developing/proposing these?	Changed "to" to ""by members of"
13	Ken Nowak (Technical Sufficiency Reviewer)	Section 3	Understand what you’re getting at here… shouldn’t the results also speak to this?	Noted
14	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.1	Unclear if the right at Bend is already modeled as senior in 2a or if that is a difference between 2a and 2b. And is protested right at Bend?	Changed language to clarify. The 250 right is currently protested, so only active/legal rights are modeling in 2a. The 250 right is an addition in 2b.
15	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.2	Is a hydrograph what you’d call a plot of reservoir storage? I typically think of it as flow?	We typically refer to both storage and flow plots as summary hydrographs when presented this way
16	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.1	Not sure what this means? Irrigation seasons change from year to year?	Changed language
17	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.1	It is odd that the outflow range about the median abruptly collapses in mid-May and barely varies? Is this due to the same irrigation schedule being used in all simulations?	Yes, added language

Comment Number	Reviewer	Location	Comment	Response
18	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.1	Why does irrigation demand seem to have s periodic up/down of ~500cfs from April to August?	This is actually due to the year that was chosen to represent the annual irrigation pattern. At the time, 2009 was chosen, but we didn't recognize until later that it had an odd pattern in the May/June timeframe.
19	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.1	I'm realizing that I don't recall much of a discussion on what historical hydrologic conditions means – e.g. data source, etc.	Added discussion in section 2
20	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.1	So, all years from historical simulation period are rank ordered by total shortage and then this plot breaks the volume out by district? Might be good to include historical year rather than just the rank-order year number? Also, some context for how these shortages compare with total request would be helpful – can you add a line or note to describe that?	Added some clarifying sentences
21	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Each?	Changed
22	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Despite the 600 cfs target, looks like median is 300 cfs and that the storage is actually higher than the 2b scenario? Any thoughts on why- the additional bend right? Also, results from 3 and 2a look identical? Is that right?	Good catch - fixed model output
23	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	18, 19?	Updated Figure number
24	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Understand the explanation, but why are 2a and 3 identical and 2b different? Additional instream demand at bend?	Good catch - fixed model output
25	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Somewhat?	Yes, changed

Comment Number	Reviewer	Location	Comment	Response
26	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	I don't see any differences, plots look identical. Can't even tell if there is 2 scenarios on the plot or just 1…seems like you should be able to see some difference – even if minor?	Good catch - fixed model output
27	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Ok, so this at least makes sense.	Noted
28	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Why is Benham falls flow lower in 2b when there is the additional 250 cfs right included in 2b? I would think it higher? Also, is the 250 CFS flow at bend in 2b an instream or diversion right? That would be helpful to understand these differences…	Good catch - fixed model output
29	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	2a and 3 look identical to me…(again)	Good catch - fixed model output
30	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	I can see that 2a and 2b would be very similar to "current", but the 140cfs in scenario 3 doesn't seem to be having much impact. I would think you'd see higher flows in spring/summer and then lower flows in fall/winter as the account becomes empty?	Good catch - fixed model output
31	Ken Nowak (Technical Sufficiency Reviewer)	Section 3.3.2	Again, would be helpful to have magnitude context…	Added
32	Ken Nowak (Technical Sufficiency Reviewer)	Section 4	So, can these scenarios be easily be switched between median and dry mode or do you have to pick one and make the necessary "investments"? also, what is the cost with respect to and the volume savings (median or dry)? Also – why is median year reduction greater than dry (fig28) – is it that there is less water available in dry years, and therefore smaller savings achieved? If so, I don't think I'd describe them as for addressing shortage in those year types, rather I'd call them reductions achievable by year type.	Added some language to clarify that the model determines if it is a dry or median year based on inflow volume and then adjusts the demand accordingly. The dry year demand reduction is added to the median year demand reduction.

Comment Number	Reviewer	Location	Comment	Response
33	Ken Nowak (Technical Sufficiency Reviewer)	Section 4	Per year I assume?	No, total - clarified language
34	Ken Nowak (Technical Sufficiency Reviewer)	Section 4	Per year?	No, total - clarified language
35	Ken Nowak (Technical Sufficiency Reviewer)	Section 4	Are these pairings of WM scenarios and flow scenarios or is it different? I'm a little confused as to where these combinations are coming from	The WM scenarios are new scenarios designed using the demand reductions and in-stream flow objectives - additional language was added to clarify
36	Ken Nowak (Technical Sufficiency Reviewer)	Section 4	Where did these come from?	Defined by BSWG
37	Ken Nowak (Technical Sufficiency Reviewer)	Section 4.1	So, there is no way to explore trade-offs between WM-flow scenario pairs? Does current include all 4 flow scenarios or just #1?	Just by inspection of the graphs - there was also an attempt at analyzing tradeoffs in another memo
38	Ken Nowak (Technical Sufficiency Reviewer)	Section 4.1	I would either expand on this a bit – i.e. explain the different models and offer some hypotheses on why the results turned out as they did or go higher level and not even mention the models by name, other than to say multiple were considered… Also, I understand that crooked is better than Deschutes – curious why the decision was made to show some (the better) of the results here, but not all…think it may be ok, but deserves an explanation…	Removed discussion
39	Ken Nowak (Technical Sufficiency Reviewer)	Section 4.1	Why the "blip" in WM3 and WM4 right around April 1	This is when the reservoir is mostly empty
40	Ken Nowak (Technical Sufficiency Reviewer)	Section 4.1	Agree storage looks slightly less, but outflows look very similar – would have expected a notable difference, given 75% increase in flow target?	Noted
41	Ken Nowak (Technical Sufficiency Reviewer)		?	Noted

Comment Number	Reviewer	Location	Comment	Response
42	Ken Nowak (Technical Sufficiency Reviewer)		Also, I find it hard to distinguish the scenarios given the same color and slightly different line types	Noted
43	Ken Nowak (Technical Sufficiency Reviewer)	Section 4.1	Where does the other 40% go?	Stays in the reservoir
44	Ken Nowak (Technical Sufficiency Reviewer)	Section 4.1	Is this the elevated median for May/June? Does the account really get depleted that quickly such that 140 can't be sustained any longer? Seems like that would be a noteworthy finding if I'm reading it right….	Missed a number in the model - reran scenario
45	Ken Nowak (Technical Sufficiency Reviewer)		Again – these are really hard to read…	
46	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Were monthly relationships/variations on the equation considered?	Yes, described in temperature tech memo
47	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Current flow?	Yes
48	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Determined or decided? Regardless, how was this done?	Decided by BSWG
49	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Can the boxplots be a little bigger? Differences are hard to discern and there looks to be space to accommodate it…and what is the significance of 13 degrees C? I don't think it was described…	Added
50	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	The median did not…	Noted
51	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Now target is 18? Why?	Higher target in summer months
52	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Why is middle Deschutes less sensitive?	More consistent flow
53	Ken Nowak (Technical Sufficiency Reviewer)	Section 5	Curves	Noted

Comment Number	Reviewer	Location	Comment	Response
54	Ken Nowak (Technical Sufficiency Reviewer)	Section 7	This is the type of overview that I think would help some of my comments in the early sections	Added similar comments earlier
55	Niklas Christensen	Section 1	I think being really clear on WR modeling steps will help the reader. What about a section "Water Resource Modeling Steps" and then insert the graphic that shows the IFS and WMAs. I recall that from a PPT.	Added a diagram and section
56	Niklas Christensen	Section 1	This is more goals of whole study, right? Below seems more detailed on WR steps.	Added basin study goals
57	Niklas Christensen	Section 1	1st step explained well but maybe more on 2nd step about WR alts	Added a diagram and section
58	Niklas Christensen	Section 1	Middle Deschutes. And figure 1 make it look like RiverWare goes further down (including Metolius).	Included in gains/ losses but not explicitly modeled. Since it isn't in the model, I would rather leave it as gains/losses
59	Niklas Christensen	Section 2	"Water user", not just Irrigation District. For example, City of Bend	Clarified
60	Niklas Christensen	Section 2	I forget – do we have GW pumping demand for muni?	Not in this model
61	Niklas Christensen	Section 2	Are diversions changed from daily to annual pattern, or is it just scaled/run for multiple years w/ the daily pattern	Clarified
62	Niklas Christensen	Section 3	Run-on	Already changed language from Ken's comment
63	Niklas Christensen	Section 3	Worth adding a little interpretation/discussion about the graph below? For example – under current operations (namely 100 cfs release) NUID would have shortages in ~40% of years, with max shortage of ~75K AF in 1 in 30 years. Is that correct?	Added some language
64	Niklas Christensen	Section 3	..these flow scenarios…..?	Changed to each
65	Niklas Christensen	Section 3	Flow scenario 3 in plot below looks like its 2a.	Yes - fixed, reran models, and updated figures
66	Niklas Christensen	Section 3	Scenario 3 doesn't seem 300 cfs higher than 2b in winter. Plots correct?	No - fixed, reran, and updated figures
67	Niklas Christensen	Section 4	Informational Flow Scenarios	Added

