BUREAU OF RECLAMATION

Upper Red River Basin Study

Appendix N: Peer Review Report

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

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.

Peer Review Report

Scientific Information in Support of the Upper Red River Basin Study (URRBS), Oklahoma

Date

December 9, 2022

Originating Office

Bureau of Reclamation, Arkansas-Rio Grande-Texas Gulf Coast Region, Oklahoma-Texas Area Office

Reclamation Roles

Director or delegated manager: Brent Esplin, Regional Director, Missouri Basin Region, Bureau of Reclamation

Peer Review Lead: Subhrendu Gangopadhyay, Civil Engineer, Technical Service Center, Bureau of Reclamation

Study Manager: Collins Balcombe, Supervisory Program Coordinator, Arkansas-Rio Grande-Texas Gulf Coast Region, Oklahoma-Texas Area Office, Bureau of Reclamation

Peer Review Scope

The URRBS was conducted through a partnership with the Oklahoma Water Resources Board (OWRB), Lugert-Altus Irrigation District, and Mountain Park Master Conservancy District. The overall purpose of the URRBS was to identify strategies that improve the reliability of irrigation, municipal, and industrial supplies from the Bureau of Reclamation's (Reclamation) Lugert-Altus and Tom Steed Reservoirs, while also maximizing overall beneficial use of water in the basin. Under state water law, when "interference" occurs (during a critical drought), senior water right permit holders have priority over junior permit holders. One of the key goals of the URRBS was to identify a range of parameters and thresholds that could initiate curtailment to minimize interference on reservoir permits. OWRB could further consider, after completion of the URRBS, incorporating this science-driven approach into OWRB's permitting and enforcement procedures within the basin.

Scientific information in support of this goal entailed the development and integration of ground and surface water models that quantified reservoir yield, as well as the magnitude and frequency of surface water permit shortages within the basin under a range of current and future water rights management scenarios, both ground and surface water. Reservoir yield and surface water permit shortages

were first quantified under a range of "status quo" management scenarios (i.e. consistent with existing water law, policy, and/or practice). These impacts were then compared to impacts that would be expected under future adaptation strategies that incorporated pre-determined thresholds intended to minimize interference during periods of drought. When reached, the threshold(s) could trigger the curtailment of surface water diversions that are junior to the more senior rights, including those to water stored in Reclamation reservoirs. If implemented, these thresholds may minimize "interference", reduce uncertainty, and protect reservoir yield while maximizing beneficial use during drought periods.

Reclamation's Policy CMP P14, "Peer Review of Scientific Information and Assessments", requires an evaluation of whether scientific information to be disseminated by Reclamation must be peer reviewed. The models, analyses, and findings produced by Reclamation have the potential to change water policy and inform regulatory decision-making by the OWRB, and thus, is considered to be **"influential" scientific information** pursuant to Section 4.A. of CMP P14.

The scientific information supporting the URRBS that was subjected to peer review under CMP P14 comprised of seven technical memorandums (TMs). Four of the seven TMs were the subject of a peer review plan that was published on Reclamation's peer review website[1] in February 2021; two TMs were the subject of a peer review plan that was published in July 2021. The final TM was the subject of a peer review plan that was published in March 2022. The list of TMs and responsible peer reviewers is provided below under "Peer Reviewers".

The reviewers were asked to provide comments solely on the scientific information being reviewed, and not on any agency decision or policy, and not on editorial mistakes, if applicable. The reviewers were asked to answer the following questions for the TMs, and if the reviewer had a concern or suggested improvement, the reviewer was asked to provide recommendations on actions that could be taken to alleviate those concerns for each of the following:

1. Are the goals, definitions, methods, and results understandable?

2. Are the methods technically sound?

3. Are methods appropriately applied and results technically sound?

4. Are assumptions and uncertainties appropriately characterized?

5. Are there any issues, concerns, or suggestions that are not covered by the questions above?

[1] https://www.usbr.gov/main/qoi/peeragenda.html.

Peer Reviewers

Peer reviewers were not involved in any manner with development of the scientific information supporting the URRBS. Reviewers were selected based on their education and subject matter expertise in hydrology and hydroclimate data analysis, water resources planning and management, and/or water resources decision-support analysis.

Three reviewers were selected for this peer review and are listed below, along with the respective TM(s) for which each reviewer had responsibility:

Peer Reviewer No. 1

Joseph Kasprzyk, PhD, University of Colorado Boulder

- Dr. Kasprzyk is an associate professor in the Civil, Environmental, and Architectural Engineering Department at the University of Colorado Boulder. His research focuses on multi-objective decision making and model diagnostics for engineering problems. Dr. Kasprzyk has over nine years of experience focusing on water resources planning and management, environmental engineering applications, and advancing methodological contributions to decision making and optimization under uncertainty.

Peer Reviewer No. 1 was responsible for reviewing the following TMs:

1. North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014: This TM described development of a stream system water budget using naturalized flows, with reported water use and reservoir data incorporated, as inputs. Natural flows are adjusted by simulated changes in base flows from connecting aquifers as calculated under various scenarios by the NFRR aquifer model2. The model also simulated uses of water rights and the operation of major reservoirs in the basin according to historical, current, or expected water use conditions and operating rules.

2. North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018. This TM provided an update of the NFRR stream water model system, including an extension of the model period, as well as documentation of the newest data incorporated into the model and model scenarios.

3. Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019: This TM described the approach, assumptions, and modeling

[2] The groundwater model has already been subjected to USGS peer review and is not included in this Peer Review Plan. The model and findings can be found at: Smith, S.J., Ellis, J.H., Wagner, D.L., and Peterson, S.M., 2017, Hydrogeology and simulated groundwater flow and availability in the North Fork Red River aquifer, southwest Oklahoma, 1980–2013: U.S. Geological Survey Scientific Investigations Report 2017–5098, 107 p., https://doi.org/10.3133/sir20175098.

results related to the impacts of "status quo" water rights management in the Lugert-Altus Reservoir hydrologic basin. Results included status quo impacts on Lugert-Altus Reservoir inflow and reservoir storage, as well as the magnitude and frequency of water availability for all surface water permits in the basin.

4. Impacts of Status Quo Management on Water Availability in the Tom Steed Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019: This TM described the approach, assumptions, and modeling results related to the impacts of "status quo" water rights management in the Tom Steed Reservoir hydrologic basin. Results included status quo impacts on Tom Steed Reservoir inflow and reservoir storage, as well as the magnitude and frequency of water availability for all surface water permits in the basin[3].

Peer Reviewer No. 2

Tiantian Yang, PhD, University of Oklahoma

- Dr. Yang is an assistant professor in the Department of Civil Engineering and Environmental Sciences at the University of Oklahoma. Dr. Yang's areas of focus include water resources management, reservoir operation and optimization, coupled natural and human systems, and machine learning predictive models and their applications to emerging problems related to water-energy nexus. He has over seven years of research experience in reservoir operation, hydropower modeling, water system decision making, and optimization algorithms for real-time control.

Peer Reviewer No. 2 was responsible for reviewing the following TMs:

1. Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project. This TM described data sources, methods, and records used to develop the RRY model. This included the inputs (e.g., inflow, precipitation) and outputs (e.g., evaporation, sedimentation, deliveries) used to simulate reservoir yield and water supply dependability.

2. Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project. This TM described data sources, methods, and records used to develop the RRY model. This included the inputs (e.g., inflow, precipitation) and outputs (e.g., evaporation, sedimentation, deliveries) used to simulate reservoir yield and water supply dependability.

Peer Reviewer No. 3

Greg McCabe, PhD, United States Geological Survey (USGS)

[3] Due to the similarity between the Tom Steed Reservoir TM and the Lugert-Altus Reservoir TM, the reviewer only provided comments on the Tom Steed Reservoir TM, recognizing that the comments on the former TM applied to the latter TM.

Dr. McCable is a research physical scientist with the USGS, as well as an adjunct professor at the University of Denver and the Metropolitan State College of Denver. His research interests include hydroclimatology, climate variability and change, synoptic climatology, climate teleconnections, and hydrologic modeling. Dr. McCabe has over 34 years of experience in hydroclimatic research at the USGS and currently serves as the team leader for the Earth Systems Modeling Branch of the Integrated Modeling and Prediction Division.

Peer Reviewer No. 3 was responsible for reviewing the following TM:

1. "Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin": This TM described the approach, assumptions, and methods for selecting a range of hydrologic indicators and thresholds that could be used to manage stream water rights in the basin and to protect the yield of Tom Steed Reservoir during drought periods.

Summary of Reviewer Comments and Reclamation Responses

Peer Reviewer No. 1.

North Fork Red River System Model Summary Report, by AMEC Environmental and Infrastructure, Inc. for OWRB, dated 2014

1. **Are the goals, definitions, methods, and results understandable?**

Overall, I found the report to be understandable and the methods are clearly conveyed. Some minor general comments may help increase the accessibility of the report. I found some confusion when the study domain was presented, between HUC-12 watershed names and how they were identified in the initial figures. I discuss this in the line-by-line Excel sheet.

Response: Given the nature of your comments and to improve overall clarity, the study team decided to prepare and publish a 2021 North Fork Red River Surface Water Allocation Model Technical Memorandum (2021 NFRR SWAM TM) that combines relevant information from both the 2014 AMEC TM and the 2018 Lynker TM, while also updating all applicable data sources, assumptions, and methods to fit the context of the Upper Red River Basin Study (URRBS). The 2021 NFRR SWAM TM is referenced throughout in the accompanying Excel files that document our comment responses for both the 2014 and 2018 TMs. That said, the 2021 NFRR SWAM TM will provide a clearer and consistent description of the model domain.

The report lacks a conclusions section, making it difficult for me to fully articulate what is considered a "result" of the model versus the model setup. Results in the appendices focus on average monthly conditions, so it is not clear how the model simulated the time evolution of results over the study time horizon. Otherwise, the model setup and goals are understandable.

Response: The 2021 NFRR SWAM TM will provide an introduction and a conclusion that discusses the purpose of this TM in terms of supporting both OWRB's water resource management planning decisions and technical analyses and results in the URRBS report. The 2021 NFRR SWAM TM will describe the data sources, domain, methods, and assumptions used in development of the NFRR SWAM. Results of the NFRR SWAM in terms of impacts of future water development scenarios on water availability are provided in Chapter 6.4 of the URRBS report. Results of the NFRR SWAM in terms of impacts of adaptation/mitigation strategies are provided in Chapter 8 of the URRBS report, as well as in a separate TM "Impacts of Water Rights Management on Water Availability in the Tom Steed Hydrologic Basin. The latter TM will be the subject of a separate peer review as part of the URRBS.

2. **Are the methods technically sound?**

The model uses a monthly timestep, obviating the need for routing or detailed travel time calculations. The authors have validated the results of the model with respect to historical information, and clearly documented assumptions associated with the flow naturalization. Therefore, I find the results technically sound.

No response needed.

3. **Are methods appropriately applied and results technically sound?**

The methods seem to be appropriately applied. The results focus on the Nash Sutcliffe Efficiency of the model versus observed data, which appear technically sound. As mentioned earlier, there is a lack of information about how the model results change over the whole study time horizon.

Response: Per the response to comment No. 1, the 2021 NFRR SWAM TM will clarify that water availability modeling results can be found in the locations previously cited.

4. **Are assumptions and uncertainties appropriately characterized?**

The authors could clarify their methodology around reservoir evaporation. In the report there seem to be some contradictory statements about evaporation, which could be cleaned up by minor edits.

Response: The 2021 NFRR SWAM TM will ensure that the methods used to calculate reservoir evaporation are clear and consistent.

Assuming no climate change is common in a study like this, but the authors did not adequately convey that assumption. I also had some confusion about whether the model is projecting into the future or only looking at historical information (although the time horizon is reported clearly at some points, there is also some language about projecting into the future that could be confusing).

Response: The 2021 NFRR SWAM TM will clarify that all modeling results are projections of future conditions in the year 2060. The purpose of the 2014 TM was not to provide modeling results in terms of water availability in the URRB study area. Future water availability results under baseline climate conditions (where future climate emulates the past) is provided in Chapter 6.4 of the URRBS report. In comparison with baseline climate conditions, the URRBS also evaluated the impacts of future climate variability and climate change on future water availability in the Lugert-Altus and Tom Steed hydrologic basins. The methods and results of the climate change analysis can be found in Chapter 9 of the URRBS report. This was done by modifying the inflow sequences developed by the NFRR SWAM based on three future climate change scenarios, and then simulating the modified inflow sequences using Reclamation's reservoir yield models.

