Appendix A

Alternative Operational Scenarios Development Report

BUREAU OF RECLAMATION

Alternative Operational Scenarios Development Report

Truckee Basin Water Management Options Pilot Study, California and Nevada
California-Great Basin Region

U.S. Department of the Interior

September 2021

Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated 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.

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Cover Photo: Prosser Dam and Truckee River (Reclamation)

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Acronyms and Abbreviations

	Full Phrase
the Basin	the Truckee River Basin
BLM	United States Department of the Interior, Bureau of Land Management
cfs	Cubic feet per second
DOI	United States Department of the Interior
EIS	environmental impact statement
Reclamation	United States Department of the Interior, Bureau of Reclamation
the Technical Team	US Department of the Interior, Bureau of Reclamation, Truckee Meadows Water Authority, Federal Water Master, California Department of Water Resources, and Pyramid Lake Paiute Tribe
US	United States
USACE	United States Army Corps of Engineers

Truckee Basin Water Management Options Pilot Study
Alternative Operational Scenarios Development Report

Need for the Pilot Study

The Truckee River Basin (the Basin) encompasses about 3,060 square miles in California and Nevada. Water in the Basin originates high in the Sierra Nevada mountains at elevations over 10,000 feet. The Truckee River flows approximately 121 miles from the outlet of Lake Tahoe to its terminus at Pyramid Lake. While 90 percent of the flow and virtually all the Basin's water storage lie in California, the vast majority of water demands are in Nevada.

The United States (US) Bureau of Reclamation (Reclamation) manages three projects within the Basin: the Washoe Project (Stampede and Prosser dams and reservoirs), the Newlands Project (Lake Tahoe Dam, Derby Dam, the Truckee Canal and Lahontan Dam and Reservoir), and the Truckee Storage Project (Boca Dam and Reservoir). There are three other dams within the Basin: Donner and Independence Lake dams which are owned and operated by Truckee Meadows Water Authority for water supply, and Martis Creek Reservoir is owned and operated by the US Army Corps of Engineers (USACE) exclusively for flood control purposes.

Drought and flooding are becoming more common in the Basin. The extreme variability from year to year in terms of winter precipitation, snowpack, and runoff make it very challenging for water managers, including Reclamation and its non-federal partners, to adapt and plan for water supplies within the constraints governing how federally owned storage reservoirs must be operated for flood risk reduction. Even in large runoff years in the Basin, the governing flood control diagrams (i.e., rule curves)[1] and snowmelt parameters[2] that dictate when and how reservoirs can be filled can require Reclamation and other water managers to maintain empty flood space in reservoirs until it is too late in the season to fill them. Even during years with significant snowpack, by the time filling is

[1] A flood control diagram, or rule curve, is a diagram showing the amount of space that must be reserved in a reservoir to be able to hold back flood waters in case of a high runoff or rainfall event to mitigate flood damage downstream. The amount of required flood space to be reserved increases during the spring, when runoff events usually occur, and decreases in the late fall. The exact amount of space that must be reserved on a given date changes based on forecasted runoff for that year.

[2] Snowmelt parameter refers to adjustments made to the allowable rate of reservoir refill based on runoff forecast. Per the Water Control Manual, flood space required between April 10 and July 5 varies according to the forecasted snowmelt runoff. Space not required for flood risk reduction may be filled for conservation purposes.

finally allowed into the flood storage space (based on the high snowmelt parameters) the runoff has often receded to a level that some reservoirs aren't always able to be filled to capacity.

Flood and reservoir refill operations are governed by the Water Control Manual issued by the USACE (USACE 1985). The manual suffers from outdated rule curves, inflexible storage requirements, constrained reservoir release thresholds, and a constrained downstream regulation goal at Reno.[3] It also does not reflect the Truckee River Operating Agreement (TROA), flood mitigation projects completed in Reno and Sparks since 1985, or the 2017 crest raise at Reclamation's Stampede Dam.

The purpose of the Truckee Basin Water Management Options Pilot Study is to develop flexible flood risk reduction criteria that account for current and potential future conditions without increasing downstream flood risk. The study will evaluate a range of alternatives including Forecast Informed Reservoir Operations, flexible rule curves, and changes to downstream regulation goals. This study will then be documented in a Viability Assessment and provided to the USACE for a potential update to the Water Control Manual.

This is a cost-share study being performed by Reclamation, Truckee Meadows Water Authority, the Federal Water Master/TROA Administrator, Pyramid Lake Paiute Tribe, and California Department of Water Resources (the Technical Team).

This report documents the process undertaken by the Technical Team to develop a preliminary range of alternatives to be examined in the study. This range of alternatives focuses on conceptual changes rather than specific numeric thresholds or rule curves. Additional detail will be added to the concepts through further study and modeling as part of the Water Management Options Pilot Study and eventual Viability Assessment.