Comment Number	Reviewer	Location	Comment	Response
68	Niklas Christensen	Section 4	Do we lump LPE under conservation	Assume LPE is leasing? Yes
69	Niklas Christensen	Section 4	I feel like there's a better word than "assumptions" but not sure what it is. Assumption sounds loose/quick/inexact, and a lot went into those numbers.	Added - (note that these assumptions were developed using data from multiple technical memoranda and consultation with BSWG)
70	Niklas Christensen	Section 4	Defined also sounds funny. Was created to be? Is the most?	Changed to "was designed to be"
71	Niklas Christensen	Section 4	Is this ~110 K AF in all year, and up to 240 K AF in dry?	Changed to - The scenario has an estimated total cost of 97 million dollars for all of the investments. It reduces irrigation demand by about 110,000 acre-feet per year in average years and up to 240,000 acre-feet per year in dry years.
72	Niklas Christensen	Section 4	Reword?	Changed to - was designed by blending the cost effective actions of WM1 with additional water conservation
73	Niklas Christensen	Section 4	Same comment as above on the 240 K AF	Changed to - It reduces irrigation demand by about 190,000 acre-feet per year in all years and up to 290,000 acre-feet per year in dry years throughout the basin.
74	Niklas Christensen	Section 4	Water	Added
75	Niklas Christensen	Section 4	Same as above	Adjusted as above
76	Niklas Christensen	Section 4	Could discuss one, then the other to be more clear. Deschutes = uncertain and not show,	Changed language per Ken's comments
77	Niklas Christensen	Section 4	% of years would be interesting. From plot I think less than 50% but more than 20% of years	Would be interesting, but did not add
78	Niklas Christensen	Section 4	Also, earlier drawdown due to smaller snowpack and earlier melt.	Removed these results
79	Niklas Christensen	Section 4	Other 40% left in Deschutes?	Changed language per Ken's comments
80	Niklas Christensen	Section 4	…results show…	Removed these results

Comment Number	Reviewer	Location	Comment	Response
81	Niklas Christensen	Section 4	Do they show smaller spring and flows, too.	Removed these results
82	Niklas Christensen	Section 5	Suggest including middle D in table below but adding section about "past operations not reflective of future conditions (e.g. reservoir storage) and hence Middle Deschutes regressions not used for analysis of WMs. Similar to discussion at PT meeting.	Results for the Middle Deschutes are also not shown because the past operations used to develop the regressions are not representative of the conditions represented in the water management scenarios.
83	Niklas Christensen	Section 6	Shape of curves important, worth mentioning? Rise steeply to 600 cfs then flatten out.	Not showing the WUA curve, so not mentioning
84	Niklas Christensen	Section 6	True but I think we need to highlight that the winter % increase is much bigger than the summer % decrease. For example, scenario 4 is a 600% winter increase most of the time, and a 15% decrease. Also, winter shows the least habitat (limiting) so increase there is important, while a decrease in the summer does not matter as much since there's so much habitat.	The impact of more flow in the winter is more notable with the amount of usable habitat increasing with each water management scenario that increases winter flow. The addition of more flow in the summer has less of an impact on the amount of usable habitat because there is already a lot of flow in the summer.
85	Niklas Christensen	Section 6	True for Bull Bend, but Dead Slough has decrease in habitat from 1000 cfs to 1800 cfs	Took out this sentence
86	Niklas Christensen	Section 6	Not necessarily true – change in flow could be big but just occurs at flat place on WUA curve. Change in flow same as in Fig 50.	This indicates that the change in summer flow at the Dead Slough site does not cause a change in suitable habitat from the current scenario.
87	Niklas Christensen	Section 7	Are these called Informational Flow Scenarios elsewhere?	Changed to reference flow scenarios
88	Niklas Christensen	Section 7	Would?	Changed
89	Niklas Christensen	Section 7	Worth flushing this out into 2 or 3 pages of Findings? Could be bullets supported by the rest of the text. Maybe that's Exec Summary, or just in the main report. If in main report, should we say "see main report for discussion of results?	Referred reader to main report

Comment Number	Reviewer	Location	Comment	Response
90	Matt Ely (Technical Sufficiency Reviewer)	Acronyms	Defined once, never used	Deleted
91	Matt Ely (Technical Sufficiency Reviewer)	Acronyms	Never used	Deleted
92	Matt Ely (Technical Sufficiency Reviewer)	Acronyms	Never used	Deleted
93	Matt Ely (Technical Sufficiency Reviewer)	Acronyms	All Irrigation District acronyms would be helpful	Added for the eight major districts
94	Matt Ely (Technical Sufficiency Reviewer)	Section 1	Never used	Deleted
95	Matt Ely (Technical Sufficiency Reviewer)	Section 1.1	Upper Deschutes River basin, Upper Deschutes River Basin, Deschutes Basin, Upper Deschutes subbasin. I really like consistency. USGS format would be Upper Deschutes River Basin – but I would suggest one and stick with it. Also, the Upper Deschutes River is referred to only as the “Upper Deschutes” throughout the report. If that is standard Reclamation usage, no problem.	Changed as appropriate
96	Matt Ely (Technical Sufficiency Reviewer)	Section 1.2	Consistency: Instream or in-stream	Changed
97	Matt Ely (Technical Sufficiency Reviewer)	Section 1.2	DEBO and WICO are not sued anywhere in the tech memo but figure 1.	Added definition to caption
98	Matt Ely (Technical Sufficiency Reviewer)	Section 2	Figure numbers are off throughout the report. I will attempt to fix but check and make sure they are called out correctly.	Thanks - corrected
99	Matt Ely (Technical Sufficiency Reviewer)	Section 2	Not in Literature Cited	Changed to website in text
100	Matt Ely (Technical Sufficiency Reviewer)	Section 2	Do not see on Figure 4.	It’s on there
101	Matt Ely (Technical	Section 2.1	I don’t think Table 1 is ever called out in the text.	Added

Comment Number	Reviewer	Location	Comment	Response
	Sufficiency Reviewer)			
102	Matt Ely (Technical Sufficiency Reviewer)	Section 2.1	Consider adding Irrigation District acronyms here. They are used throughout the report and I had to go back and figure out which was which.	Added
103	Matt Ely (Technical Sufficiency Reviewer)	Section 2.1	Figure 5 shows 301,000 AF. The two Central Oregon Irr District annual diversions total 301,400 AF.	Corrected
104	Matt Ely (Technical Sufficiency Reviewer)	Section 2.1	Figure 5 shows 29,500 AF	Corrected
105	Matt Ely (Technical Sufficiency Reviewer)	Section 2.1	Figure 5 shows 82,000 AF. The two Ochoco Irrigation District annual diversions total 76,700 AF.	Corrected
106	Matt Ely (Technical Sufficiency Reviewer)	Section 2.1	Are the monthly spikes in the winter and spring for COID(?) explained?	No - they are stock water runs that occurred in 2009
107	Matt Ely (Technical Sufficiency Reviewer)	Section 2.2.2	Does the beginning of the irrigation season have a legal start date (i.e., March 15 or April 1) or is it dependent on the annual conditions?	Legally it is April 1, but actually deliveries vary depending on annual conditions
108	Matt Ely (Technical Sufficiency Reviewer)	Section 2.3	Minimum outflow requirements?	Not exactly - it is a bypass requirement from the original storage right.
109	Matt Ely (Technical Sufficiency Reviewer)	Section 3.1	I only see one difference and I suggest not using the word “small” as the term is qualitative. It might be considered a “big” difference to someone.	Changed
110	Matt Ely (Technical Sufficiency Reviewer)	Section 3.1	Table 3 references a 100/140 cfs minimum flow., but no explanation of 100 cfs is provided.	Only 140 was used; changed
111	Matt Ely (Technical Sufficiency Reviewer)	Section 3.1	Not mentioned for 2a and 2b in the Informational Flow Scenarios descriptions above.	Added
112	Matt Ely (Technical Sufficiency Reviewer)	Section 3.1	The 100 cfs flow is never explained or referenced.	Only 140 was used; changed
113	Matt Ely (Technical Sufficiency Reviewer)	Section 3.1	Why not put all 4 here or all 4 in the Appendix?	Done

Comment Number	Reviewer	Location	Comment	Response
114	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.1	Is the end of the irrigation season a legal date (i.e., Oct 15) or dependent upon annual conditions?	Dependent on annual conditions - but changed to November 1
115	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.1	All years above the 80% flow exceedance, right?	Yes - added
116	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.1	All acronyms defined would be helpful.	Added
117	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.1	Are the June peak flows from snowmelt or delivery operations?	Snowmelt - Tumalo Creek is unregulated
118	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.1	Consistency: Instream or in-stream	Changed to in-stream
119	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.1	With high peaks in late June/early July though.	Changed to late summer months
120	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.2	Previously just referred to as the Bend protested water right application. Took me a second to figure out these were the same.	Added - to represent river conditions if the Bend protested water right were prioritized
121	Matt Ely (Technical Sufficiency Reviewer)	Section 3.2.2	Increased winter outflows of 300 and 600 cfs caused	Yes - added
122	Matt Ely (Technical Sufficiency Reviewer)	Section 4	Yet COID shows ~35,000 AF for Conservation	Changed small to lower
123	Matt Ely (Technical Sufficiency Reviewer)	Section 4.1	Here you define TID but not done consistently throughout the report	Just used acronym
124	Matt Ely (Technical Sufficiency Reviewer)	Section 4.1	And here you define OID but not done consistently throughout the report	Just used acronym
125	Matt Ely (Technical Sufficiency Reviewer)	Section 4.1	And then you define TID again.	Just used acronym
126	Matt Ely (Technical Sufficiency Reviewer)	Section 6	Suitable? Sufficient? But not “a lot.”	Suitable
127	Matt Ely (Technical Sufficiency Reviewer)	Appendix A	Seems you could put all 4 Scenarios in the Appendix or in the main body of the report.	Done