5. **Are there any issues, concerns, or suggestions that are not covered by the questions above?**

My full comments can be found in the Excel line-by-line report. I have no other issues, concerns, or suggestions.

Comment responses can be found in the Excel file.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	5	Sec. 1.2	*"An additional uncertainty arises" … I found it curious to mention the future activities of permit holders, when the model does not appear to be projecting into the future. The authors should clarify this point when discussing the time horizon later.*	The model is projecting future conditions (year 2060) based on a range of future ground- and surface water development scenarios. The 2021 NFRR SWAM TM will clarify that the model is simulating future conditions.
Peer Reviewer No. 1	7		*There may be a disconnect between how the HUC units were explained in the text on page 5 versus how watersheds were labeled on the figure. Although the watersheds are named HUC-12 on the figure, there are 8 digit identifiers given. The names of the watersheds are also not named. It may also be helpful to quickly remind the reader that the HUC system is hierarchical and the whole watershed is one level of HUC, and inside of it are the HUC-12 basins.*	The 2021 NFRR SWAM TM will provide a clearer and consistent description of the model domain and ensure consistency of nomenclature.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	8	Sec. 2.1	*I'd like to see a clearer explanation of the climate change assumption here. The authors say that flows are uncertain due to climate change, but that the traditional approach is that historical flows represent future conditions. It would be clearer to explicitly say that they are not assuming climate change in this study. Otherwise it wouldn't be enough to simply use naturalized flows, since the timing and magnitude of flow will change as well.*	The 2021 NFRR SWAM TM will clarify that all modeling results are projections of future conditions in the year 2060. The purpose of the 2014 TM was not to provide modeling results in terms of water availability in the URRB study area. Future water availability results under baseline climate conditions (where future climate emulates the past) is provided in Chapter 6.4 of the URRBS report. In comparison with baseline climate conditions, the URRBS also evaluated the impacts of future climate variability and climate change on future water availability in the Lugert-Altus and Tom Steed hydrologic basins. The methods and results of the climate change analysis can be found in Chapter 9 of the URRBS report. This was done by modifying the inflow sequences developed by the NFRR SWAM based on three future climate change scenarios, and then simulating the modified inflow sequences using Reclamation's reservoir yield models.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	9		*The CRAM acronym should be defined.*	The 2021 NFRR SWAM TM will be sure to define the CRAM acronym.
Peer Reviewer No. 1	9		*The authors say that the objective function is "cost" of all flows in the system, but it would help to say a little more about this. How is that cost function defined?*	The 2021 NFRR SWAM TM will elaborate on the "cost" objective function.
Peer Reviewer No. 1	13	Table 1	*More clarity should be given between scenario 0 and 1. I had to look very carefully and noticed only one word difference between the two descriptions. These scenarios do not really seem to appear anywhere else in the report; some clarifying text about these scenarios would help contextualize them.*	The 2021 NFRR SWAM TM will clarify that the model was not set up only to operate with the five model scenarios cited in Table 1. In fact, the URRBS did not evaluate Scenarios 0, 1, or 3. The URRBS evaluated an entirely new set of scenarios as described in Chapter 6.2. The 2014 TM's purpose was not to directly support the URRBS modeling scenarios, but rather, to describe the data, methods, and assumptions of the NFRR SWAM and support OWRB's general analyses in the basin that may support water resource planning decisions that may be beyond the URRBS scope. The 2021 NFRR SWAM TM will provide information in the appropriate context of the URRBS.
Peer Reviewer No. 1	14	Table 2	*The subscripts a and b are not referenced in the above table.*	The 2021 NFRR SWAM TM will make reference to both subscripts.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	16, 18	Table 3 and 4	*Earlier, the authors mention they have pan evaporation data; when Table 3 and 4 are presented, the evaporation rate somewhat implies that the evaporation was measured directly at the reservoir. Which is the source of evaporation data? And if the pan evaporation was used, what was the coefficient used to calculate the actual evaporation rate? (see below for question about Section 6.3 as well)*	The 2021 NFRR SWAM TM will clarify the source of evaporation data. For the post-reservoir-construction model period, reservoir evaporation losses were calculated by multiplying monthly pan evaporation measurements by a free surface coefficient factor of 0.7 to obtain a monthly net evaporation rate for the reservoir. The monthly net evaporation rate was then multiplied by the reservoir surface area to obtain monthly evaporative losses out of Lugert-Altus and Tom Steed Reservoirs. For the pre-reservoir-construction model period, evaporation was calculated through a combination of linear regression with measured evaporation at nearby weather stations and/or by adjusting post-construction evaporation with pre-construction recorded precipitation. A more detailed description of how reservoir evaporation was calculated can be found in the two TMs related to the reservoir yield models developed by Reclamation in support of the URRBS. Those TMs are being peer reviewed by a separate peer reviewer(s).

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	18	Sec 3.4	*I was confused by not using the Bretch Diversion Canal in naturalization. Could the authors give a brief comment on the relative magnitude of diversion? I got the impression it was a small number but it might be good to spell that out. Perhaps there can be a mention of Section 6.5 that seems to explain this better.*	While the initial development of the NFRR model did not include the Bretch Canal data, the 2018 naturalization update did incorporate these data. Bretch diversions range from 10 cfs (minimum divertable flows) to 1,000 cfs (maximum diversion).
Peer Reviewer No. 1	23	Sec 5.0	*The authors should clarify the implication of the different start dates in the subsequent table of stream gauges (Table 7). In the text it just says "covering the period from 1950 to 2012" but obviously some gauges start much later. It appears as though this information is provided in the Appendix, individually for each gauge, but I'd like to see the general philosophy discussed in the main text.*	The 2021 NFRR SWAM TM will clarify the implication of the streamgage records cited in Table 7. Also, clarification will be provided on which of the streamgages cited in this report were necessary for the URRBS.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	27	Sec 6.2	*The sentence "this assumption is virtually certain to be strictly false", while true, could be problematic down the road. If possible, it would be interesting to know what percentage of inflow is generated in Texas, which could obviate concerns that Texas water management will be impactful in this model.*	The 2021 NFRR SWAM TM will provide a more defensible explanation on why water management in Texas was assumed to have no impact on NFRR hydrology in Oklahoma, and subsequetly on water availability in the Lugert-Altus and Tom Steed hydrologic basins. An explanation also is provided in Chapter 1.2 in the URRBS report. According to the Texas Region A Water Plan (draft TWDB, 2021), which encompasses Subbasin I of the Red River Compact which includes tributaries to the NFRR, little to no growth is projected in this area within Texas, water supplies are provided almost exclusively by groundwater, and development of surface water supplies are not anticipated. Therefore, it was assumed that no impacts would occur from Texas-based development upstream of either Lugert-Altus Reservoir or Tom Steed Reservoirs, and no further collaboration with Texas-based entities was required for the URRBS.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	27	Sec 6.3	*"Reservoir evaporation cannot be measured" -- it can? I don't think you need this comment. And, this might effect my above comment about evaporation rates that are provided in previous tables without context.*	The 2021 NFRR SWAM TM will remove that statement and clarify how evaporation is measured and accounted for in the model. A more detailed description of how reservoir evaporation was calculated can be found in the two TMs related to the reservoir yield models developed by Reclamation in support of the URRBS. Those TMs are being peer reviewed by a separate peer reviewer(s).
Peer Reviewer No. 1	27	Sec 6.3	*Was there adjustment of the pan evaporation rates, given that the energy balance of a pan is different than a reservoir? Also I am assuming that the monthly evaporation rate was assumed to not change over the years in the simulation (even though it seems as though the authors had time-varying evaporation that could be used in the historical analysis)*	Yes. As stated in the comment response above, the 2021 NFRR SWAM TM will clarify how reservoir evaporation losses were calculated.
Peer Reviewer No. 1	29	Sec 6.6	*It might be good to explicitly remind the reader that the *annual* demands are changing but the monthly *pattern* is always assumed to be the same. The text wasn't clear on this point, in my opinion.*	The 2021 NFRR SWAM TM will make it clearer that the monthly demand pattern remains unchanged.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	31	Bottom of Page	*I'm not sure the sum notation is needed in the naturalized flow equation, since the terms are already added and subracted from another. Usually the sum notation is used when those terms are repeated over another domain, for example if all the gauges are somehow added together.*	The 2021 NFRR SWAM TM will make sure to remove the sum notation.
Peer Reviewer No. 1	32		*A minor confusion on the idea that "changes in reservoir storage and reservoir evaporation volumes calculated from end of month reservoir storage values", given the comments about not being able to measure evaporation. My suggestion would not be to repeat the evaporation calculation approach on this page, since it is mentioned elsewhere in the report.*	The 2021 NFRR SWAM TM will clarify how evaporation is measured and accounted for per the response provided above. The paragraph cited by the reviewer will be removed from this section.
Peer Reviewer No. 1	36		*When discussing Nash-Sutcliffe Efficiency for scenarios, the authors may want to use the scenario numbers from earlier, for consistency.*	The 2021 NFRR SWAM TM will cite scenario numbers appropriately.
Peer Reviewer No. 1	38		*I was surprised there was not a conclusion section? Even just a few sentences would wrap up the report nicely.*	The 2021 NFRR SWAM TM will provide an introduction and a conclusion that discusses the purpose of this TM in terms of supporting both OWRB's water resource management planning decisions and technical analyses and results in the URRBS report.

North Fork Red River System Model Summary Report, by AMEC Environmental & Infrastructure, Inc. for OWRB, dated 2014				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	62, 64	Figure A13, A15	*The purple lines on these graphs seem to be missing? If it turns out they are just underneath the red line, a comment should be made in the caption to alert the reader to this.*	The 2021 NFRR SWAM TM will take this into account and address accordingly.
Peer Reviewer No. 1	74	Figure A25	*A bigger legend would help, indicating the differences between circles and squares.*	The 2021 NFRR SWAM TM will take this into account and address accordingly.

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.

1. **Are the goals, definitions, methods, and results understandable?**

The purpose of the report is to explain the updating of the North Fork Red River Model (NFRR) to include the years up to 2016, enhance some of the technical capabilities of the model, and add usability tools including better generation of multiple scenarios. For the most part, the goals, definitions, methods, and results are understandable and follow some of the same conventions as the 2014 report. Having read the 2014 report, it is interesting to contrast the two reports. There are aspects of the current report that require reading the original report, and I commend the authors for pointing readers to the earlier report. Some details here about the improved modeling are provided very concisely, and this could make it difficult for someone to follow the logic. I've tried to focus on this limitation in my line-by-line comments. This report goes into more detail about options within the Excel model, which can be useful. The report falls short of being a comprehensive user manual for the model, though. So depending on the desired properties of this document, the authors may want to think about clarifying how to access those documents in a footnote to this report.

Response: Given the nature of your comments and to improve overall clarity, the study team decided to prepare and publish a 2021 North Fork Red River Surface Water Allocation Model Technical Memorandum (2021 NFRR SWAM TM) that combines relevant information from both the 2014 AMEC TM and the 2018 Lynker TM, while also updating all applicable data sources, assumptions, and methods to fit the context of the Upper Red River Basin Study (URRBS). The 2021 NFRR SWAM TM is referenced throughout in the accompanying Excel files that document our comment responses for both the 2014 and 2018 TMs.

2. **Are the methods technically sound?**

I was favorably impressed by some of the new modeling techniques in this report. It was nice to see the use of hydrologic modeling to fill in gaps from problematic gauges. The new area-volume curves are likely more accurate. The improved scenario analysis will enable different modeling studies that help with the overall project. Overall, the methods do seem to be technically sound. My main comment is to clarify several methodology-related items that are enumerated in my line-by-line comments.

No response needed.