Alternative Operational Scenarios Development Process

The process for developing alternative operational scenarios involved four virtual workshops during which the Technical Team and other key stakeholders documented current conditions and management, identified problems and opportunities and actions for addressing them, created screening criteria based on objectives and constraints for flood control management, screened potential actions, and combined actions into alternatives. **Appendix A** lists the agencies in attendance at the workshops. Workshop attendees participated and provided their feedback through answering pre-workshop questions and brainstorming in plenary sessions and small breakout groups. Each workshop began with an overview of the objectives for that specific workshop and for the overall alternatives development effort.

[3] The downstream regulation goal at Reno is the flow threshold designed to mitigate flood impacts. Water managers store reservoir inflow into the flood space during a flood event, insofar as possible to maintain the flow at or below 6,000 cubic feet per second (cfs), as measured at the Reno gage. After the event has passed, water managers typically release water from the flood space as quickly as possible without exceeding the downstream regulation goal.

Workshop 1

Before alternative operational scenarios development Workshop 1, participants were asked to watch a recorded PowerPoint presentation to familiarize themselves with the background of flood control management in the Basin and the Water Management Options Pilot Study and with the objectives of the alternative operational scenarios development process. Meeting organizers solicited input from participants before the meeting on their objectives for the alternative development effort and their ideas for encouraging effective participation during the workshops.

The two-day Workshop 1 began with all participants reviewing draft materials documenting baseline conditions in the Basin, including Basin characteristics, water management facilities, and other factors affecting the Basin. Other factors included things like climate change, agreements and other governing documents, and dam safety and flood mitigation projects. Discussion then turned to documenting current flood control management as required by the Water Control Manual. This management makes up the No Action Alternative.

Workshop participants then identified objectives for flood control management in the Basin. Objectives centered around maximizing management flexibility and downstream flood protection while maintaining or improving water supply and instream flows. The objectives developed during this workshop would be used to create screening criteria to compare alternative actions against one another. No action was expected to fully satisfy all objectives; rather, screening an action against the objectives would illustrate the pros and cons of that action in terms of which objectives it would satisfy or not satisfy.

After identifying objectives, participants brainstormed problems or opportunities presented by the current flood control management in the Water Control Manual (i.e., the No Action Alternative) in combination with current baseline conditions, including flood control projects. Problems and opportunities fell into the following primary themes:

- Timing of refill and drawdown in the governing rule curves being overly restrictive and hindering reservoir management
- Downstream flood thresholds being too restrictive and not accounting for recent and future flood mitigation projects
- Dam safety concerns and resulting limitations on operation of Martis Creek Dam affecting flood control management at the other facilities in the Basin
- Precipitation and runoff forecasts not having all information about on-the-ground conditions

Participants also brainstormed potential actions to address the problems and opportunities. Some problems or opportunities had multiple different actions that could address them.

The final discussion topic for Workshop 1 was identification of constraints for flood control management in the Basin. While objectives provide a relative comparison between alternative actions, constraints are sideboards that any action must meet in order to be considered as part of the range of alternative operational scenarios. Constraints included requirements such as not increasing

frequency or magnitude of flood flows, capability of being addressed through an update to the Water Control Manual, and compliance with requirements of governing documents and agreements.

Workshop 2

During the one-day Workshop 2, participants reviewed and finalized screening criteria that the facilitation team drafted based on the objectives and constraints developed during Workshop 1. Then they turned to the issue of identifying data gaps or clarifications needed for the alternative actions developed during Workshop 1. The point of this discussion was to ensure that there was enough information on the alternative actions so that they could be evaluated effectively against the screening criteria. Participants submitted written input identifying possible data gaps in advance of the workshop to help start the discussion. The conclusion of this discussion was that, while there were items associated with alternative actions in need of further study in order to perform technical evaluations, there were no gaps needing to be filled before the more general and qualitative evaluation against the screening criteria.

Workshop 3

The two-day Workshop 3, focused on evaluating alternative actions against the screening criteria. Actions were grouped by the problem or opportunity they addressed, and each action was evaluated against constraints first. If an action did not satisfy one or more constraints, it was eliminated from further consideration as part of this study. Actions eliminated in this manner may still warrant consideration and follow-up through separate efforts. See **Section 5.1**, Actions Eliminated from Alternative Operational Scenarios but Recommended for Separate Follow-up, for additional information on these actions.

If an alternative action satisfied all constraints, participants evaluated how well the action would satisfy each objective identified during Workshop 1. This was accomplished by assigning a score from 0 to 5 to indicate how the action would meet the objective in comparison to the current baseline. A score of 0 meant that the action would make things worse compared to the current baseline; a score of 5 was for actions that would result in a major improvement over baseline.