Comment Number	Reviewer	Location	Comment	Response
128	Jonathan LaMarche	Figure 3	Can you move the Whychus Creek control point closer to TSID, as it represents the gage (control point) just below the TSID diversion. I know that the locations are all relative to each other and technically it's correct, but some folks might think it's referring to the gage in Sisters.	Moved it to below Sokol since I am reporting at Sisters
129	Jonathan LaMarche	Figure 4	I realize that the "gains" downstream of Hwy 126 are mostly return flows from OID, but there is a component of these gains that are from McKay Creek as well. Can we add a gain node to just below Ochoco Creek to represent this?	the only place where these gains are simulated in the model would be down at the gain/loss point so I don't think it would be appropriate to add a node to the diagram
130	Jonathan LaMarche	Section 2.1	Suggest adding a section that describe in detail the priority (for the base case), location, timing, and amount of the instream flow targets used in the model. For the instream flow requirements (ISFR) we actually used a combination of BiOP flows (senior to districts), state set ISWRs (which are junior to everything), and ISWRs resulting from conservation (which are equivalent in priority to the districts). With regard to earlier comments on the She actual locations (e.g., Bend Minimum to the location upstream of Tumalo Creek confluence)?	I think this would be useful but would require a lot of time/work that is not available at this time.
131	Jonathan LaMarche	Section 2.1	I think for the lay person we need to explain why this is typically done for these types of modeling studies.	Added footnote
132	Jonathan LaMarche	Section 2.1	It'd be nice to have a similar table for the instream flow targets, maybe defined by month.	I think it would be difficult to get people to agree on what this should be (i.e., including the 250 or not). I think we describe the patterns for the scenarios

Comment Number	Reviewer	Location	Comment	Response
133	Jonathan LaMarche	Figure 5	It'd be nice to have a similar graph of the instream target flows used in the simulations	I think it would be difficult to get people to agree on what this should be (i.e., including the 250 or not). I think we describe the patterns for the scenarios
134	Jonathan LaMarche	Section 2.3	Suggest that we indicate how the uncontracted water is used.	Changed
135	Jonathan LaMarche	Section 2.3	Technically only two of the irrigation demands are irrigation districts.	Changed
136	Jonathan LaMarche	Section 3.1	I think you mean figure 6.	Yes, but moved this figure to appendix
137	Jonathan LaMarche	Section 3.1	Do you really mean water rights? I think this is a combo of consumptive water rights and biological targets from USFWS/USBR. For example, the Crooked R. flow at Hwy 126 is a USFWS target, not a ISWR.	Change it to read - For this scenario, all live flow water rights including both in-stream and out-of-stream rights were solved to be met in priority if water was available as they are currently defined.
138	Jonathan LaMarche	Section 3.1	This is somewhat surprising. Might mentioned that it (instream flow target or requirements) doesn't include the instream water right downstream of Bend due to protest by COID. I'm also guessing we didn't include the ISWR for the mainstem Deschutes from Wickiup to the Little Des confluence (upstream of Benham Falls), nor the ISFR for the mainstream Deschutes from Benham to Bend. In other words, I think we modeled the Bi-Op targets below Crescent, Crane, and Wickiup on the Deschutes; but not the ISWRs. I don't remember.	See above
139	Jonathan LaMarche		The demands weren't satisfied though in scenario 1.	Yes - I changed the wording a bit to capture this - see above

Comment Number	Reviewer	Location	Comment	Response
140	Jonathan LaMarche	Figure 6	This is a great figure. Very helpful. Can you use leader arrows to point to the actual locations (e.g., Bend Minimum to the location upstream of Tumalo Creek confluence)? Also, is the Whychus minimum @ Sisters, or is it just below TSID. Technically speaking, TSID is only required to meet the minimum flow just below their diversion and they don't have to make up (release more water) for the roughly 10 cfs of channel losses. Is the TID minimum the state ISWR, or is it the ISWR that's resulted from the conservation efforts?	Moved this figure to the appendix - no additional changes were made
141	Jonathan LaMarche	Section 3.2	Do you mean in the calibration phase of model development? Or as expected under the proposed water management paradigm?	Changed to - expected under the defined scenario
142	Jonathan LaMarche	Section 3.2.1	Describe the instream flow requirement below Bend. See comment below for figure 13.	Added this as a footnote credited to J. LaMarche
143	Jonathan LaMarche	Figure 13	Note the ISFR is based on the districts water conservation efforts and instream transfers/leases which have an equivalent priority to the underlying districts priority dates. The ISFR does not reflect the protested ISWR application flows, which have a much junior priority date.	Added this as a footnote credited to J. LaMarche
144	Jonathan LaMarche	Section 3.2.1	Is it the simulated flow "at Sisters"? The diagram shows the control point for Whychus being below TSID, but above Sokol diversion. The low flow point is definitely what you've indicated here "Whychus Creek @ Sisters", but the minimum target is now management (set by) the "Whychus below TSID" site.	I am reporting at Sisters per Mark T's request when we were showing results to BSWG. I will move the control point in the diagram
145	Jonathan LaMarche	Section 3.2.1	Were there any shortages to the city of Bend (from surface water)?	Some - it looks like about 6 cfs at most
146	Jonathan LaMarche	Section 3.2.2	Year around, or just during the summer?	Year round - but really only comes into play in the summer

Comment Number	Reviewer	Location	Comment	Response
147	Jonathan LaMarche	Section 3.2.2	I'm not sure I get what you're saying here.	Yes, confusing statement and I don't think it is necessary. Removed it
148	Jonathan LaMarche	Section 3.2.2	I would think that if the ISWR below Bend is made a senior priority, then it should be met all the time for any month, because the ISWR is much smaller than the natural flow @ Bend (~1300 cfs). If there's any kind of simulated delivery to the districts under scenario 2a, 2b, or 3; then the ISWR below Bend should've been met all the time if it's a senior priority to the districts.	It is made only made senior in 2b, but it is still subject to the amount of water available in the system - there was an issue in the model that I corrected
149	Jonathan LaMarche	Section 3.2.2	Although this is true, the minimum instream target flow is actually set below TSID. In essence what this means is that TSID is not required to bypass flows in excess of the ISWR in order to make up for channel losses, which are roughly 10 cfs or about 30-40% of the low flow in the summer.	Added language
150	Jonathan LaMarche	Section 3.2.2	These results make me think that we're using the ISWR target for the "at Sisters" gage and making TSID make up for channel losses. Speaking of which, did we include these channel losses in the model?	The control point is prior to the 8 cfs loss and the Sokol diversion. Yes, the 8 cfs loss is included in the model.
151	Jonathan LaMarche	Section 3.2.2	It looks like flow targets in 2a and 2b are basically met, but not in 3. Is this the case?	Yes, because 3 increases to 140 cfs as the target, which depletes the uncontracted account sooner
152	Jonathan LaMarche	Section 3.2.2	Given that there's some much inefficiency within the various districts, I think it's important to point out that the shortages are based on the current demand at the POD, which includes the district inefficiencies. This is important because under the water management scenarios, only some of the "supply" options include reduce the ag footprint (leases and transfers). The other mechanisms keep the consumptive use footprint static, and only reduce demand from the streams.	Added suggested language

Comment Number	Reviewer	Location	Comment	Response
153	Jonathan LaMarche	Section 3.2.2	It looks like TID is shorted in all years. I'm assuming this is because we used the state ISWR in the simulations.	Yes, and TID shares proportionally in the shortage
154	Jonathan LaMarche	Section 3.2.2	Given that the diversions off the mainstem Deschutes are shorted about half the time, I question the results for the instream flow requirements below Bend (figure 24), which basically demonstrates the 250 ISWR can't be met when the ISWR is always a priority. If the districts aren't shorted (from the Deschutes), then the ISWR should at least be met half the time, unless I'm not understanding how the scenarios are setup.	There was an issue in the model that I corrected
155	Jonathan LaMarche	Section 4	The graph looks like it depicts a higher demand reduction for average years compared to dry years	Added a note to the caption to say that the dry year reduction is added to the median year reduction.
156	Jonathan LaMarche	Section 4	Isn't this a demand reduction option, as opposed to a water supply option?	Yes - changed
157	Jonathan LaMarche	Section 4	Would be good to provide this type of table for the informational scenario section too.	Noted
158	Jonathan LaMarche	Table 4	Relative priority of the model objectives need to be included	Noted
159	Jonathan LaMarche	Section 3	I thought TID used a single demand, and the model simulated the live flow from Tumalo Creek was used to satisfy the demand, with Crescent Lake releases making up for any leftover demand?	Yes, that is true, but in order to credit some of the demand reductions to Tumalo Creek, the live flow request was reduced by 60% of the reduction which left more in stream. The rest of the reduction was credited to Crescent Creek
160	Jonathan LaMarche	Figure 39	I think the current minimum flows are over 100 cfs. These look to be lower than that.	Yes, updated these numbers
161	Jonathan LaMarche	Section 4	Hmmmm. I would think that more of this would be credited to the ISWR associated with Tumalo Creek, but I'll defer to the prior input given by the BSWG group.	This does credit more to Tumalo; the live flow demand is reduced by 60%
162	OWRD	Section 1.1	Very helpful overview – consider using this language in the Study Report.	Expanded this to a section describing the process