3. **Are methods appropriately applied and results technically sound?**

Overall, the methods appear appropriate. The improvements within this report make the study even better, relative to the initial 2014 study. I liked seeing full timeseries plots of reservoir storage, which helps alleviate my comment on the initial report that it only focused on monthly average information rather than showing evolution throughout the entire time horizon. My only main concern about the results section is that the NSE values are so high! There was insufficient information in the report to explain how the calibration happened, and I am somewhat concerned that the extremely high NSE values have something to do with a "perfect foresight" issue where too much information is exposed to the model, allowing it to exhibit nearly perfect performance.

Response: Naturalized flows were developed using observed demands and reservoir storage; the high NSE scores account for the fact that the historical scenario, which was ran for validation purposes to identify errors or data gaps, incorporated the same data as those used to develop the naturalized scenario. That said, a discussion will be included in the 2021 NFRR SWAM TM to better explain the validation process and interpretation of results.

4. **Are assumptions and uncertainties appropriately characterized?**

As mentioned above, a clearer treatment of the calibration would help show sources of uncertainty in the data. I have also included several minor line-by-line comments about assumptions; for example, one of the new area-volume curves for the reservoirs seems to suggest a reservoir expansion, which is not fully explained. Otherwise, assumptions and uncertainties are appropriately characterized.

No response needed.

5. **Are there any issues, concerns, or suggestions that are not covered by the questions above?**

The above comments and my line-to-line feedback summarizes all of my issues, concerns, and suggestions. There are no further comments.

No response needed.

2018 AMEC Report

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	5		*This figure doesn't seem like it belongs within the table of contents?*	The 2021 NFRR SWAM TM will take this comment into account.
Peer Reviewer No. 1	6		*As I mentioned in the original report, I don't think the summation sign is needed in the equation.*	The 2021 NFRR SWAM TM will take this comment into account.

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	8	Figure 1	*In this version of the figure, I am still somewhat confused by how the basins are named. I also noticed that the Texas areas are not plotted in a different color here. Was there a different assumption about Texas made here versus in the 2014 report? Overall, it could just be that the naming convention for USGS gauges is different than the HUC watersheds. But if I need clarification on that point, I'm sure the general readership would too.*	The 2021 NFRR SWAM TM will ensure consistency in nomenclature of HUC watersheds. The assumption regarding the lack of future water resources development in Texas affecting future hydrology in the NFRR basin remains unchanged. Per the comment response provided for the 2014 AMEC NFRR SWAM TM, according to the Texas Region A Water Plan (draft TWDB, 2021), which encompasses Subbasin I of the Red River Compact which includes tributaries to the NFRR, little to no growth is projected in this area within Texas, water supplies are provided almost exclusively by groundwater, and development of surface water supplies are not anticipated. Therefore, it was assumed that no impacts would occur from Texas-based development upstream of either Lugert-Altus Reservoir or Tom Steed Reservoirs, and no further collaboration with Texas-based entities was required for the URRBS. A more thorough description of Texas hydroogy is provided in Chapter 1.2 of the URRBS report.

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	10	Figure 2	*Similar to the above comment, the 2014 report made it clear that there were broader assumptions made about Texas contributions to flow. Here, the VIC cells include parts of the watershed that are within Texas. I agree with the approach, but I wonder if this isn't worth mentioning. This discrepancy could mean that there is a different assumption about contributing area about only one of the watersheds in Texas, whereas the other Texas watersheds are treated the same as in the 2014 report.*	All Texas watersheds were treated the same. The report has been revised to remove the perception of a discrepancy with how the Texas watersheds are treated in the model. See comment above for details.
Peer Reviewer No. 1	10	Section 2.3	*When the authors mention "new" elevation-area-volume curves, do these represent new assumptions about the reservoir (such as sedimentation) or are they just more accurate than the ones used before?*	For Lugert-Altus Reservoir, the 2007 sediment survey was used. For Tom Steed Reservoir, the 2009 sediment survey was used. The term "new" is referring to specific sediment conditions applied to the curves for the analysis that were determined during the model calibration process to ensure consistency between the models. A more detailed description on the development of elevation-area-volume curves is provided in the two TMs related to the reservoir yield models developed by Reclamation in support of the URRBS. Those TMs are being peer reviewed by a separate peer reviewer(s).

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	10	Section 2.3	*What is the assumed rate of sedimentation? How is this assumption justified?*	The report has been revised to elaborate on the source and justification for sedimentation rates. The sedimentation rate used for Lugert-Altus Reservoir was 414 acre-ft/yr, and the rate used for Tom Steed Reservoir was 165 acre-ft/yr. These rates are based on the 2007 and 2009 sediment surveys, respectively.
Peer Reviewer No. 1	10	Section 2.3	*The authors comment on evaporation here, which might address some of my questions in the 2014 report. The current report says "observed pan evaporation rates were used"; does this imply that the pan evaporation is actually variable from year-to-year (unlike in the 2014 report)?*	Yes, monthly pan evaporation rates are variable over the period of record. When available for the post-reservoir-construction model period, pan evaporation measurements were used to calculate evaporation losses out of the reservoir. For the pre-reservoir-construction model period, evaporation was calculated through a combination of linear regression with measured evaporation at nearby weather stations and/or by adjusting post-construction evaporation with pre-construction recorded precipitation. A more detailed description on the development of elevation-area-volume curves is provided in the two TMs related to the reservoir yield models developed by Reclamation in support of the URRBS. Those TMs are being peer reviewed by a separate peer reviewer(s).
Peer Reviewer No. 1	11	Figure 4	*For the Tom Steed Reservoir Volume-Area Curve, why does the 2060 curve extend further than the 2009 curve? Does this imply there will be an expansion of the reservoir?*	This is a mistake. The 2021 NFRR SWAM TM will show equal maximum surface areas between the reservoir volume estimates provided in 2009 and 2060.

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	12	Section 2.5	*In the section that discusses the Bretch Canal, there is a typo ("were used was used"). Beyond that minor mistake, I feel as though this typo might imply the authors were missing some words that are relevant. I'd like to see a stronger comparison of Bretch Canal between the 2014 report and the current one, since I know this was a big deal in the previous report. Where did this new or revised data come from?*	Monthly Bretch Canal diversion records were provided by the reservoir operator as part of this update. These data were used to naturalize the flows in Elk Creek since reservoir construction. Measurements of divertible flow were taken at the diversion dam and are assumed to be reduced by 5.8% due to canal losses and evaporation before reaching the reservoir. Daily flow data from the USGS gage 07304500 was used to determine the maximum divertible flow in Elk, the details of which are included in the Tom Steed Reservoir Yield Report. The 2021 NFRR SWAM TM will provide these additional details.
Peer Reviewer No. 1	14		*"Start the simulation with their historic starting contents": In the 2014, were the reservoirs assumed to be full at the beginning of the simulation?*	Yes, all model simulations assumed both Lugert-Altus and Tom Steed Reservoirs were full at the beginning of the model period. The 2021 NFRR SWAM TM will make sure this is clearly stated.
Peer Reviewer No. 1	14		*It is encouraging to see the options for Bretch Canal Diversion. The authors of the 2014 report discussed that there was no data for the conveyance capacity of that canal. Has that issue been resolved?*	Yes, it has been resolved, see comment above.
Peer Reviewer No. 1	22, 23	Figure 8 and 9	*Some lines appear to be missing? If they are overplotted, it would be good to mention that in the caption.*	The 2021 NFRR SWAM TM will take this comment into account.

North Fork Red River System Model Naturalization Update, by Lynker Technologies for OWRB, dated 2018.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 1	24	Figure 10	*I would like to see a more descriptive caption. It is unclear what we are supposed to focus on when looking at the figure.*	The 2021 NFRR SWAM TM will include a more elaborate caption that describes how groundwater demands are linked to groundwater demands on mainstem HUCs. Clarity also will be provided on which HUCs were considered mainstem.
Peer Reviewer No. 1	32	Section 4.1.1	*The authors say "all gages are calibrated to a NSE value of greater than 0.95". It would be helpful to see a sentence explaining what parameters were changed within this calibration. This is mentioned in my overall report; the extremely high NSE values are somewhat surprising, especially compared to the first report. I am slightly concerned about an "overfitting" problem.*	Naturalized flows were developed using observed demands and reservoir storage; the high NSE scores account for the fact that the historical scenario, which was ran for validation purposes to identify errors or data gaps, incorporated the same data as those used to develop the naturalized scenario. That said, a discussion will be included in the 2021 NFRR SWAM TM to better explain the validation process and interpretation of results.
Peer Reviewer No. 1			*Similar to my comments about the 2014 report, I am somewhat surprised that there is not a "conclusion" to this document. I think the authors did a good job of conveying the overall modeling philosophy used in this project, but the report text is sometimes lacking because it is presented in such a concise manner (assuming people have read the other report too).*	The 2021 NFRR SWAM TM will provide an introduction and a conclusion that discusses the purpose of this TM in terms of supporting both OWRB's water resource management planning decisions and technical analyses and results in the URRBS report.

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019

1. **Are the goals, definitions, methods, and results understandable?**

This technical memorandum summarizes the results for a large modeling study, with model workflow starting at a groundwater model that feeds a water allocation model and subsequently a reservoir yield model. After setting up a series of model scenarios, the report summarizes many results that show how the reservoir yields are affected by various assumptions that occur "upstream" of the reservoir. The goals of the report are understandable (i.e., the section "Basin Study Goals"); my main suggestion is to have an entire dedicated section to summarize important definitions for the rest of the report. Sometimes in the current draft, a definition will be given in the middle of a discussion of modeling, so the reader has to switch gears and remember the definition while trying to understand something about the modeling that may be unrelated. The methods and results are also understandable; my question #4 answer presents further comment about how their presentation can be improved.

Response: This comment raises an important point that highlights a dilemma study partners faced when it was decided that certain TMs supporting the Upper Red River Basin Study (URRBS) would need to be peer reviewed by an external panel. When this TM (and the companion TM on Tom Steed) was written back in 2018, its purpose was to provide study partners, who already are familiar with context and terminology, with an executive summary of methods and results of status quo management scenarios. The rationale was that the details, including the necessary definitions/context you have pointed out, would be provided later in the full URRBS report. In fact, Chapter 6 of the URRBS report, currently under development, contains a detailed and comprehensive discussion of definitions, assumptions, approach, and results of the status quo management analysis. Recognizing that these details would be provided anyways, study partners believed it would be redundant to revise the Status Quo TMs ahead of your review to contain the appropriate level of detail you understandably seek. We apologize for any confusion this created in your review. With this in mind, any comments that require revisions, such as those provided in the line-by-line comment document, will be addressed in the URRBS report in the applicable chapter as cited in our comment responses.

2. **Are the methods technically sound?**

Because the models are documented in other reports, I will just comment on how the methods were explained within this report. In the context of this report, therefore, I believe that everything was technically sound.

No response needed.

3. **Are methods appropriately applied and results technically sound?**

Other than the comments in my line-by-line report, my only major suggestion with respect to the results is to better explain the reason why applying "seniority" to stream water use yields negligible results for some of the outputs. I could imagine readers being curious about this; giving an example in the text that explains the relative magnitudes of variables throughout the modeling chain could alleviate these potential questions.

Response: You are correct that applying "seniority" yields negligible results on water availability in Lugert-Altus Reservoir, and we agree that an example of the magnitude of variables would better explain why impacts are negligible. In Chapter 6 of the URRBS report, a discussion will be added that highlights the relatively small consumptive volume (678 acre-ft/yr) of existing streamwater permits ("Existing SW") that are junior to Lugert-Altus Irrigation District's permit of 85,630 acre-ft/yr. The reason impacts from future new streamwater permits ("Full SW") also are negligible is because, according to the naturalized streamflow dataset generated by the NFRR SWAM, water is not available for the appropriation of new streamwater permits. It is important to note that in light of the results cited above, "seniority" triggers in the Lugert-Altus Reservoir hydrologic basin have been eliminated from consideration in the URRBS. However, unlike the Lugert-Altus Reservoir hydrologic basin, results from the NFRR SWAM in the Tom Steed Reservoir hydrologic basin show that water *is (or could be)* available for appropriation of new streamwater permits. For this reason, unlike Lugert-Altus Reservoir, applying "seniority" to new permits above Tom Steed Reservoir does apply. Since publication of the Tom Steed Reservoir TM in 2018, study partners have broadened the definition of "seniority" to encompass a wide range of reservoir storage elevation, inflow, and Palmer Drought Severity Index thresholds. These thresholds are described in another TM, titled "Formulation of Curtailment Alternatives in the Tom Steed Reservoir Hydrologic Basin". This TM is being peer reviewed by a separate peer reviewer(s).

4. Are assumptions and uncertainties appropriately characterized?

I appreciate that writing a report like this can be quite challenging, since there are many assumptions and uncertainties to characterize. Having gone through the document closely, I am still confused as to the following major points that could be better explained in this document, an appendix, or similar: What is the relevance of the year 2060? Did the study assume that current trends from the historical record will continue after 2016 and then results are calculated at 2060? How do assumptions about sedimentation factor into this?

Response: The year 2060 was selected for the URRBS to be consistent with the year 2060 planning horizon incorporated into all supply and demand assessments included in the Oklahoma Comprehensive Water Plan 2012 Update. Water availability results in the URRBS were calculated under eight future ground- and stream-water development scenarios as they would manifest in the year 2060, ranging from no development (i.e., "Naturalized" scenario) to full development (i.e., "Full SW/Full GW"). Because both USGS streamgage data and reservoir storage data include the influence of historical withdrawals, withdrawals that cannot be quantified in time and space due to the absence of metered usage, those historical withdrawals are imbedded within all calculations of future water availability; therefore, in answer to your question, yes, current trends from the historical record are assumed to continue through the year 2060, albeit with the added impacts of new withdrawals as defined by the multiple ground- and stream-water development scenarios considered. Regarding sedimentation, all reservoir yield/water availability projections assumed 2060 sediment conditions.

- *What is the difference between "status quo" and "no operating rules"?*

Response: Our apologies in advance for the lack of brevity, but the details are important. First, please note that since publication of this TM in 2018, the "no operating rules" scenario is no longer considered a viable scenario for consideration in the URRBS report.

This is because the "no operating rules" does not reflect the reality of how the reservoir is managed by the Lugert-Altus Irrigation District (ID). Therefore, our response focuses solely on clarifying the definition of "status quo operating rules". The discussion below is detailed in the Lugert-Altus Reservoir yield modeling TM that is the subject of a separate peer review.

The Lugert-Altus ID holds an 85,630 acre-ft/yr agricultural irrigation permit, and the United States holds a 4,800 acre-ft/yr M&I permit for water stored in Lugert-Altus Reservoir for use by the city of Altus. Importantly, the United States M&I water right for the city of Altus water is senior to Lugert-Altus ID's irrigation water right. As such, a key variable in the model simulation relates to the method by which Lugert-Altus ID avoids interfering with the senior water right for city of Altus M&I use. In 1954, the Lugert-Altus ID and city of Altus signed a settlement agreement that requires the Lugert-Altus District to manage irrigation operations such that the District can deliver 4,800 acre-ft in any given year to the city of Altus for M&I purposes if requested, while also maintaining 10,000 acre-ft in storage at the end of each irrigation season to ensure that 4,800 acre-ft can be delivered to the city of Altus the following year. This end-of-season provision aims to ensure that sufficient storage is available to deliver M&I water in the case that conditions are dry or become dry the following year. Specifically, the settlement agreement states that "…upon completion of any irrigation run and filling of the city reservoirs (lakes), there shall remain in the Altus Dam and Reservoir a minimum of 10,000 acre-ft of active storage". To "fill the city reservoirs (lakes)" with 4,800 acre-ft of M&I water, a total of 10,000 acre-ft in storage is needed. This is because 5,200 acre ft/yr in "push" water is needed to create the necessary hydraulic head/pressure to convey the city of Altus' allotted water through the canal system. In effect, Lugert-Altus ID operates to maintain 20,000 acre-ft in storage to ensure compliance with the settlement agreement, 10,000 acre-ft of which is allocated for the current irrigation year, with the other 10,000 acre-ft allocated for the following year. Furthermore, Lugert-Altus ID's current practice is to set aside an additional 5,000 to 9,000 acre-ft to account for evaporative losses, bringing the total storage reserve to up to 29,000 acre-ft for each irrigation season. These losses are adjusted throughout the season (typically May to September) to reflect real-world climate conditions and storage volumes.

For the purposes of the URRBS reservoir yield analysis, when Lugert-Altus Reservoir reservoir storage falls below the 29,000 acre-ft threshold, irrigation is discontinued. It should be noted that this threshold was used by Lugert-Altus ID under real-world conditions during the drought of record when inflow was low and evaporation rates were high. Given this, it is considered a conservative, yet defensible assumption in the yield model; however, it should be noted that the storage threshold needed to comply with the settlement agreement changes from year to year and within the irrigation season depending on real-world conditions.

Based on the operational considerations cited above, water was considered available for irrigation only when Lugert-Altus Reservoir storage is above 29,000 acre-ft (the storage needed to protect the 4,800 acre-ft/yr of M&I water for the city of Altus).

Is there a reason why some permits are "regular," but this does not include domestic uses? Is it correct to assume that the projections assume that the future split between regular and domestic use will be maintained in the future (i.e., no large population growth that would lead to an explosion in domestic use)?

Under Oklahoma water law, streamwater is managed under a joint Prior Appropriation-Riparian system. The term "Riparian" refers to the right of smaller users to withdraw surface water for domestic and household uses without a permit. Similar to groundwater, uses above and beyond domestic purposes require a permit (either regular, temporary, provisional temporary, etc.), which are managed under a "Prior Appropriation" system. As the reviewer knows, this means that the older a permit's application date, the more "senior" the water right is relative to a "junior" water right that has a more recent application date. Under Oklahoma's joint Prior Appropriation-Riparian system, a domestic reserve is set aside in the stream and excluded from calculations made by OWRB of unappropriated surface water for new permits. It is difficult to measure the direct impacts of domestic or permitted use in the NFRR basin because Oklahoma law does not require users to meter or otherwise measure the volume of water diverted from an authorized diversion point. That said, permit holders are required to report their use to the OWRB on an annual basis which is maintained by OWRB in their water rights database.

With that context in mind, ground- and stream-water development scenarios were formulated with the purpose in mind of being able to attribute causes of the incremental impacts on water availability in the basin associated with future human development. For reasons described above in response to the comment about using the historical record, existing domestic uses are already accounted for in the historic record, and are thus accounted for in all future development scenarios. Regarding *future* domestic use, some assumptions had to be made, including zero future domestic use (such a scenario would allow one to assess the incremental impact of groundwater development combined with existing streamwater permits alone), a low volume of future domestic use, or a high volume of future domestic use. The range of future domestic use scenarios considered reflects the range in potential future population growth in the hydrologic basin. In the Lugert-Altus Reservoir hydrologic basin, regardless of population growth, modeling results show that no water is available for the appropriation of new regular steam permits.

I realize that most of this has already been covered in the report, but I just wanted to communicate lingering confusion that I still had after studying the document. Hopefully these will help with efforts to better make the assumptions clear in the text. Several comments in the line-by-line document also explicate my concerns in this area.

See responses in the line-by-line document.

5. **Are there any issues, concerns, or suggestions that are not covered by the questions above?**

The above comments and my line-to-line feedback summarizes all of my issues, concerns, and suggestions. There are no further comments.

See responses in the excel spreadsheet.

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019				
Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1	4	Modeling Approach	*I understand the general point of starting the report with a comment about generically what a "model" is, but I wonder if it adds more confusion than it alleviates. In my opinion, I see "the model" as doing two things -- trying to depict, as accurately as possible, the real world using mathematics -- and then using the model as a testbed to test different alternative management scenarios. Calling it "establishing the relationship" may make it seem like the model is doing more than it is. A model like this is simply trying to show the historical relationship at first. Then the model is put in use to do scenario analysis. If any of those ideas are useful in tweaking this language, please use them. I do like the comments about the model being based on sound scientific practices. I just wouldn't make the statement so general as to saying "multiple variables" -- Instead I might even say, "This model gives us an accurate representation of hydrology and water use, and then allows us to test new assumptions and predictions about how changing management might influence that hydrology and the sustainability of future reservoir water supplies."*	This language has been revised in Chapter 2 of the URRBS report.
Peer Reviewer No. 1	4	Modeling Approach	*I found it a little strange to have the "It is important to note" language within the third bullet point of the modeling approach (all the other bullets just cleanly mention the modeling goal). I had to go back to the previous page to*	All terminology and acronyms will be appropriately defined and contexturalized in the URRBS report. This comment and others below understandably point out the lack of context and/or clearly defined terminology. It

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Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
			*remind myself of the definition of the MAY acronym. I almost wonder if a short definitions section before Methods would be useful. For example, these definitions could be folded into "Basin Study Goals." Putting those definitions *first* would help contextualize the EPS and MAY concepts in the actual modeling bullet point. The idea of how MAY is defined (relative to the 20-year life of the basin, the saturated thickness of at least 5 feet, etc.) is not modeling per se, but rather a regulatory definition.*	highlights a dilemma study partners faced when it was decided that certain TMs supporting the Upper Red River Basin Study (URRBS) would need to be peer reviewed by an external panel. When this TM (and the companion TM on Tom Steed) was written back in 2018, its purpose was to provide study partners, who for the most part are already familiar with context and terminology, with an executive summary of methods and results of status quo management scenarios. The rationale was that the details, including the necessary definitions/context you have pointed out, would be provided later in the full URRBS report. Recognizing that these details would be provided the URRBS report, study partners believed it would be redundant to revise the Status Quo TMs ahead of your review to contain the appropriate level of detail you understandably seek. We apologize for any confusion this created in your review. With this in mind, any comments that require revisions, such as this comment and others below, will be addressed in the URRBS report in the applicable chapter as cited in our comment responses. This particular revision has been made in Chapter 2 of the URRBS report.

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Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1	5	NFRR Aquifer Model Overview	*This may just be my own confusion, but on the previous page, there is some idea that EPS is connected with a 20-year life, whereas in the fourth bullet point in this section, it is mentioned that the NFRR Aquifer model gives EPS for *different* aquifer lives. As per my previous comments, it will be very important to have a clear accurate definition of EPS somewhere prominent in the text.*	Under Oklahoma law, the EPS is each landowner's proportionate share of the aquifers maximum annual yield (MAY). The MAY is the amount of water the aquifer can provide for beneficial use in any given year in order to ensure that the life of the aquifer will be maintained at least 20 years. The key word is "at least". It is common for officials to consider longer aquier life spans (e.g., 40 and 50 years). This distinction is made clear in the URRBS report.
Peer Reviewer No. 1	6		*On the last bullet point before Figure 2, I was a little confused about the discussion of "observed hydrologic record" versus the other discussion of naturalized flow. Are these domestic uses not included in the naturalization process? I may just be reading this incorrectly. Overall, I interpret figure 2 to mean that the PT permits are not large in magnitude relative to the other permits; if it is appropriate to spell this out somewhat, it might help the reader understand better.*	Yes, existing domestic groundwater uses and existing groundwater provisional temporary permits (PTs) are included in the stream naturalized process because these withdrawals are accounted for the in the observed hydrologic record. Regarding Figure 2, you are correct that the purpose is to demonstrate the relatively small volume of existing groundwater PTs relative to existing regular groundwater permits. The same applies to domestic stream uses and to the relative volume of streamwater PTs compared to regular PTs cited in Figure 3.

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Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1	7		*"Develops a stream system water budget using naturalized flows, with reported water use and reservoir data incorporated, as inputs" This comma is confusing me. I think the sentence should say something like "Develops a stream system water budget using naturalized flows, where reported water use and reservoir data are incorporated as inputs in addition to naturalized flow" -- to convey that the water use and reservoir data are added back in to the naturalized flows.*	The language has been revised in Chapter 5 of the URRBS report to more clearly summarize the naturalization process as follows: "Develop a NFRR water budget using naturalized flows that are developed by adding evaporative losses, stream withdrawals (i.e., reported water use), changes in reservoir storage, and other losses back into the observed streamflow record." Details on the naturalization process are found in the 2014 AMEC and 2018 Lynker TMs.
Peer Reviewer No. 1	7	NFRR SWAM Scenarios	*My suggestion would be to make a table of the scenarios instead of having them in a bullet list. That would allow the authors to make sub-categories (i.e., "diversions? Yes/no" "demand data" "groundwater data" etc.) I found the bullet points hard to follow, with the many caveats included, etc. This could also help clarify that there is "Without Seniority" and "With Seniority." I realize there are other tables throughout the report, but sometimes I struggle with how the scenarios are named, so anything that can spell out the different pieces to the reader would be greatly beneficial.*	Table 2 in the subject TM summarizes the NFRR SWAM scenarios. The table will be revised to ensure scenario names (e.g., "2013 GS and Existing SW") are provided on the far left column. The revised table is provided in Chapter 6 of the URRBS Report alongside a more concise narrative of NFRR SWAM scenarios.