Comment Number	Reviewer	Location	Comment	Response
163	OWRD	Section 2	The map should delineate the Upper Deschutes – with the current map it is difficult to decipher what is actually included.	Good suggestion - changed map to include upper Deschutes subbasin
164	OWRD	Section 2	What does this mean?	It is a RiverWare construct that checks in-stream flow control points
165	OWRD	Section 2	Provide more detail – are these gains and losses due to surface water/groundwater interactions.	Please see referenced Riverware development document for more information
166	OWRD	Section 2	Describe what is meant by control points.	Described above
167	OWRD	Section 2	Legend needs formatting and schematic doesn't match legend or above description	Formatted
168	OWRD	Section 2	Legend needs formatting.	Formatted
169	OWRD	Section 2	What is meant by this statement?	Due to recent changes in the basin, operational rules are still being negotiated. Just wanted to acknowledge that this model represents a point in time and that things may change
170	OWRD	Section 2.1	What does this mean? What is the rationale for doing this? Does this account for seasonal variability	This is common practice in any planning modeling exercise
171	OWRD	Section 2.1	Describe recent changes to provide minimal context to the reader – is this in reference to the statement above called out by OWRD8? Are these changes that have occurred since 2009?	Explained in later sections and previous documentation - OSF operations and Prineville legislation
172	OWRD	Section 2.1	Model assumes static diversion volume, does not incorporate inter-annual variability of diversions based on available supply or management.	the daily pattern for each district is multiplied by the annual volume and the daily pattern is used; seasonal variation is incorporated in this pattern. The demand pattern is what the district requests, but the model limits what is delivered based on available water supply

Comment Number	Reviewer	Location	Comment	Response
173	OWRD	Section 2.1	Diversion patterns appear to represent daily time series from single year rather than a multi-year time series or average of daily values. It appears the diversion pattern does not capture long term operating patterns.	It is correct that a single daily time series is used in the modeling; this is common practice in planning modeling studies.
174	OWRD	Section 2.2	Move this up to address other comments? Maybe a quick timeline of events that activities that have modified operations?	Noted
175	OWRD	Section 2.2	Are all of the descriptions below representative of new operations?	Yes
176	OWRD	Section 2.2	Either spell out or use the acronym.	Noted
177	OWRD	Section 2.2	Is this the account specifically for the frog?	Yes - it represents the minimum pool designated for frog habitat - mostly a modeling construct
178	OWRD	Section 2.3	May just mention that Ochoco isn't operated for flow targets, if that's the case. I was left wondering if I missed something about its operations when I saw the results figures in later section	Ochoco is operated to maintain a minimum 5 cfs flow in the creek - this is reflected in the plots
179	OWRD	Section 2.3	Include entity name like above?	Noted
180	OWRD	Section 3	Awkward sentence construction.	Revised
181	OWRD	Section 3.1	Is it safe to say that this is representative of "baseline operating conditions"?	Yes - but we chose not to use that terminology
182	OWRD	Section 3.1	Isn't this Section 3?	Changed
183	OWRD	Section 3.1	What is the amount of the instream flow right?	Described later - they vary based on location and time of year
184	OWRD	Section 3.1	Year round or only during particular months/seasons?	The minimum is year round, but really only takes effect in the winter
185	OWRD	Section 3.1	Difficult to visualize – is this a cumulative amount?	Yes
186	OWRD	Section 3.1	Year round or only during particular months/seasons?	The minimum is during the non-irrigation season when water is available
187	OWRD	Section 3.1	Do the operating rules remain the same during irrigation season?	Releases from Prineville are largely based on flood control and irrigation demand during the irrigation season

Comment Number	Reviewer	Location	Comment	Response
188	OWRD	Section 3.1	May need more context as to how this differs from Flow Scenario 2a.	The 250 only takes effect in 2b - the rest of the scenario is the same as 2a
189	OWRD	Section 3.1	Specify season?	Added
190	OWRD	Section 3.1	Specify season?	Added
191	OWRD	Section 3.1	Great image. Is there one for each Scenario?	Yes - all moved to appendix
192	OWRD	Section 3.2.2	Typo?	Yes - corrected
193	OWRD	Section 3.2.2	Difficult to see the median line in yellow without the “current” behind	Because there is little change
194	OWRD	Section 4	Why NUID?	Because they have the most junior right and the largest shortages
195	OWRD	Section 4.1	?	Section removed

Attachment B – Technical Sufficiency Reviews of Technical Memorandum: Compilation and Analysis of Climate Change Information in the Deschutes Basin

Comment Number	Reviewer	Location	Comment	Response
1	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 1, Page 2	Clarify that you explored these options in the hope that results would be better due to explicit subsurface/surface modeling and coupling. Explain GSFLOW and PRMS? And why PRMS in crooked sub-basin?	Changed: "Anticipating streamflows that were more representative of basin conditions and physical processes, the Basin Study leveraged a GSFLOW model of the Upper Deschutes basin that was developed by the U.S. Geological Survey (Gannett 2017). In addition, Reclamation developed a PRMS model of the Crooked River sub-basin". to "Given the limitations of the streamflows generated with the CRBIA VIC model, the Basin Study explored other hydrology models that could possibly better represent groundwater-surface water interactions. The Basin Study leveraged a GSFLOW model of the Upper Deschutes that was being developed by the U.S. Geological Survey concurrently with the Basin Study (Gannet 2017). GSFLOW couples MODFLOW, the USGS groundwater flow model, and PRMS, the USGS precipitation-based hydrology model, and was expected to provide better streamflows than the VIC model given that it had the potential to better represent the groundwater-surface water processes that occur in the Upper Deschutes. The GSFLOW model did not extend to the Crooked River sub-basin, so Reclamation developed a PRMS model of the Crooked River Sub-basin. In addition, the Crooked River sub-basin does not experience the same level of groundwater-surface

Comment Number	Reviewer	Location	Comment	Response
				water interaction that occurs in the Upper Deschutes, so the PRMS model was determined to be sufficient"
2	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 1, Page 2	What was the calibration WRT?	Change to: Because the GSFLOW model was calibrated for purposes not related to the Basin Study including flows in the lower basin and groundwater levels near the confluence of the Crooked and Deschutes Rivers, its calibration quality was low with respect to streamflow especially in the upper basin
3	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section1, Page 2	Maybe re-frame slightly along "Each have strengths and weaknesses and therefore collectively represent the best available data"?	Changed to: All of the models have strengths and weaknesses and therefore collectively represent the best available data.
4	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 1, Page 3	Averages?	Changed
5	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 1, Page 3	Redundant	Deleted
6	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 1, Page 3	Is that an average or an "extreme year"?	The text actually said the precipitation to exceed that value. So, not an average, but not extreme either.
7	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 2, Page 3	Clarify as historical	Added historical
8	Technical Sufficiency Reviewer 1 (Ken Nowak)	Figure 3	maybe clarify in text that this is the historical period that will be used throughout the document unless otherwise specified - as the other plots don't include this bit in their caption?	Added clarification: "Figure 4 and Figure 5 show the monthly median temperature range represented by the five HDe scenarios for the 2040s and 2060s relative to the historical period (1980 to 2009)"
9	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 7	Can you be explicit on which sub-basins, tributaries this includes…?	Added Upper Deschutes, Little Deschutes, Middle Deschutes, Tumalo Creek, and Whychus Creek
10	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 7	This it makes sense to explain that PRMS is the surface hydrology model of GSFLOW (and explain GSFLOW) for context using those two together. Also, assume VIC is the entire domain - might want to say that just to round out the	Added a sentence describing the domain of the VIC model. Added two new sections to generally describe the development of the VIC and GSFLOW models with less detail than

Comment Number	Reviewer	Location	Comment	Response
			discussion. It is in a footnote to the table below but doesn't really come out in the text.	the PRMS model development section.
11	Technical Sufficiency Reviewer 1 (Ken Nowak)	Table 1	? Is there a map with all of these sites… might be helpful	Added sites to Figure 8.
12	Technical Sufficiency Reviewer 1 (Ken Nowak)	Table 1	Why no VIC in Crooked? - would seem likely to better there than in upper Deschutes?	Added VIC to the table. VIC is available for the Crooked, but we decided to build the PRMS model after recognizing that its calibration quality was not sufficient. This is due to the entire Deschutes being calibrated to one flow point below the confluence of the Crooked and Upper Deschutes, leading the Crooked flows to have a groundwater dominated signature and higher baseflows than occur in the basin.
13	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 9	Specify USGS product?	Added "USGS"
14	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 9	Consistency	Changed to sub-basin
15	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 9	How/why? - doesn't look too different compared to Upper Deschutes	Removed this sentence
16	Technical Sufficiency Reviewer 1 (Ken Nowak)	Figure 9	Consistency	Changed to sub-basin
17	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 12	Why?	Removed this sentence
18	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 12	I can see parameters controlling ET being a calibration, but I don't see how a climatological adjustment is calibrated. Also, the parameters are not well described. Consider a short description of each? E.g. what's snow_cdh_adj?	Removed discussion of climatological adjustment and all references to specific PRMS parameters
19	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section3, Page 12	Reasonably?	Changed
20	Technical Sufficiency	Section 3, Page 12	Are there more? Or is it just those 3? "like" seems to imply	Removed this sentence

Comment Number	Reviewer	Location	Comment	Response
	Reviewer 1 (Ken Nowak)		they are examples, but not a complete list.	
21	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 12	Is there any USGS guidance on how to calibrate PRMS and if this is consistent with that in terms of process and parameters? Always good to show you are following the suggested approach when possible.	Looking at the USGS documentation, there is only one example with a calibration process. There is no recommended process. The process used in this case is not the same as the USGS example, but I don't think that means there is an issue with the process.
22	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 13	Assume blue is obs and green is simulated? Would be good to be more clear. Also, did I miss how the calibration period was selected?	Added green/blue to caption. Also added calibration period to earlier sentence
23	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 13	What aspect of snowmelt made it hard? Isn't Prineville snowmelt too? That one seemed to work out ok	The size of the model basin and the uncertainty in the unregulated flows are the likely suspects.
24	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 13	These statements are tough to follow and are not sure how to interpret in context of R^2 and NSE scores.	Made various changes to improve readability
25	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 14	Might want to go into a little more detail on this? Was it added back in later?	Added "The estimated groundwater contribution was added back in once calibration was complete."
26	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 3, Page 15	Don't feel like I have a good handle on why this one was so different in the outcome. Is there anything fundamentally different or is it just a small area and the precip. might be off?	The size of the model basin and the uncertainty in the unregulated flows are the likely suspects.
27	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 4, Page 15	I understand that PRMS model is the only model that was developed/ calibrated for Reclamation, but was thinking there would be similar sections for VIC and GSFLOW - even if the setup/calibration portions are short and just point to whatever effort produced it and so you might now how it performed?	Added sections to address this
28	Technical Sufficiency Reviewer 1 (Ken Nowak)	Figure 13	Given the relatively small differences between the unregulated, baseline raw, baseline BC, I'm surprised at how much the BC impacts the flow at early and late seasons and times, the direction of the impact from the BC	Concur. Double checked that the correct bias correction approach was used and that it was used consistently for both VIC and GSFLOW. These issues are why we are continuing to investigate bias correction approaches.

Comment Number	Reviewer	Location	Comment	Response
29	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 4, Page 16	Could be that I've been reading this across multiple settings, but I don't recall seeing anything that would explain why only MWW and MWD are shown	Added
30	Technical Sufficiency Reviewer 1 (Ken Nowak)	Figure 14	Might be good to explain what some of these changes are in % - especially when you see some of the big winter jumps in flow… 0.5" doesn't seem like a lot, but maybe that's 100% increase?	Added graphs with percentage
31	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 4, Page 16	Looks like Bias Correction is making results worse… have you tried quantifying the impact of BC?	Not to date - that is a good suggestion and will suggest for further analysis
32	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 4, Page 19	This generally makes sense, given the different GW treatment. However, I'm again concerned about the annual volumes, especially with GSFLOW; is there a way to back of the envelope check for reasonableness of the annual volume relative to the precip.?	Concur
33	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 4, Page 22	VIC seems very susceptible to this funky receding limb zig-zag whereas GSFLOW is not. Is the same method being applied?	Yes, the same method is being applied.
34	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 4, Page 24	Point to appendix	Done
35	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 5, Page 26	Did you consider a possibly longer irrigation season?	Yes, I looked into a possibly longer growing season, but the irrigation diversions would still be limited by water right dates (i.e. most diversion can't start until April 1). So, decided to leave the diversion timing alone.

Comment Number	Reviewer	Location	Comment	Response
36	Technical Sufficiency Reviewer 1 (Ken Nowak)	Section 6, Page 27	Per discussion, consider bolstering this section with (1) high level possible explanations of model and BC performance (e.g. GW nature of location, associated hydrograph, low flow periods, etc.), (2) note that we are actively working to address these issues through research, (3) urge caution in using results too literally; message is that there is considerable uncertainty - don't want to plan only for optimistic end of uncertainty range.	Changed conclusions to read: "There were challenges with developing future adjusted climate hydrology in the Upper Deschutes due to the groundwater dominated nature of the system. The characteristic hydrograph that has higher baseflows and attenuated peak flows is not well simulated by the VIC and PRMS hydrology models. The GSFLOW model, which is designed to better capture these behaviors, was calibrated for the lower basin and therefore did not satisfactorily capture the hydrology in the Upper Basin. Since the flows in the Upper Basin are critical to water management, this limited their use in the Basin Study. In addition, the bias correction procedure introduced an additional layer of uncertainty since the modeled flows were largely different from observed flows. The issues with the hydrology models, in particular GSFLOW, are continuing to be addressed. The USGS is actively working on calibrating a new version of the GSFLOW model for use in future studies of the upper basin. In the interim, the results of the study should be used with extreme caution since there is considerable uncertainty with both the raw and bias-corrected results. "
37	Niklas Christensen	Section 1	If study is still ongoing should we say “is being completed”. Not important, just a thought.	I think at the time of publication, it will have been completed.
38	Niklas Christensen	Section 1.2	I don’t think “bias-correction not effective” since the calibration was poor is correct. Calibration was poor, so results relied more on the bias-correction, but the bias-correction was unable to generate realistic streamflow.	Bias correction generally works

Comment Number	Reviewer	Location	Comment	Response
39	Niklas Christensen	Section 1.3	Historical	Changed
40	Niklas Christensen	Section 1.3	I don't see range for precip so should it say: Monthly temperature range and average monthly precip	Changed
41	Niklas Christensen	Section 2	Future	Changed
42	Niklas Christensen	Section 2	All models on the scatter plots show warming so should this say "all models"? Or "all models over the Deschutes Basin" or someway to limit to just models shown on plots?	Changed
43	Niklas Christensen	Section 2	Should this say "change projected by…" instead.	Changed
44	Niklas Christensen	Section 2	No need to include but could say "2-6 degrees by 2040s and 4-10 degrees by 2060s". Shows a smaller range and helps people see the trend w/o having to look at the figure.	Noted
45	Niklas Christensen	Section 3	Maybe not worth doing but could be worth giving more context first. GSFLOW was preference, did not calibrate well, VIC tried, etc.	Noted
46	Niklas Christensen	Section 3	Should the subscripts be in the heading since they refer to all VIC, GSFLOW, PRMS in the column?	Changed
47	Niklas Christensen	Section 3.1	This confused me, maybe reword? Flows in lower Crooked are influenced by cross-basin GW flows?	It is the calibrated VIC flow that was impacted because it was trying to calibrate to the Madras shape - this cause the VIC crooked river shape to look like the upper Deschutes - added a few words to clarify
48	Niklas Christensen	Section 3.2	Aren't the elevation bands for more than just snow melt? I'd think there's a lapse rate for snow accumulation and a bunch of other temp/precip dependent hydrologic processes	Probably, but I think this is just what Scott focused on
49	Niklas Christensen	Section 3.2	Variability in calibration. I thought variability in streamflow on my first read through. Also, could cite how sparse the precip station network is (I assume it's sparse) and therefore likely not representative of precip over such elevation/etc. Although we get 100m precip dataset from SMRF it's probably based on a handful of original stations, right?	Added in calibration

Comment Number	Reviewer	Location	Comment	Response
50	Niklas Christensen	Section 3.2	Is the bottom plot offset by 1 year? Even with thinking about the WY year shift, it looks like WY 1994 on middle plot is on 1995 in bottom plot.	It is reported at the end of the year so appears offset
51	Niklas Christensen	Section 3.2	Crooked River at Prineville	Changed
52	Niklas Christensen	Section 3.2	Observed-unregulated	Changed
53	Niklas Christensen	Section 3.3	…can be found in….	Located
54	Niklas Christensen	Section 3.3	Figure #s off…	Fixed
55	Niklas Christensen	Section 3.3	This paragraph does not touch on the discontinuities/steps that are likely an error in the bias-correction process. Or something about unintended	The steps are a result of the bias correction process itself and seem to amplify when there is a large difference between the model output and unregulated data
56	Niklas Christensen	Section 4	Figures below are similar to fig 4 and 5, just reference those?	This was so that you could easily look at this in the section with the hydrology
57	Niklas Christensen	Section 4	I think %% change in temp is a misleading metric since it depends on units (e.g. Kelvin would be a small %)	I think because the chart above shows it in degrees F, it is reasonable to assume it is related to degree F
58	Niklas Christensen	Section 4	…the…	Changed
59	Niklas Christensen	Section 4	…is likely…	Changed
60	Niklas Christensen	Section 4	Nonetheless,…. Or someway to tie the paragraph together. Or someway to tie the paragraph together.	Added
61	Niklas Christensen	Section 4	VIC? Maybe embedded table title should have VIC and other figure above have GSFLOW. Also, is secondary y-axis correct and raw streamflow uses that, and Unregulated and BC uses primary axis?	Added VIC to caption - yes, secondary axis was for the raw flow
62	Niklas Christensen	Section 4	A little confusing since above has BC Output too. Calibrated Streamflow Results; Calibrated Output?	Changed
63	Niklas Christensen	Section 4.1	Paragraph mentions GSFLOW and PRMS. VIC?	Changed
64	Niklas Christensen	Section 4.1	“Simulation/projection of” right? I have great confidence in the hydrology of the UD	Changed
65	Niklas Christensen	Section 4.1	Irrigation ET Demand Adjustment?	Changed
66	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 1.2	Minor point for consistency and clarity. The Upper Deschutes River Basin is also referred to as the Upper Deschutes, Upper Deschutes	Changed