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Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1	9		*The text discusses that specific conditions for "Interference" are not codified in Oklamhoma law, and then it indicates that the model used a reservoir storage-based trigger. This all makes sense, but it might be helpful to clarify, in the text, the procedure that is used in the real world for triggering interference. I'd imagine it might be something that is determined somewhat qualitatively by regulators?*	The points raised in the accompanying MS Word document (i.e., small volume of existing permits junior to Lugert-Altus Irrigation District and the unavailability of streamwater for future new permits), "seniority" triggers in the Lugert-Altus Reservoir hydrologic basin have been eliminated from consideration in the URRBS. However, unlike the Lugert-Altus Reservoir hydrologic basin, results from the NFRR SWAM in the Tom Steed Reservoir hydrologic basin show that water is (or could be) available for appropriation of new streamwater permits. For this reason, unlike Lugert-Altus Reservoir, applying "seniority" to new permits above Tom Steed Reservoir applies. Since publication of this TM in 2018, study partners have broadened the definition of "seniority" to encompass a wide range of reservoir storage elevation, inflow, and Palmer Drought Severity Index thresholds. When reached, these thresholds would effectively define when interference is occurring, and thus would trigger curtailment of streamwater permits that are junior to the permit held by Mountain Park Master Conservancy District. These thresholds are described in another TM, titled "Formulation of Curtailment Alternatives in the Tom Steed Reservoir Hydrologic Basin", which is being peer reviewed by a separate peer reviewer(s). In answer to your question, procedure to implement curtailments is beyond

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Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
				the scope of the URRBS. Upon completion of the URRBS, if the Oklahoma Water Resources Board were to decide to implement these curtailment triggers, then the procedures for doing such would be developed by the Oklahoma Water Resources Board; implementation procedures would likely involve varying degrees of real-world monitoring and enforcement.
Peer Reviewer No. 1	9		*The text says that when Seniority is triggered, only "regular" users, and not domestic users, are curtailed. Is that distinction clear? I don't know that the word "regular" is obvious, but maybe it is. This underscores the importance of having clear definitions at the beginning of the text (sometimes it feels like clarifications are added in an ad hoc manner, in the current draft, in the middle of other modeling discussions).*	The URRBS report will be sure to provide definitions of all terminology with appropriate contextualization. The types of permits issued in Oklahoma are defined in Chapter 2 of the URRBS report. In answer to your question, the distinction is made clear in the URRBS report that only "regular" streamwater permits would be curtailed when seniority is triggered. Under Oklahoma law, domestic uses are exempt from permitting and therefore were considered exempt from curtailment.
Peer Reviewer No. 1	11	Figure 3	*The figure caption references the drought of record, but the text explaining this figure calls it the "2013" scenario. I'd recommend using consistent scenario naming, and referencing the formal name of the scenario in the figure caption.*	A clear and consistent nomenclature will be used in the URRBS report to describe NFRR SWAM scenarios, whether it is in narrative form or in referencing scenarios in tables and figures.

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Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1			*This might be a style preference, but I found the document's sections hard to follow sometimes. A hierarchical number style (section 2, section 2.1, section 2.1.1) may help the reader understand the hierarchy of the various sections.*	The URRBS report incorporates a hierarchical number style for all section headings as you suggest.
Peer Reviewer No. 1	13		*"Reclamation's Reservoir Yield Model calculates future reservoir storage based on computed historic inflows derived using actual observed historic reservoir levels", says the text, contrasting this with SWAM which apparently relys on "stream gage data." I don't understand how observed reservoir levels can be used to calculate *inflows* to the reservoir, since the inflows are an input, meaning the storage levels are responding to the input? I might be missing something. Another aspect of this description that is confusing is the mention of 2060 -- the 2060 date also appeared in the 2018 Lynker report and its significance was not justified.*	The text is correct but will be revised to more clearly describe the method used by Reclamation to simulate future reservoir storage/water availability. Reclamation uses reservoir elevation data recorded by HydroMet network, which collects remote field data and transmits it via satellite to provide real-time changes in reservoir storage. These data, along with other inputs and losses collected at the reservoir, are used to derive inflows into the reservoir. The observed (computed) inflow dataset can then be used to make predictions about future inflows into the reservoir based on a range of climate- and/or human-induced factors. A summary of this method is provided in Chapter 6 of the URRBS and in more detail in the two TMs related to the reservoir yield models developed by Reclamation in support of the URRBS. Those TMs are being peer reviewed by a separate peer reviewer(s). The year 2060 was selected for the URRBS to be consistent with the year 2060 planning horizon incorporated into all supply and

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019				
Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
				demand assessments included in the Oklahoma Comprehensive Water Plan 2012 Update.
Peer Reviewer No. 1	13		*The text puts a fine point on the fact that both SWAM and the Reservoir Yield model were adjusted "to simulate similar reservoir storage." I guess the idea of saying that both were adjusted means that one wasn't assumed to be "the truth" and the other was changed to match the first one. But I wonder if that wouldn't cause confusion. I guess this is the reason why the text specifies that there will be a separate explanation of this in the future.*	A robust model calibration process was performed by OWRB and Reclamation as part of the URRBS. For the Lugert-Altus Reservoir hydrologic basin, Reclamation and OWRB came to a consensus on utilizing Lugert-Altus Irrigation District's operation rules that ensure compliance with the 1954 settlement agreement in OWRB's NFRR SWAM modeling. Consensus also was made on use of Reclamation's estimates of reservoir area capacity, net evaporation, seepage, and reservoir releases. For the Tom Steed Reservoir hydrologic basin, Reclamation and OWRB came to a consensus to utilize both of the Elk Creek and West Otter Creek-Glen Creek inflow records derived by Reclamation as a "baseline flow record" into the NFRR SWAM's larger water budget, which is comprised of estimates of evaporation, consumptive demands, return flows, etc. along the stream network. Similar to Lugert-Altus Reservoir, Reclamation and OWRB also came to consensus on incorporating Reclamation's assumptions related to Tom Steed Reservoir's area capacity curve, net evaporation, seepage, and releases to ensure that the SWAM simulated reservoir storage and firm yield under a similar set of assumptions as that of

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019				
Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
				Reclamation's firm yield model. The consensus of our two agencies was important in demonstrating the validity and consistency of reservoir storage and firm yield estimates calculated by the OWRB's SWAM as part of the URRBS. What was particularly relevant too is that the baseline inflow dataset used by the SWAM to quantify inflow depletions was the same inflow dataset used by Reclamation in its firm yield calculation. This means that depleted inflows can be simulated and compared to non-depleted inflows on an "apples to apples" basis using the firm yield model. Furthermore, given that OWRB's and Reclamation's models included the same set of assumptions for calculating firm yield, the SWAM's estimate of firm yield should be similar if not identical to the estimate made by Reclamation.
Peer Reviewer No. 1	14	Table 2	*I really like this table. I wonder if the left-most column couldn't have a more succinct name, that can be referred to earlier in the text to help clarify the difference between the various "dimensions" of scenarios. This seems to be done in Table 5, for example.*	The table will be revised to ensure scenario names (e.g., "2013 GS and Existing SW") are provided on the far left column. The revised table is provided in Chapter 6 of the URRBS Report alongside a more concise narrative of NFRR SWAM scenarios.

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019				
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Peer Reviewer No. 1	15		*The third bullet point indicates the 40-year results were the same as the 50-year results. It might be useful to just say why that might be? It just seems like the 40-year number would be slightly less than the 50-year number.*	According to the NFRR aquifer report published by USGS, for the 40-year and 50-year EPS scenarios, most (90 percent) aquifer depletions occurred during the first 20 years of pumping. During that time, annual EPS pumping decreased as the thinner parts of the aquifer went dry. Annual aquifer storage changes decreased as annual EPS pumping decreased, and approximate steady-state conditions were reached after about 30 years. These approximate steady-state conditions explain why the 40- and 50-year EPS pumping rates are the same. This point has been clarified in Chapter 6 of the URRBS report.
Peer Reviewer No. 1	16	Table 3	*The columns about "Change in Base Flow" -- is this relative to the Naturalized scenario? It might be worthwhile to list that.*	Yes, the change is relative to the naturalized scenario. This has been clarified in Chapter 6 of the URRBS report.
Peer Reviewer No. 1	22	Table 5	*Some of the other tables have more footnotes, but Table 5 seems to be lacking these. One potential footnote could clarify the "no operating rules" model type, since that wasn't readily apparent to me as I was reading through. (there are a lot of scenario dimensions to keep in one's head, so the more reminding you can do, the better!)*	Since publication of this TM in 2018, the "no operating rules" scenario is no longer considered a viable scenario for consideration in the URRBS report, so it has been eliminated from consideration. This is because the "no operating rules" does not reflect the reality of how the reservoir is managed by the Lugert-Altus Irrigation District.

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019				
Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1	23	Figure 8	*It might be useful to orient readers, in the caption, to the fact that there are three rows associated with sedimentation. The sedimentation aspects of this have been a source of confusion for me.*	Chapter 6 of the URRBS report has been revised to only cite future reservoir storage in the year 2060 (i.e., we do not cite year 2016 sediment conditions of the reservoirs). More clarity also has been provided in Chapter 6 of the URRBS on the respective impacts from sedimentation versus upstream withdrawals on future storage within both Lugert-Altus and Tom Steed Reservoirs in the year 2060.
Peer Reviewer No. 1	25	Figure 10	*I appreciated the end of the caption that explains why the impacts of Seniority are negligible on Status Quo operating rules, but it may be helpful to add another sentence about No Operating Rules, since Seniority seems to have an effect here.*	Since publication of this TM in 2018, the "no operating rules" scenario is no longer considered a viable scenario for consideration in the URRBS report, so it has been eliminated from consideration. This is because the "no operating rules" does not reflect the reality of how the reservoir is managed by the Lugert-Altus Irrigation District. The reason that Seniority impacts under Status Quo operating rules are negilgible is discussed in our response to Comment No. 3 in the companion MS Word file.

Impacts of Status Quo Management on Water Availability in the Lugert-Altus Reservoir Hydrologic Basin, by Bureau of Reclamation and OWRB, dated 2019				
Report Reviewer	***Page(s) or other reference location***	***Line Number(s) if applicable***	***Comment***	***Agency Response (Reviewers leave blank)***
Peer Reviewer No. 1	30		*It may be helpful to have the results summary also include brief summaries of the methods. For example, the second bullet point touches on impacts on the NFRR aquifer that would occur "after 2060". There are some critical assumptions on how the study was carried out (i.e., what trends were assumed to continue to 2060), which will impact the validity of these projections. The reader may need to be reminded of this, at this point in the Memorandum, because there are so many moving pieces with the methodology.*	The URRBS evaluated future conditions in the year 2060. The statement referencing potential impacts beyond 2060 is not supported by the analyses and has been deleted.

Peer Reviewer No. 2

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***1. Are the goals, definitions, methods, and results understandable?*** *-The study goal is well defined. As a brief background, the inputs and outputs of the reservoir yield model for Tom Steed Reservoir have been updated over the years. It is needed to first verify the model, then to project the reservoir firm yields in the long-term future based on the changing available data and up-to-current reflections of the assumptions and judgments from both local hydrology and anthropogenic factors, such as water rights and inflow depletions due to withdraws. This report first defined four firm yield methods; described the detailed calculations and data, and provided a full spectrum analysis on the simulation results of OTAO's reservoir yield model for the Tom Steed Reservoir's long-term operation.* *-The definitions and terminologies used in this report are appropriate and easy to understand.* *-The methods are clearly described at the beginning of this report, and are further explained in later sections. The employed study scenarios (i.e., methods 1-4 per the report) differ in the study period, experiment settings, the best available data, and whether the future anthropogenic factors that being accounted.* *-Most of the key results are summarized in tabular format with some flow illustrations in figures. The presentation of the results is clear and concise. There are some minor presentation/text addition suggestions, which will further help highlight the scientific merits of the study. Please see more in specific comments.*	*No response needed*

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***2. Are the methods technically sound?*** *- The methods applied are technically sound. Four methods are defined and applied together with the Tom Steed reservoir's firm yield model. Specifically, Method 1 describes the pre-construction plan and the calculation of the firm yield from 1926-1959; Method 2 defines the pre-construction planning period from 1949-1969 to confirm the DPR's 1971 re-evaluation of the Mountain Part Project, which also extends the Method 1 study period with updated and applicable data sources; Method 3 studies the post-construction firm yield update from 1926-2016 and is designed to reflect the post-construction conditions and to account for the best available environmental data through 2016; The last Method 4 covers the same study period of 1926-2016, but it is formulated to use the depleted inflow estimates derived by OWRB with considerations of both water rights and water availability in the NFRR basin. The comparison and design of the latter two methods clearly depict the influences from anthropogenic factors over the NFRR basin, while the first two methods serve the model verification and baseline study prior to the dam construction, which is under the natural environmental forcings scenarios.* *- The applied reservoir yield model is not complicated. It is an excel-based simulation model based on water balance and existing reservoir operating rules. Though it is a simplistic model, it seems to be capable of meeting all operation and analysis requirements by the agency.*	*No response needed*

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***3. Are methods appropriately applied and results technically sound?*** *- The design of methods is subtle and well-thought. The results are technically sound and easy to understand by both subject-matter experts and non-subject-matter audiences.*	*No response needed*

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***4. Are assumptions and uncertainties appropriately characterized?*** *- The footnotes throughout the report are very useful in helping the audience understand the rationale, results, study assumptions, experiment settings, and used terminologies.* *- The main assumptions are appropriately characterized, especially for the different settings used in Method 3 and Method 4. Section 3.4 explicitly illustrates the main differences between these two important comparison scenarios, as well as the applied assumptions.* *- In the section when the reservoir firm yield model water balance equation is illustrated, it is suggested to further summarize or tabular how each inputs/outputs are obtained in different methods. Most of the technical contents are well introduced in later text. Nevertheless, a leading summary would be beneficial for the audience to get an overview of how the model inputs are obtained and how they differ from one method to another if any. Such a leading summary about all the model inputs would prevent the audience from losing the bigger picture when focusing on each detailed piece of information under each method.* *- The potential uncertainty and risk section is nicely written. The discussion thoroughly covers many natural and human-induced factors that may influence the reliability of obtained results. The additional discussion on the Bretch Diversion and Canel Expansion Alternative provides an inclusive consideration of the possible engineering and human impact to the long-term reservoir firm yield.*	*The report was revised to add a summary table of data sources and assumptions for each model variable across the four methodologies.*

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***5. Are there any issues, concerns, or suggestions that are not covered by the questions above?*** *See below comments. Some issues identified are rather minor. Fixing them will definitely increase the overall scientific illustration and presentations. None of them are critical regarding the bone of the main study and experiments. A few places may need additional explanations and clarifications. In short, there are no critical scientific questions/concerns except for some wording accuracy and presentation suggestions.*	
Peer Reviewer No. 2	viii		*The climate community acknowledges the term "GCMs" as the "General Circulation Models". The term "Global Climate Model" is an official name of General Circulation Models. Suggest revising the acronym to "General Circulation Models or Global Climate Models"*	The acronym "GCM" was a remnent from a a previous draft of the report and has been removed.
Peer Reviewer No. 2	page 1 parahragh 1		*The mentioning of "future inflow into the reservoir cannot be predicted" needs more scientific explanations and supports. The prediction of future reservoir inflow depends on how long the lead time of forcing data, as well as the uncertainty tolerance an operator can accept. There are many ways we can obtain an estimation of future reservoir inflows with the helps from the hydrologic/hydraulic model with forcings from GCMs, Numerical Weather Predictions, or statistical regression on historical data, i.e., the Ensemble Streamflow Predictions. Each approach may just differ in its accuracy and applicability over various space and time. But the methods/tools are widely available. It is suggested to reword this part of the sentence and try to be more specific on under what situations the reservoir inflow can or cannot be predicted.*	This statement was revised to reflect the general understanding that the future cannot be known with any degree of certainty.

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2	Page 4 Table 1		*In this firm yield estimates table by the four methods, it shows the reservoir firm yields are not estimated, or not applicable, i.e., Method 1 of 50 years, and 85 years; Method 2 of 85 years; and Method 4 of 50 years and 100 years. I understand the supporting sediment data are limiting the estimation per the explanations in this section. However, it seems the model shall be able to calculate a number with the prior defined annual sediment accumulation rates in different methods and periods. Were there some practical reasons or other underlying limitations that prohibit the model from estimating the firm-year at these future years in a consistent manner? It will be nice to provide additional explanations in texts or footnotes on the time consistency of model results*	The report has been revised to add firm yield estimates under the other sedimentation accumulation time frames. These estimates were footnoted as unpublished estimates.
Peer Reviewer No. 2	page 7 last paragrpah		*A minor suggestion: adding a conceptual diagram with storage maximum or elevations, showing the active conservation pool, flood control, and surcharge pool, will be more intuitive for readers to relate the physical settings/rules to the total available storage and/or key operating elevations of the Tom Steed Reservoir. If the specific elevations are classified information, an indication of the conceptual levels will be enough and helpful.*	The report has been revised to add the suggested conceptual diagram of reservoir pools, elevations, and capacities.
Peer Reviewer No. 2	page 21-22		*Per the prior suggestions, the visual illustration of the pool elevations and storage capacities will be much more intuitive to help the audience understand the physical settings and the operating limits of the Tom Steep Reservoir. I see the pool elevation numbers are mentioned here, and they can be combined and better shown in a diagram. (See above comment)*	The report has been revised to add the suggested conceptual diagram of reservoir pools, elevations, and capacities.

Reclamation's Reservoir Yield (RRY) Model on Lugert-Altus Reservoir, W.C. Austin Project				
Report Reviewer	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2	Pages 97-98		*It will be nice to add some explanations of how the missing data/records in those tables are handled in the models and calculations. Suggest adding a separate paragraph or a footnote to further explain from the technical perspective on how the missing data records are handled if there are any.*	The report has been revised to provide cross-references and explanations for which data were used to fill in missing records.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***1. Are the goals, definitions, methods, and results understandable?*** *-The study goal is clearly described in both the executive summary and the reservoir yield overview section 2, in which understanding the water supply reliability to farmers of Lugert-Altus ID, and the frequency distribution of water supply availability over the period of record are out of great importance for the reservoir operation.* *-The definitions and terminologies used in this report are appropriate and easy to understand.* *-The methods applied are also straightforward. Different study scenarios (i.e., methods 1-3 per the report) are nicely summarized at the beginning and further explained and described in later sections.* *-Most of the key results are summarized in tabular format with some flow illustrations in figures. The presentation of the results is clear and concise. There are some minor presentation/text addition suggestions, which will further help highlight the scientific merits of the study. Please see more in specific comments.*	*No response needed*

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***2. Are the methods technically sound?*** *- The methods applied are technically sound. Three designed methods distinguish themselves, and each has a clear and individual goal for model validation, baseline simulation, and reality check, respectively. The executive summary section thoroughly described the differences among each method and highlighted the key simulation results. Section 2 further explained each method regarding the detailed assumptions and settings.* *- In addition, the reservoir yield model is also comprehensively introduced, which considers both the operating thresholds and water rights. The reservoir yield model used in this study is an excel-based model. It is not as complicated as other decision support systems, i.e., RiverWare, which has many complicated modules for managing other reservoir operating goals, such as hydropower, hydraulics, and environmental constraints. But, based on the nature and purpose of the Altus reservoir, the applied reservoir yield model is able to meet all operating constraints and considerations. The description of the reservoir yield model is appropriate and easy to understand.*	*No response needed*
Peer Reviewer No. 2			***3. Are methods appropriately applied and results technically sound?*** *- In general, the methods and models are appropriately applied to the study case, and the results are technically sound.*	

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2			***4. Are assumptions and uncertainties appropriately characterized?*** *- The main assumptions are appropriately characterized, especially for Method 3 of Upper Red River Basin Study Firm Yield Update (1926-2016). Section 2.3 summarizes the key assumptions per the Status Quo TM. Uncertainty analysis is also provided to most of the data and results, i.e., the presentation of flows and data measurements with statistical analysis.* *- One minor issue is the use of estimated precipitation from Net Evaporation instead of the in-situ observation networks. The derived precipitation may not bring significant impact and uncertainty to the reservoir yield estimation, but some level of explanations and analysis are needed.*	*See response below*
Peer Reviewer No. 2			***5. Are there any issues, concerns, or suggestions that are not covered by the questions above?*** *See below comments. Some issues identified are rather minor. Fixing them will definitely increase the overall scientific illustration and presentations. None of them are critical regarding the bone of the main study and experiments.*	
Peer Reviewer No. 2	viii		*The climate community acknowledges the term "GCMs" as the "General Circulation Models". The term "Global Climate Model" is an official name of General Circulation Models. Suggest revising the acronym to "General Circulation Models or Global Climate Models"*	The acronym "GCM" was a remnant from a previous draft of the report and has been removed.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2	page 1 parahragh 1		*Suggest adding another factor of "foreseenable climatic and hydrologic forcings" to the statement of "accounting for future inflow is largely dependent on ….." The reason being the "inflow" could still be influenced by precipitation/evap per the changes of the water cycle and watershed behaviors. The past inflow condition and future depletions are both important, but adding the hydrologic conditions will be more inclusive.*	This statement was revised to reflect the fact that informed assumptions were made regarding potential depletions caused by both future anthropogenic factors and climatic factors.
Peer Reviewer No. 2	page 2 last paragrpah		*I see the purpose of Method 1 is clearly provided here, and it is very nicely explained. Adding a sentence here to further describe the expected reservoir model yield results/differences, as well as the purposes of having/comparing methods 2&3, would greatly highlight the scientific goals and the purposes of the later study. I see the later page 3 further explains the method settings. However, a leading summary sentence about the settings used in methods 2&3 in the last paragraph of page 2 would be beneficial for readers to quickly get an overall understanding of the designed study comparison in this executive summary section.*	The report has been revised to add a summary statement about the purpose of comparing the three different methodologies. A summary table also was added citing data sources and assumptions for each model variable across the four methodologies.
Peer Reviewer No. 2	page 9 - page 10		*A minor suggestion: adding a conceptual diagram with storage maximum or elevations, showing the active conservation pool, flood control, and surcharge pool, will be more intuitive for readers to relate the physical settings/rules to the total yields and available water presented in prior Table 1 of the executive summary section.*	The report has been revised to add the suggested conceptual diagram of reservoir pools, elevations, and capacities.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2	page 12		*A minor suggestion: Figure 3 shows the Canel systems of the Lugert-Altus ID.W.C. Austin Project. At first sight, it is very similar to prior Figure 1. Suggest changing the Altus Aqueduct and other canel systems that are referred to in this section to a different color, i.e., red, to distinguish from the prior Figure 1.*	Figures 1 and 3 have been modified to provide differentiate more clearly between their context and features.
Peer Reviewer No. 2	Page 29 Last paragrpah		*This paragraph nicely described the main simulation result under the method 1 scenario. However, when recalling the goal of method 1, which indicated from prior sections that "This analysis (a.k.a Method 1) is performed for comparative purposes and to verify the yield model's performance in replicating the pre-construction calculation performed in the late 1930s.", it needs some further analysis and highlights on how this piece of result matches the expectations. In other words, more strong statements and explanations are needed here to directly show that the goal of method 1 is met based on the obtained simulation results.*	The report has been revised to clarify that the DPR results were validated in this yield update and are available upon request.
Peer Reviewer No. 2	Page 31 Section "Precipitation"		*It seems method 2/3 uses precipitation measurements that were not directly from in-situ observations; instead, the precipitation is estimated indirectly through the Net Evaporation measurements. Given the commonly accepted hydrological fact that Evap measurements are more difficult than measuring precipitation and have larger uncertainty, it may be a valid question how and why this study took this route instead of using direct rainfall measurements as Method 1. As the main driver of the water cycle, precipitation itself is a very important variable in estimating irrigation demand, streamflow estimation, and calculating reservoir storage water balance. In my opinion This part needs*	Precipitation, along with pan evaporation, is measured at a weather station near Altus Dam. The effects of precipitation are included in the monthly pan evaporation measurement and therefore do not need to be accounted for separately in the yield calculation. The report has been revised to clarify how precipitation is measured in-situ and used for the yield calculation.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
			some further explanations to make the scientific case that the uncertainty of indirect precipitation estimation is under good control.	
Peer Reviewer No. 2	Page 32 Last Paragrpah		*Is the identified critical drought period from the data (i.e., Aug 2010 to Apr 2015) corresponding to other reports and documentation over this area? It would be nice to give some supporting documents and citations since this is a derived critical drought period in the presented study.*	The drought of record will vary for each watershed/basin based on the local climate and hydrology. Given the variation in site-specific conditions, no other studies were identified that performed an assessment on the drought of record for the Lugert-Altus or Tom Steed Reservoir hydrologic basins. That said, the report has been revised to cite a state-wide drought assessment performed by USGS (Scientific Investigations Report 2013-5018), as well as data provided by the National Integrated Drought Information System.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2	Page 48 last -49 first paragraph		*In this paragraph, the "dependability" is defined, which is the main subject that is being evaluated in this study, instead of "firm" annual yield. This part is nicely delivered. One suggestion is to give a real-world or conceptual example with some numbers to show in what extreme situations the annual yield is high but the "dependability" is compromised. In addition, I feel the firm annual yield and the "dependability" sometimes can be supplementary to each other. Is this the case? It is important to further distinguish the "annual firm yield," and the "dependability" focuses of this study.*	The report has been revised to further distinguish between annual firm yield and dependability and how/why providing an estimate of Lugert-Altus Reservoir's firm yield is not consistent with how the reservoir is operated. Revisions also were made to clarify the difference between annual yield and dependability.
Peer Reviewer No. 2	Page 68		*Here, it may be more inclusive to further mention the uncertainty due to observation data itself. Most of the collected data is in monthly resolution either at point measurement or estimation. The temporal resolution and spatial distribution of the model inputs may place some additional uncertainty. However, based on the scope and goal of study, when aggregating the outcomes to an annual scale, the input data-induced errors (in terms of positive and negative errors) may cancel each other to some extends, and only have neglectable impacts on the reservoir yield model. Sensitivity analysis on the reservoir yield model may be useful at some point, especially when a new or more comprehensive data acquisition platform becomes available.*	The report has been revised to account for uncertainty caused by the time scale of the model.