Comment Number	Reviewer	Location	Comment	Response
			Basin, Upper Deschutes basin, and Upper Deschutes subbasin. Suggest using The Upper Deschutes River Basin in all instances (or abbreviating (UDRB).	
67	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 2.0	Were the datasets compatible? Were there obvious differences along the borders of the grids? Just curious if the two different datasets introduced bias.	We did not do a comparison. Footnote added to indicate that there could be a bias due to using the two different datasets.
68	Technical Sufficiency Reviewer 2 (Matt Ely)	Figure 10	Change met site label from OHOCO MEADOWS to OCHOCO MEADOWS?	Done - couldn't completely replicate map and it doesn't look as nice, but the spelling is correct now.
69	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.2	Something is missing in this sentence. Did you adjust ET to dial in the annual flow volumes?	Yes, added "were calibrated".
70	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.2	Did you have any “reasonable” values to constrain the modeled ET. Cranking ET up or down can certainly dial in flow, but the adjustments could also be made to precip and temp. ET value from another source can increase the quantitative certainty of the simulated water budgets.	Just the parameters that control ET were adjusted.
71	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.2	Were they adjusted?	Yes. Adjusted language
72	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.3	Coefficient of determination, right? I would suggest mentioning acceptable ranges for R2 and NSE. 0.6-1.0, maybe?	Added
73	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.3	R2 values of 0.14, 0.01, and -0.31 seem really low, assuming it is the coefficient of determination? I would normally think anything below 0.6 was below an acceptable range.	Changed the sentence to: The monthly streamflow volume timing performed well when the yearly volume matched closely; however, the overall calibration quality was low (R2 0.01 and NSE 0.53).
74	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.3	Also really low.	Changed the sentence to: The monthly streamflow volume timing performed well when the yearly volume matched closely; however, the overall calibration quality was low (R2 0.01 and NSE 0.53).

Comment Number	Reviewer	Location	Comment	Response
75	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.3	I'm not sure what this means. The modeled groundwater discharge from the Deschutes GSFLOW model was subtracted from the measured streamflow because it was not accounted for in the PRMS model. Is this correct? What was the modeled groundwater discharge in ft3/s?	Clarified - around 50 cfs
76	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.2.3	Matched? Simulated?	Simulated
77	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 3.3	Refers to Figure 14	Fixed
78	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 4	Figure 15	Fixed
79	Technical Sufficiency Reviewer 2 (Matt Ely)	Sectoin 4	You discuss it later, but wouldn't you expect to see Dec flows increase if the precip changes from snow to rain in a future warmer climate (MWW)?	Yes, but it seems unreasonably large and likely due to the bias correction process rather than something we would expect to see
80	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 4	Curious if the change from snow to rain in the wintertime changed the timing and volume of recharge and groundwater discharge to stream, respectively	It's a good point, but calibrated GSFLOW model had so much uncertainty, it is difficult to determine if the model output is due to physical processes or model issues.
81	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 6.1	Section 2.0?	Yes
82	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
83	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
84	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
85	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
86	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed

Comment Number	Reviewer	Location	Comment	Response
87	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
88	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
89	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
90	Technical Sufficiency Reviewer 2 (Matt Ely)	Section 8	Not cited in text	Removed
91	Jonathan LaMarche	Section 1.3	I would describe the climate in general terms such as “Mediterranean” with cool wet winters and warm dry summers.	Added
92	Jonathan LaMarche	Section 1.3	This seems extremely low for a basin-wide average. I don’t think the Redmond Airport is a good representation of climate in the basin. Precipitation variation doesn’t capture the seasonal variability that occurs over most of the basin (see comment #1), nor the importance of snow accumulation and melt in the region of the basin that produces most of the streamflow.	Added language
93	Jonathan LaMarche	Section 3	I’m not sure basalt aquifer is the correct description. I’d use the descriptions in the Gannett and Lite geologic framework paper. “…. regional aquifer formed in the younger volcanic deposits of the Cascades.	Changed to highly permeable volcanic aquifer
94	Jonathan LaMarche	Section 3	I suggest showing a summary hydrograph, or typical year hydrograph of the Deschutes below Snow Cr compared to Crooked R @ Post.	Noted
95	Jonathan LaMarche	Section 3.1	Perfect example. Nice	Thank you
96	Jonathan LaMarche	Section 3.2.1	Streamflow at Opal Springs is 90% groundwater, recharged from the Cascades (outside of the Crooked Ri basin). You might want to acknowledge this fact, and indicate how you used the data from this gage, and calibrated the model given this fact.	This is noted later in the report when discussing calibration

Comment Number	Reviewer	Location	Comment	Response
97	Jonathan LaMarche	Section 3.2.1	I would say that this occurs frequently, but not all the time; even if snow does accumulate in the lower elevations it doesn't always lead to a ROS event.	Changed to can experience
98	Jonathan LaMarche	Section 3.2.2	See comment #6.	This is noted later in the report when discussing calibration
99	Jonathan LaMarche	Section 3.2.2	Unless you're referring to historical discontinued gages, all of the currently operated gages in the Crooked and Ochoco watersheds are owned and operated by OWRD, except for the Crooked River @ Osborne Canyon and the Crooked River @ Opal Springs. Many of the discontinued sites were also operated by OWRD.	Removed USGS
100	Jonathan LaMarche	Section 3.2.2	I would re-phrase this. Not sure if you're really referring to enough "precipitation entering" the basin. I would think that this is relatively static parameter defined by the precipitation gages, and not one that would be "adjusted". I think you mean enough streamflow exiting the basin compared to the observed flow which integrates the precipitation/ET flux over the basin.	The precipitation data were adjusted because the gridded data, developed from point source precip measurements, can often have error and not completely capture the total amount of precipitation entering the basin. The modeler felt that this was an appropriate and often needed task.
101	Jonathan LaMarche	Section 3.2.2	Exactly.	Noted
102	Jonathan LaMarche	Section 3.2.3	Indicate which is observed and which is simulated. Any ideas as to why the model performs poorly in some of the years (dry years)?	Changed
103	Jonathan LaMarche	Section 3.2.3	Good. Please use full descriptions though. CROO = Crooked River at …..????h is observed and which is simulated. Any ideas as to why the model performs poorly in some of the years (dry years)?	Changed
104	Jonathan LaMarche	Section 3.2.3	Excellent. Disregard earlier comments.	Noted
105	Jonathan LaMarche	Section 3.3	The central part of the basin was a key area of calibration with respect to the GW component of the modeling.	Accepted changes

Comment Number	Reviewer	Location	Comment	Response
106	Jonathan LaMarche	Section 4	I think we should keep this section as it also provides a road-map, examples, and documentation to when BC isn't suitable; and more broadly why we didn't use quantitative results in this section.	Noted
107	Jonathan LaMarche	Section 4	Add a bit more description for the lines. Black is unregulated flows based on observed gage data. Solid lines are the biased correct simulated flows. Dashed lass are the un-biased corrected simulated flows.	Added
108	Jonathan LaMarche	Section 4	VIC doesn't simulate that actual processes by which streamflow is being generated though (i.e., the sub-surface flow); classic example of a model simulating reasonable results for the wrong reasons (i.e., the wrong calibration parameters). I think that fact (not simulating the actual mechanisms by which flow is being generated) needs to be added to this paragraph it to be a complete description.	Added language
109	Jonathan LaMarche	Section 4	?? could increase the reliance, not the reliability.	Changed
110	OWRD	Section 1	The introduction doesn't really introduce anything related to "development of future projected climate adjusted flows"	Changed the title of the memo to: Compilation and Analysis of Climate Change Information in the Deschutes Basin
111	OWRD	Section 1.1	This seems highly technical – consider introducing technical terms ("climate adjusted", "bias corrected", "spatially-downscaled", "quantile mapping") later when there is more context? Who is the intended audience?	This memo is intended for a technical audience to ensure technical sufficiency. It is assumed that the reader would have some background in the presented technical topics
112	OWRD	Section 1.1	Check consistent use of "streamflow" vs "stream flow"	Changed to streamflow
113	OWRD	Section 1.2	This could benefit from some additional context?	Changed scenarios to analysis to make sentence clearer
114	OWRD	Section 1.2	This could benefit from some additional context?	This memo is intended for a technical audience to ensure technical sufficiency. It is assumed that the reader would have some background in the presented technical topics
115	OWRD	Section 1.2	Consistent GSFLOW vs GSFlow	Changed to GSFLOW

Comment Number	Reviewer	Location	Comment	Response
116	OWRD	Section 1.2	Confusing sentence. Does this mean that “lower basin and groundwater levels” were part of the calibration purpose? Or were they part of what is related to the Basin Study?	Adjusted sentence for clarity
117	OWRD	Section 1.2	This could benefit from some additional context?	This is explained in later sections
118	OWRD	Section 1.3	Pretty broad statement. What about “typical inter-mountain west climate”	Changed based on previous comment
119	OWRD	Section 1.3	No discussion of snowpack? Generally, somewhere in the intro there should be descriptions of distinction between upper Deschutes and Crooked seasonality, explanation of geology that dictates routing of hydrology, discussion of storage, which buffers hydrology etc.	Added discussion of snowpack
120	OWRD	Section 2	What were model data downscaled from in CMIP, 1 degree, more, less? Also, are there citations for the ”other basin study applications”?	This paragraph is intended to be a summary of previous work referenced in the document - more information can be found in the references
121	OWRD	Section 2	The report would benefit from having a table or a list showing the scenarios in greater detail.	Noted
122	OWRD	Section 2	Are the dashed lines mean and standard dev? That should be described in figure caption.	Described in paragraph above figure - a bit wordy to add to the caption
123	OWRD	Section 2	Suggest that WET scenarios be blue or green, DRY should be orange, brown etc.	Noted
124	OWRD	Section 3	Check for consistent use of hyphen	Changed for consistency
125	OWRD	Section 3	What basalt aquifer? CRB? Or basalts of the Cascades?	Adjusted language based on previous comment
126	OWRD	Section 3	Suggest including an overview figure earlier in the memo?	Noted
127	OWRD	Section 3.2.1	Consistent use of terms.	Noted
128	OWRD	Section 3.2.1	Wondering if SMRF UPSCALED, not downscaled the 1/16 dataset to 100m DEM?	Downscaled
129	OWRD	Section 3.2.1	This figure doesn’t seem to be cited in text. Should be P11, pp4 maybe?	Added reference based on previous comment
130	OWRD	Section 3.2.2	Suggest reminding reader what specific model parameters were adjusted.	Noted
131	OWRD	Section 3.2.2	Not a complete sentence.	Adjusted based on previous comment
132	OWRD	Section 3.2.2	It would be interesting to see how much parameters were adjusted to get reasonable numbers.	Noted

Comment Number	Reviewer	Location	Comment	Response
133	OWRD	Section 3.3.3	Not sure R2 can be negative.	It can be
134	OWRD	Section 4	Since this term is used above and throughout the memo, it may be beneficial to move this discussion earlier or at least reference this discussion? An example of systematic model error should be given. A deeper description of what model data or parameter needed correction would be beneficial as well. Quantile mapping should be briefly defined too.	This memo is intended for a technical audience to ensure technical sufficiency. It is assumed that the reader would have some background in the presented technical topics
135	OWRD	Section 4	Check figure numbers.	Checked
136	OWRD	Section 4	Again, are the model results for the full decade (2060s) or only the single year (2060)?	Explained earlier in the document
137	OWRD	Section 4.1	How do you define high calibration quality and or can you show us what you mean in a figure?	This section was removed
138	OWRD	Section 4.1	Check figure numbers	This section was removed
139	OWRD	Section 4.1	What's at Prineville? Should you say, "Crooked River at Prineville" or "Prineville Gage"?	This section was removed
140	OWRD	Section 5	What is meant by this?	Used information developed in previous studies
141	OWRD	Section 5	Confusing word order. Do you mean "grow plus ET less precip."	ET is the amount of water needed by the plant to grow
142	OWRD	Section 5.2	Be consistent between "R2" and "R-squared"	Changed for consistency
143	OWRD	Section 5.2	Suggest renaming – Water Demand Adjustment or Irrigation District Demand	Adjusted Irrigation Demands
144	OWRD	Section 6	Conclusions should definitely describe the findings. What did this particular study accomplish? Cite real numbers etc.	Noted
145	OWRD	Section 6	There is always room for improvement. Specific breakdown of the study limitations and specific steps to be taken in the future to improve the study is needed here.	Noted
146	OWRD	Section 6	Whose? The models or the flows?	Changed to the models'

Attachment C – Reviews Completed by OWRD

From OWRD memorandum dated November 16, 2018:

Topic	Document	Information Provided	Previous Review?	Comments
Basin Study DRAFT	DRAFT Report, Upper Deschutes River Basin Study	Report that summarizes the results of the Basin Study, describes potential water management options/tools, and lays out potential next steps.	Yes, high-level red flag review	See memo and redline comments. DRAFT sent 11/6, FINAL sent 11/14 (*addressed in revised draft*)
Hydrology and Water Supply	TECHNICAL MEMORANDUM - Analysis of Regulated River Flow in the Upper Deschutes Basin using Varying In-Stream and Out-of-Stream Conditions	Describes modeling studies of river flows, incorporating ranges of hydrologic conditions based on recorded data, current water usage patterns and water rights, and hypothetical water management scenarios; identifies estimated shortages in water supplies for assumed conditions.	Yes	Separate comments sent by Jonathan L. on 10/30/18. See attached for additional comments (*addressed per Attachment A*)
Climate Change	TECHNICAL MEMORANDUM – Compilation and Analysis of Climate Change Information in the Deschutes Basin	Presents climate change models used to project potential future variability in precipitation and temperature; discusses applications relative to Basin Study objectives.	Yes	Separate comments sent by Jonathan L. on 10/29/18 See attached for additional comments (*addressed per Attachment B*) Comments (*addressed per Attachment B*): The conclusions from this memo were not as clear as they could be. It would be beneficial if this memo could make some clear recommendations regarding next steps so that it could serve as a "technical handoff" as we work to improve these different models. This document will benefit from a technical edit. Technical terms are used at the beginning of the document and throughout the document without much description or context. Depending on the

Topic	Document	Information Provided	Previous Review?	Comments
				intended audience, this may be difficult for readers.
Instream Ecological Needs	TECHNICAL MEMORANDUM - Oregon Spotted Frog and Deschutes Redband Trout Habitat Modeling and Riparian Analysis at Two Sites on the Upper Deschutes River	Instream flow study at two sites on the Upper Deschutes River below Wickiup Reservoir; evaluates relationships between streamflow and both instream and adjacent riparian wetland habitats.	Yes	Sent to ODFW for review. No comments from OWRD. Note: This will be an exciting contribution to the water management world as there are not many WUA studies for amphibians.
Stream Temperature	TECHNICAL MEMORANDUM - Prineville Reservoir and Crooked River Temperature Model	Development of a temperature model of Prineville Reservoir and the Crooked River; explores the effects of potential water management approaches on water temperatures.	Yes	Comments for consideration by the author(s) – no changes requested. No comments from OWRD. Comments from DEQ: Pg.17: The Powell Butte Agrimet Station is on a plateau above the Crooked River canyon. Temperature, wind, and humidity conditions at the station are probably significantly different from conditions in the canyon. Were the station data adjusted to better represent canyon conditions? How sensitive is the model to these parameters? Pg.28: Is there a good basis for the assumption that Bear Creek inflow temperatures are the same as Crooked River inflow temperatures? Temperature graphs throughout the document should have a line at 18C for the temperature standard.
	TECHNICAL MEMORANDUM - Whychus Creek and Middle Deschutes River Temperature Assessments	Assessment of relationships between stream temperature, streamflow and air temperature at three sites (Whychus Creek, Middle Deschutes River, and Tumalo Creek); regression analyses used to	Yes	Comments for consideration by the author(s) – no changes requested. Comments from OWRD:

Topic	Document	Information Provided	Previous Review?	Comments
		assess potential predictors of stream temperatures.		The Basin Study should consider appropriate use of this analysis and provide the necessary caveats. WRD and DEQ requested that the authors include standard summary statistics for their regression equations, but there was no additional funding for the group to perform these computations. Additionally, we made the point that these regressions are not valid if the system itself is changed. Consider including a statement in section 2.3.2 of the Basin Study about the limited application of the model developed here – this assessment assumes that the conditions present when the regression was formed remain stable. If this tool is used to assess water temperature conditions in the future, we caution the user to carefully consider whether factors controlling the regression relationships have changed. Comments from DEQ: It would be helpful to see graphs of the daily 7DADM temperature, flow, and air temperature for each site. As mentioned in the memo, this study could be improved by addressing the autocorrelation in model parameters and considering additional factors that might influence stream temperature.
Irrigation District Infrastructure and Water Use	TECHNICAL MEMORANDUM - Literature Reviews (individual documents) for Arnold, Central Oregon, Lone Pine, North Unit, Ochoco, Swalley, Three	Compilations of available data on irrigation systems including supply, storage, distribution, water use, and water conservation.	Unsure	N/A