Reclamation's Reservoir Yield (RRY) Model on Tom Steed Reservoir, Mountain Park Project.				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response (Reviewers leave blank)**
Peer Reviewer No. 2	Pages 75-76, 79-81, 83-86,		*It will be nice to add some explanations of how the missing data/records in those tables are handled in the models and calculations. In prior sections, there are few places that briefly mentioned the missing data/records but not consistently throughout all three methods. Suggest adding a separate paragraph or add corresponding texts if there are missing records being handled in the calculation.*	The report has been revised to provide cross-references and explanations for which data were used to fill in missing records.

Peer Reviewer No. 3

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin

Below are a few general comments for the authors to consider. Detailed recommendations and questions are listed in the accompanying spreadsheet. Also included as part of the review is the pdf of the report with the comments embedded in the report to help the authors locate and better understand the context of the comments in the spreadsheet.

Response: We appreciate you compiling your comments into the Word file here, as well as in the PDF file and the excel file. To maintain consistency with our review process, we combined the comments you submitted in the PDF with those in the excel file.

1. **Are the goals, definitions, methods, and results understandable?**

The goals of the report are clearly stated and most variables and terms are well defined. In general, the results are clearly described, however in some areas of the report the text is difficult to understand and clarification or additional explanation is needed. These issues can be addressed through revisions of the text. Overall, the interpretation of the results appear to be appropriate, but there are some results that are not explained well.

See excel file for detailed responses.

2. **Are the methods technically sound?**

The methods are technically sound and are explained in detail in the report. Although the methods are technically sound, they seem to be overly complicated for the application, the same results could be obtained with a more direct and less complicated approach. For example, a multiple stepwise regression could have been used to identify the important predictors of drought.

See excel file for detailed responses.

3. **Are methods appropriately applied and results technically sound?**

Although the methodology seems overly complicated, the application of the methods appears to be appropriate.

No response needed.

4. **Are assumptions and uncertainties appropriately characterized?**

The authors have made a substantial effort to clearly explain the assumptions and uncertainties associated with the research.

No response needed.

5**. Are there any issues, concerns, or suggestions that are not covered by the questions above?**

The paper needs significant revisions to improve the readability of the paper. Some sections of the report are difficult to follow and in many areas additional explanation is needed. Also, because the methodology is so complicated it would be helpful if the authors provided a flow chart of all the pieces of the analyses so that readers can get an overall picture of the process and methodology.

Response: The report has undergone substantial revisions to address your comments and improve readability and clarity. Please see excel file for detailed responses.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 1		*Maybe this sentence could be re-worded to state that the protection is against increased withdraws from new permits.*	Clarification has been added to text.
Peer Reviewer No. 3	page 1		*OWRB should be spelled out the first time it is used.*	Corrected.
Peer Reviewer No. 3	page 1		*Does interference refer to junior rights holders interfering with senior rights holders? This usage is not clear.*	A footnote has been added to make this clarification
Peer Reviewer No. 3	page 2		*NFRR should be spelled out the first time it is used.*	Corrected.
Peer Reviewer No. 3	page 2		*maybe "evaluated" is a better word to use rather than "simulated".*	Corrected.
Peer Reviewer No. 3	page 3		*Maybe be explicit and specify that this is reservoir inflow. Also, this is the first time that reservoir inflow is mentioned. It might be helpful to mention it in a previous sentence and why it is used.*	Corrected.
Peer Reviewer No. 3	page 3		*Are these drought periods? It would be good to be specific as to what these seven model periods represent.*	The time periods refer to periods used in cross-validation to test combinations of predictors - e.g., inflow, PDSI, etc. The text has been clarified.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 3		*This number (441) is not mentioned earlier or explained. Some explanation is needed here.*	This number (441) is a result of the experimental design using the combination of predictor thresholds - PDSI and inflow, which were analyzed from a minimum value (0th percentile) to maximum value (100th percentile) in 5 percent increments. This results in a matrix of 21 x 21 values or 441 values in total. The text has been clarified.
Peer Reviewer No. 3	page 4		*Maybe this could be reworded to say that that SPI is an RDI related to an LDI.*	The text has been clarified.
Peer Reviewer No. 3	page 11		*Some explanation for why it is important for an indicator to not be overly sensitive is needed.*	Additional clarification has been added and a reference to Jolliffe (2012) discussion on robust measurement.
Peer Reviewer No. 3	page 12		*What survey is being referenced here?*	This reference was an error and has been removed.
Peer Reviewer No. 3	page 14		*It isn't clear what "trending" means here, maybe "monitoring" is a better word to use.*	The text has been clarified.
Peer Reviewer No. 3	page 15		*Some explanation is needed to explain why logistic regression was selected for model development.*	Logistic regression is a standard statistical method used to estimate the probability of occurrence of an event, specifically, drought event in this study, using a set of predictors.
Peer Reviewer No. 3	page 16, figure 3		*What about using data for the climate division to the west of climate division 4 and 7? That region appears to be a headwaters region.*	The contributing area for the Tom Steed reservoir is distributed over climate divisions 4 and 7.

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Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 17		*This should be re-written to indicate that the PDSI values for climate division 8 resulted in a higher correlation.*	We believe the reviewer is referring to climate division7 and not 8. This has been edited in the report text.
Peer Reviewer No. 3	page 17		*Why was climate division 4 selected when PDSI for climate division 7 performed well?*	Climate division 07 (Southwest) was selected, and the typographical error in the text has been corrected.
Peer Reviewer No. 3	page 17		*Was the mean PDSI for climate divisions 4 and 7 tested for how well it correlated with RDIs?*	This is a good suggestion, but we wanted to select a single representative climate division for the analyses.
Peer Reviewer No. 3	page 18, Table 3		*Should provide p values of the correlations.*	All correlation coefficients are significant at the 5% significance level ($r_{critical}=0.206$). A note has been added below Table 3 with this information.
Peer Reviewer No. 3	page 19		*How was the 1926-2016 period of record selected?*	The period of record was selected based on the earliest available reservoir inflow record begins in 1926 and the models developed by Reclamation and OWRB continue through the year 2016. A footnote has been added
Peer Reviewer No. 3	page 19		*It isn't clear what "lines that plot RDI-inflow correlations" means. Should this be "lines that indicate RDI-inflow correlations"?*	This change has been made.
Peer Reviewer No. 3	page 19		*Some explanation is needed to specify what is presented in figures 7-11. What aspects of PDSI, PHDI, and SPI are presented?*	Clarification has been added to text.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	Tables 5, 6, and 7		*These tables are not explained well. The tables are important to the results and need to be clearly explained. The details of how they were derived are needed.*	Clarification has been added to text.
Peer Reviewer No. 3	Figures 6, 8, 10, and 12		*The figure caption indicates that frequency distributions are shown, but it looks like they are cumulative frequency distributions.*	Captions have been updated to state, cumulative frequency distribution.
Peer Reviewer No. 3	Tables 5-7		*It would be helpful to use color or shading to differentiate low values from high values.*	This change has been made.
Peer Reviewer No. 3	page 29		*In most climatic and hydrologic research, January through December is termed a calendar year. Calling this period a water year might be confusing to readers.*	While we understand that the terminology might be confusing, the term "water year" seems to be the appropriate terminology for the context here.
Peer Reviewer No. 3	Figures 14-19		*The figure captions start with "Observed drought". It would be good to remove the word "observed" since the droughts are not observed, but identified based on rules.*	A footnote has been added to state that technically, a drought was not observed; rather, it was identified based on the parameters used to define the drought, but for the purposes of this report, the term "observed" is used to describe the occurrence of historical droughts.
Peer Reviewer No. 3	Figures 21-22		*These figures can be removed. Figure 23 summaries the important information in these figures and is easier to understand.*	We believe both sets of figures provide value and will keep the figures as they are.
Peer Reviewer No. 3	Table 9		*The term "observed" does not seem appropriate here.*	See response to Comment 26
Peer Reviewer No. 3	page 38		*Does "drought or non-drought" refer to drought or non-drought months, or to drought periods?*	The former, we have clarified in the text.

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Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 40		*How were the observed droughts identified or determined? Additional explanation is needed here.*	See response for the comment above on Row 28. As the next sentence states, a this statistic measures how well each model accounts for the different variables (variation) involved with predicting each definition of drought. In other words, a drought was observed based on the specific parameters that define each drought in accordance with the drought definition.
Peer Reviewer No. 3	page 41		*Using "conservatively" here is confusing. Some readers might think that this term means that drought is identified as soon as a small move to the downside occurs, whereas others might think that it means that a drought only occurs when things get really dry. The use of the term needs to be defined here, or a different term should be used.*	The text has been clarified.
Peer Reviewer No. 3	Tables 10 and 11		*For easier interpretation of these tables it would be helpful to use shading or color to help differentiate the low values from the high values.*	This change has been made.
Peer Reviewer No. 3	page 47		*This statement is not clear. Are you testing for the amount of variation explained in the predictions or accounting for the variation explained in drought occurrence? A possible statement could be "account for the amount of variation in drought occurrence."*	The text has been clarified.
Peer Reviewer No. 3	page 47		*It would be good to be more specific here and replace "these" with the specific subject of this statement.*	This change has been made.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 47		*This sentence is a bit confusing. Maybe the sentence could be re-written to say "The objective here was to identify the highest performing models."*	This change has been made.
Peer Reviewer No. 3	page 48		*How were the model and validation periods selected? Why not just use the entire period of record rather than break the time series up into arbitrary periods?*	The sub-setting of time periods was not arbitrary but based on known dry and wet periods in the Basin so that model perforemance could be evaluated over a broad range of hydrologic conditions.
Peer Reviewer No. 3	page 49, Figure 26		*The figure caption could use additional explanation. For example, does "light colored" refer to the different color shades? Also, why are there six color shades, but 7 droughts? How were the "observed droughts" determined?*	The text has been clarified. Additionallyc the text should have read 6 instead of 7; this has been corrected.
Peer Reviewer No. 3	page 49		*Why were 10 subgroups selected?*	The Hosmer-Lemeshow (HL) test is a commonly used procedure to evaluate the goodness of fit in logistic regressions. This test is sensitive to the number of groups selected. A value of ten is the default value suggested in the R function, *ResourceSelection::hoslem.test*, and this default value was used for consistency to test all the logistic regression models. Note that the HL test statistic was one among several other model evaluation statistics for evaluating logistic regression model fits.
Peer Reviewer No. 3	page 50		*Should mention here that that a low p-value indicates that the model simulations are significantly different from the observations.*	Suggested clarification text has been added.