Topic	Document	Information Provided	Previous Review?	Comments
	Sisters, and Tumalo Irrigation Districts			
Water Conservation Tools (Irrigation)	TECHNICAL MEMORANDUM - Water Conservation Assessment	High-level summary estimates of water conservation potential and associated costs for the eight irrigation districts in the study area; addresses piping district-owned canals, piping private laterals, and on-farm conservation.	Yes	Comments for consideration by the author(s) – no changes requested. Note: This provides a good summation of potential water savings through efficiencies of delivery of irrigation water (Irrigation Districts only). That being said, we would have liked to see a bit more prioritization, next steps, or some similar analysis. It was difficult to discern what the next steps should be. It could be beneficial to overlay this analysis with priority habitats or reaches? There is a huge need matched with a correspondingly huge price tag – another level of analysis may help the basin figure out where to start since this work will, by necessity have to happen sequentially. Question: Is there any mention or reference to FCA's work or the NRCS watershed planning process in the Basin Study? Would this be useful information to share?
Market-Based Tools	TECHNICAL MEMORANDUM - Market-Based Approaches as a Water Supply Alternative (LPE Task 7)	Evaluates the potential for market-based approaches as water supply options; addresses price incentives to promote efficient water use and reallocation of existing supply relative to potential water management objectives.	Yes	Comments for consideration by the author(s) – no changes requested. **Section 4.1 Line 1 Re: permanent transaction -** The language and definition of "permanent transaction" used for "the purposes of this study" should not be understood to be transfer of water right. Patrons don't end up holding a confirming water right - they are only selling their use of district water to another patron. The water right will only become appurtenant to the buyer's land if a water right transfer is approved by the district and the

Topic	Document	Information Provided	Previous Review?	Comments
				land owner (Fort Vannoy court case). After the transfer is approved, the district will still remain the holder of the water right. **Section 4.3 Line 1 Re: permanent water right transactions** - We assume this means transactions between landowners. [These numbers don't match the number of transfer orders issued in the last 5 years (2, being T-12251 and T-11713) or total acres involved in permanent transfers in the last 5 years (44.63) unless some are missing in our Water Rights Information System.] **Section 4.3 Line 2 re: last five years** - Assumed the last five years was 2013-2017 until reading in the References that Shawn was interviewed in 2016. Might use dates instead of number of years here if it is important. Comment: A very compelling concept, but it was unclear how a market would be operationalized in the Basin.There are significant unknowns, including how the market would be regulated, how prices/unit would be established, and if there is enough interest in the basin to spend significant money to move water instream and/or between districts. Furthermore it is unclear how this tool would work within existing water law and policy.
Enhanced/New Storage	TECHNICAL MEMORANDUM - Assessment of Potential Enhancements or New Storage Opportunities	Provides information about potential approaches, additional storage volumes, and costs for new water storage opportunities; helps inform evaluations of storage options as a	No	No comments.

Topic	Document	Information Provided	Previous Review?	Comments
		possible element of future water management strategies.		
Legal & Policy Factors (*comments addressed per OWRD-GSI discussions*)	TECHNICAL MEMORANDUM - Water Right Assessment (Task 1A)	Summary of existing information on water rights and water use (irrigation, municipal, quasi-municipal and instream) in the Upper Deschutes basin.	Yes	See PDF with embedded comments. See also updated spreadsheet. Changes requested consistent with comments only if the comment seeks to correct inaccurate information. Other comments are for the author(s) to consider. Note: The USGS and the GSI reports seem to be playing down the amount of groundwater that is pumped from domestic wells. I think it should be addressed scientifically given the uncertain impact of exempt uses. I would think that 6 months out of the year all of the domestic irrigation adds up to a small irrigation district (area and duty wise) and the amount of people who are on domestic wells probably is getting close to the population of Redmond (depending upon the size of the study area). I would think that domestic well users use significantly more than their city counterparts due to the relative cost of water.
	TECHNICAL MEMORANDUM - Water Right, Legal and Policy Opportunities and Impediments for Stored Water (Task 2, Part 2)	Evaluates potential water right opportunities for managing reservoirs to increase streamflow in the Upper Deschutes outside of irrigaiton season and to establish mitigation credits (note: Task 2, Part 1 was not implemented per BSWG decision as additional information became available).	Yes	See PDF with embedded comments. Changes requested consistent with comments only if the comment seeks to correct inaccurate information. Other comments are for the author(s) to consider.
	TECHNICAL MEMORANDUM - Water Right, Legal and Policy Opportunities and	Explores potential ways to move water rights and/or water supply to meet various needs.	Yes	See PDF with embedded comments. Changes requested consistent with comments only if the comment seeks to correct inaccurate information. Other

Topic	Document	Information Provided	Previous Review?	Comments
	Impediments Associated with Options for Water Movement (Task 4)			comments are for the author(s) to consider.
	TECHNICAL MEMORANDUM - Water Right Opportunities and Impediments for New or Expanded Reservoir Storage (Task 5)	Identifies opportunities and impediments for new or expanded water storage from a water rights/legal perspective.	Yes	Comments for consideration by the author(s) – no changes requested. Pg. 5 Rules regarding multi-purpose storage. This is best treated as a policy statement. Suggest moving up to Introductory paragraphs. Pg.5 end of page "Finally, the Deschutes Basin Program rules…" Move statement up to Basin Program on pg. 3. It is not other rules of the Commission. Note: This document could be written similarly to Task 2 - describing the need for new or expanded reservoir storage, process (policy, water availability, etc), barriers, and recommended policy changes. The water rights primer may not be the best use of time and space here.
	TECHNICAL MEMORANDUM - Supply and Demand of Deschutes Groundwater Deschutes Basin Groundwater Mitigation Credits (Task 6)	Evaluates the projected supply of, and demand for, mitigation credits for allowing new uses of groundwater.	Yes	Minor editorial comments, please address. See attached PDF.
	TECHNICAL MEMORANDUM - Whychus Creek Water Right, Legal and Policy Opportunities and Impediments (Task 3)	Considers potential groundwater-surface water exchanges and below ground storage opportunities in the Whychus Creek basin.	Yes	Follow-up discussions with GSI. Revised memo forthcoming.

Topic	Document	Information Provided	Previous Review?	Comments
Hydrologic Forecasting Improvements	TECHNICAL MEMORANDUM - Current Hydrologic Forecasting, Potential Improvements, and Next Steps	Evaluation of opportunities for improvements in hydrologic forecasting approaches that could enhance water management operations in the Upper Deschutes and Crooked River basins.	Yes	See PDF with embedded comments. Changes requested consistent with comments only if the comment seeks to correct inaccurate information. Other comments are for the author(s) to consider. Note: From my scientific perspective, new SNOTEL or even ASO are going to give a small to moderately improved view of a particular water year, during the water year and thus will not provide a forecast as much as a near real time cast. This is useful but not near where we would ultimately like to be in my opinion. Because there is some storage buffering ability (e.g., annual storage carry over in years of precip excess) in the reservoirs and Upper Deschutes aquifer, availability from one year to the next is also dependent on precipitation trends over multiple years. Thus, examining the accuracy of longer-term forecasting could add the most beneficial predictive information to water managers.
	TECHNICAL MEMORANDUM - Upper Crooked River Basin SNOTEL	Evaluates potential opportunities for improving hydrologic forecasting that could enhance water management operations; explores possible sites for additional snow telemetry stations in the Upper Crooked River basin.	Yes	Minor editorial comments, please address. See attached Word Doc.
Improved Gaging of Diversions	TECHNICAL MEMORANDUM - Crooked River Diversion Gaging	Evaluates potential opportunities for improving water management by installing additional gaging on Crooked River diversions below Prineville Reservoir.	Yes	See Word Doc with embedded comments. Changes requested consistent with comments only if the comment seeks to correct inaccurate information. Other comments are for the author(s) to consider.
Potential Storage Enhancement	TECHNICAL MEMORANDUM - Prineville Reservoir	Evaluates the potential for enhancing storage at Prineville Reservoir via	No	Very minimal review only. Comments for consideration by

Topic	Document	Information Provided	Previous Review?	Comments
through Flood Control Operations	Operating Rule Curve	modifications to the rule curve guiding flood control operations.		the author(s) – no changes requested.
Multi-Criteria Evaluations	TECHNICAL MEMORANDUM - Multi-Criteria Evaluation of Alternatives and Scenarios	Summarizes criteria developed by the BSWG for evaluation of potential water resource management tools; evaluates potential water management tools and hypothetical scenarios relative to the identified criteria.	No	Comments for consideration by the author(s) – no changes requested. Note: Very well written. This provides a good alternatives analysis, but doesn't necessarily help the basin figure out where to start and how to make that decision.
Technical Sufficiency Review	Technical Memorandum: Summary of Technical Sufficiency Reviews, Upper Deschutes River Basin Study (*in process*)	Provides comments received from technical reviewers on Basin Study technical documentation; includes descriptions of how comments are addressed in the Basin Study report.	N/A	N/A
Basin Study Work Group	Basin Study Work Group Charter	Defines the purpose, structure, and processes for the Basin Study Work Group (BSWG) as agreed to by the BSWG Steering Committee.	N/A	N/A
Basin Study Administration	Memorandum of Agreement: Deschutes Basin Board of Control and Reclamation	Establishes the terms guiding performance of the Basin Study and the associated cost-share responsibilities between the Deschutes Basin Board of Control (acting as the fiscal agent for the BSWG) and Reclamation.	N/A	N/A
Study Scope, Schedule & Budget	Plan of Study	Sets forth the planned scope, schedule & budget for the Basin Study; tasks to be addressed within the fixed budget were evaluated and agreed upon by the BSWG	N/A	N/A