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Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 51		*Should this be "the Null hypothesis" rather than "the model"?*	A rejected model meant that the null hypothesis was *not* rejected. The null hypothesis was only rejected when a model was not rejected. We purposefully characterized the analyses in this way to improve readability for the intended audience. No revision was made.
Peer Reviewer No. 3	page 51		*What does it mean for a model to "not pass both the Model Period and the Validation Period"? Does this refer to statistical tests for these periods? If so, a more specific statement is needed.*	Yes. Clarification has now been added in the text.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 53, Table 14		*More information is needed in the Table caption. A lot of the information is not clearly explained. For example, what are the values in parentheses? What do the last two columns signify? In the 3rd row under drought there is "(5-0)2/0=85, how can a value divided by zero be 85, it should be undefined? Many of the equations do not result in the value to the right of the "=" sign.*	The values in the parentheses are part of the sample calculations. Additional clarification has been added to the caption to reference the equation being used. The calculations had rounded some of the decimals off incorrectly in excel. The table has been revised to ensure things are calculated as intended for everything to equal what was intended. The equation for this statistic is shown on page 49. The equation sums each subgroup's ability to correctly predict which months were observed to be classified as being drought or wet Expected Drought months were determined by taking the sample size (108) times the average event probability in the subgroup. Since Model Period A consists of 108 months, observed drought and wet months cannot exceed 108 together (i.e. Observed and Expected Wet months are simply determined by taking 108 minus the Observed and Expected Drought months).
Peer Reviewer No. 3	page 54		*Should state the Null hypothesis for this test.*	Yes we agree, the equation for Null Log Likelihood has been added to this section as well.
Peer Reviewer No. 3	page 54		*The text states "Inflow p-values corresponded to models derived based on PDSI alone (without inflow), and PDSI p-values corresponded to models derived based on inflow alone (without PDSI)." This explanation seems to be opposite of what the model is doing.*	Yes. Clarification has now been added in the text (see below). The model without inflow p-values corresponds to models derived based on PDSI alone, and without PDSI p-values corresponds to models derived based on inflow alone.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 55		*It isn't clear what is meant by "it did not pass both the Model Period and the Validation Period". Does this refer to ANOVA test for these periods? If so, this should be explicitly stated.*	Yes. The text has been updated following reviewer suggestion.
Peer Reviewer No. 3	page 56, Table 16		*In the caption it seems like this should be PDSI, not inflow.*	Agreed, the table should be named "without inflow"
Peer Reviewer No. 3	page 56, Table 17		*In the caption it seems like this should be Inflow, not PDSI.*	Agreed, the table should be named "without PDSI"
Peer Reviewer No. 3	page 57, second full paragraph		*This same information is provided on page 51. Possibly it is not needed here and is redundant.*	We think the redundancy is necessarily as this points made on this page are used to defend a key decision point.
Peer Reviewer No. 3	page 57 and 58		*Why do droughts become less variable as drought worsens? Some additional explanation is needed for this statement - "a drought worsens, conditions become less variable and easier to predict".*	The following additional explanation is now included in the text. In other words, the stability of the physical hydrologic system, i.e., drought conditions, is reflected in both lower inflow and PDSI values, and therefore, both of these variables contribute to the prediction skills of the logistic regression model.
Peer Reviewer No. 3	page 58, last paragraph		*This section is confusing and needs additional explanation.*	We added clarification text and have referenced Table 18 where the statistics are presented.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 59		*Under what circumstances were these models periods rejected? Can this statement be re-phrased to be more clear and specific?*	Clarification text (below) has now been added to the description. Model period rejection was based on statistical findings using p-values calculated by H-L GOF for inflow-PDSI; ANOVA for PDSI alone; and ANOVA for inflow alone (see Table 18).
Peer Reviewer No. 3	page 59		*How were model periods rejected? or do you mean model periods for which specific models were rejected?*	Table 18 has now been referenced. This table includes additional details.
Peer Reviewer No. 3	page 59		*The information about conservative and less conservative scenarios has been mentioned earlier in the paper.*	We think the redundancy is necessarily as this points made on this page are used to defend a key decision point.
Peer Reviewer No. 3	page 61		*The sentence "This left B-G models." requires more information.*	Clarification text has been added.
Peer Reviewer No. 3	page 61		*It isn't clear how the drought scenarios were tested statistically? Do you mean drought models?*	Added drought model. The terms drought scenarios and drought models are used interchangeably in this study.
Peer Reviewer No. 3	page 61		*How was the performance of model periods tested? It seems like model periods are static.*	In cross-validation mode, i.e., developing logistic models using a subset of years for each period (e.g., B-G), and testing the performance of the developed logistic regression using the remaining years from that period. This description has now been added to the text.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 61		*The sentence "Therefore, of the three, Model Period B was eliminated from further consideration." sounds like a part of the record was eliminated for use. This same type of statement is used later in the paper.*	Thank you for the comment. No change was made to the text as this period was omited based on the BIC scores obtained for the model verification (cross-validation) step.
Peer Reviewer No. 3	page 62		*The use of "models" and "model periods" is confusing. Some clarification is needed.*	We added these definitions and others to the definition section in Part I for readers to be able to reference for additional clarification.
Peer Reviewer No. 3	page 63		*A reader will want more information about these 441 fifth-percentile occurrence percentiles. Each section should be explained in enough detail that it can stand alone.*	Clarification text has now been added to the description.
Peer Reviewer No. 3	Figure 28		*Something that needs additional explanation is how a 5th percentile threshold can be larger than observed monthly inflow-PDSI conditions.*	Clarification text has now been added to the description.
Peer Reviewer No. 3	page 64		*It isn't clear why this replacement was done. Some additional explanation is needed.*	The text has been revised.
Peer Reviewer No. 3	page 65		*Please explain why 0.12 is an important value.*	An explanation is provided in the paragraph above the equation on p.65. In summary, this value (12%) is the climatological probability of drought for the drought scenario D15.
Peer Reviewer No. 3	pages 66-67		*This discussion is difficult to follow. Is there a way to clarify the take-home messages of these paragraphs?*	Minor revisions were made to the narrative to improve clarity.

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Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	Figure 30		*Does "positive drought predictions" mean accurate drought predictions?*	No, a positive drought prediction in this context merely indicated only that a drought was predicted, not whether that prediction was accurate. The term "positive" has been removed from these figures for clarification.
Peer Reviewer No. 3	page 74		*The methods used have been used in more than meteorological applications. I think that the use is more general than indicated here.*	Text updated as suggested.
Peer Reviewer No. 3	page 75		*This discussion should be re-written explaining that the MSE is computed and used for analyses, rather than that the MSE "compares" or "squares". The MSE is a statistic and does not actively do anything.*	Text updated as suggested.
Peer Reviewer No. 3	page 75		*Does this mean 0th, 5th, 10th,15th....95th percentiles. Some more specifics are needed.*	Added clarification that the sequence of 0 to 95th percentile was developed in 5% increments.
Peer Reviewer No. 3	page 76		*Delete "This threshold occurred at the 36th percentile of the observed period of record".*	Thank you for the comment. We felt retaining this clarification is helpful and was therefore not deleted.
Peer Reviewer No. 3	Table 26		*It isn't clear what all of the equations in the table mean. Why not just report the result, the equations are not needed and are confusing,*	Thank you for the comment. This table shows the MSE calculations, and we felt it will be helpful to the readers to see the calculations. Thus, no change was made to this table.
Peer Reviewer No. 3	Table 29		*The "/" should be defined in the table caption.*	Updated as suggested
Peer Reviewer No. 3	page 82		*Has the conditional probability approach been mentioned earlier? This sentence seems to imply that it has already been mentioned.*	Yes, it references variables and outcomes defined in Table 21. A refernce to Table 21 is now added to the text for clarification.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	page 82		*Should this be 219?*	212 is the correct value; 105 correct and 107 droughts were determined to be false positive
Peer Reviewer No. 3	page 83		*Why were these 15 thresholds selected? Some specific details are needed here.*	This comes from Table 31, and this clarification has now been added to the description.
Peer Reviewer No. 3	Table 30		*Suggest just reporting the results and not the equations. The results match the column headings.*	Thank you for the comment. This table shows the conditional probability calculations, and we felt it will be helpful to the readers to see the calculations. Thus, no change was made to this table.
Peer Reviewer No. 3	page 89		*The second sentence should be reworded so that it is clear that the MSEs and Conditional probabilities resulted from comparisons of predictions and observations.*	Added clarification -- Through calculation of each threshold's MSE and Conditional Probability by considering observed and predicted probabilities …
Peer Reviewer No. 3	page 89		*It isn't clear how these 16 thresholds were selected? How does this selection relate to the 15 thresholds in table 31?*	Clarification has been added to the text - 1 threshold from Table 27 and 15 thrresholds from Table 31, for a total of 16 thresholds.
Peer Reviewer No. 3	page 96		*The phrase "For these reasons" needs to be supported by examples of the "reasons", only one reason is mentioned earlier.*	The complicated nature of why reservoir storage might drop and the belief that using the top of the conservation pool as the only trigger are the two main reasons discussed.
Peer Reviewer No. 3	page 97		*Should "zero percent full" be "<10 percent full"?*	It is less than (<) 100 percent to 0 percent full - the description in the text is correct. Thus, no change was made.

Formulation of Streamwater Rights Management Alternatives in the Tom Steed Reservoir Hydrologic Basin				
Reviewer Name	**Page(s) or other reference location**	**Line Number(s) if applicable**	**Comment**	**Agency Response**
Peer Reviewer No. 3	Table 35		*Why is occurrence frequency indicated as a percentile rather than as a percent? Also, only the numbers are needed and not the "rd" and "th" indications.*	Results are presented in terms of cumulative probability, hence values are given in terms of percentiles.
Peer Reviewer No. 3	page 107		*The statement "and months with MSE scores that were higher than the baseline are not shaded in green" is not needed.*	We feel like these words are needed to provide more explicit understanding of the table.
Peer Reviewer No. 3	page 109		*The statement "POD and SR were added together and a net change in combined POD-SR was tabulated" suggests that POD and SR are equally important. Is that true?*	Changed added to combined - should help with the clarification as to why this was done; to facilitate interpretation as a net change in terms of POD-SR.
Peer Reviewer No. 3	page 109, last paragraph		*The statement "and months with MSE scores that were higher than the baseline are not shaded in green" is not needed.*	Thank you for the comment. We felt retaining this clarification is helpful and was therefore not deleted.
Peer Reviewer No. 3	Tables 42 and 43		*In the caption, the statement "and months with MSE scores that were higher than the baseline are not shaded in green" is not needed.*	Thank you for the comment. We felt retaining this clarification is helpful and was therefore not deleted.
Peer Reviewer No. 3	page 112		*This statement suggests that increased frequency of curtailments is a good thing. Will water users agree with that?*	An increase in curtailment frequency in this sense means that most droughts in this region have been observed to start in the latter part of the year. Additional clarification has been added to distinguish the context of this conclusion.
Peer Reviewer No. 3	page 112		*There should be some explanation here why September was specifically chosen.*	Additional clarification was added. April, September, October, and November performed well and since September is the end of the irrigation season for the region it was selected for further testing.
Peer Reviewer No. 3	pages 113-114		*It isn't clear what "Low", "High" and "Full" refer to.*	This scenarios are referring to new stream permit volumes, additional clarification has been added.