Workshop 4

During the two-day Workshop 4, participants came up with methodologies for combining actions into alternative operational scenarios and then implemented those methodologies to develop a set of complete alternatives. The elements needed to make up each complete alternative operational scenario were based on those found in the No Action Alternative and included the following:

- Reservoir refill
- Normal flood operations
- Fall drawdown
- Flood space
- Martis Creek Reservoir flood operations
- Ramping rates

For each element listed above, an alternative operational scenario either included a new action developed during the workshops or carried forward the relevant action from the No Action

alternative. The selection of actions for individual elements within an alternative operational scenario was governed by the methodology being applied. For example, one methodology used to create an alternative operational scenario was to combine the actions receiving the highest total score from each problem or opportunity category. Because no actions that satisfied the screening constraints were developed for Martis Creek flood operations or ramping rates, current management from the No Action alternative was carried forward for those elements for all alternative operational scenarios.

Participants at the workshop developed 13 different methodologies for combining actions into alternative operational scenarios. Sometimes, different methodologies resulted in identical alternative operational scenarios. After applying these methodologies and removing duplicate scenarios, workshop participants were left with four alternative operational scenarios to receive further study. These scenarios are described in **Section 4**, Final Alternative Operational Scenarios.

Stakeholder Contributions

Reclamation collaborated with the stakeholders listed in **Appendix A** throughout the alternative operational scenario development process as described in **Section 2**. Meeting attendees brought a range of expertise and experience, from on-the-ground reservoir management and regulatory oversight to technical modeling to Tribal and municipal water and flood control planning. Meeting organizers solicited written input from attendees on key topics before workshops and between workshop sessions. During the workshops, attendees brainstormed ideas and provided input in large-group plenary sessions and smaller breakout groups. This variety of formats for providing input was designed to accommodate differing individual preferences and comfort levels to ensure that all stakeholders could effectively contribute.

All cost-share partners and key stakeholder agencies participated actively in the workshops, contributing ideas, clarifying actions, and confirming information. While meeting organizers at times prepared draft materials outside of workshops, these materials were always reviewed, refined, and approved by the full group of attendees during the workshops.

Final Alternative Operational Scenarios

The No Action alternative and the four action alternative operational scenarios that will be further studied, modeled, and evaluated as part of the Water Management Options Pilot Study are described below. Each of the four alternative operational scenarios developed by the workshop participants is characterized by a theme related to the methodology or methodologies used to develop it. See **Appendix B** for the complete Alternative Operational Scenarios Matrix.

Alternative 1 – No Action

Alternative 1 would carry forward current management in the Water Control Manual. Spring reservoir refill and fall drawdown would be governed by the current rule curves and snowmelt parameters. Downstream flows would continue to be regulated to 6,000-cubic feet per second (cfs)

as measured at the Reno gage, insofar as possible. Flood space allocations between the reservoirs in the Basin would remain the same. This would include the 30,000 AF joint flood space allocation between Boca and Stampede reservoirs, at least 8,000 AF of which must be reserved in Boca Reservoir.

Martis Creek Reservoir would continue to be authorized to store water for flood control once flows at the Reno gage reached 14,000 cfs as described in the Water Control Manual; however, Martis Creek dam will not be operated again until dam safety concerns are addressed. Until then, Martis Creek Reservoir will continue to provide only passive or incidental flood control. Regarding ramping rates, releases from Truckee Basin reservoirs would continue to be prohibited from increasing or decreasing by more than 1,000 cfs per hour. As described in **Section 2.4**, Workshop 4, this management for Martis Creek Reservoir flood operations and ramping rates would be the same under all alternative operational scenarios. Therefore, it is not repeated under the action alternative operational scenarios described below.

Alternative 2 – Optimizing Storage for Fisheries and Water Supply

Alternative 2 is composed of the actions that, for each problem or opportunity, would best meet the objectives related to satisfying water demands throughout the year, improving environmental in-stream flows downstream of rivers, and increasing flexibility to account for changing precipitation and runoff conditions as well as recent and future downstream flood mitigation projects. Spring reservoir refill and fall drawdown would be governed by a dynamic model based on anticipated operations, forecasted precipitation and temperature, existing snowpack, water yield, and other factors, accounting for operations forecasts, weather forecasts, precipitation, current storage levels, climate seasonality, and other antecedent conditions.

The downstream regulation goal at Reno gage would be updated to be a dynamic threshold that accounts for recent and future flood mitigation projects. The updated threshold would likely be formatted as a new number that is higher than the current 6,000-cfs threshold, with additional language to allow for flexibility. This could come in the form of language added after the numeric threshold such as "XX cfs or flooding impacts felt" or "XX cfs or non-damaging flows" or from tying to information that is already periodically updated, such as National Weather Service action stages. The threshold could also be formatted as a single updated number with provision for periodic modeling updates to change the number in the future as needed.

Alternative 2 would also update the joint flood space allocations between Boca and Stampede reservoirs to have a wider range for the flood space in Boca instead of a single minimum number or percentage. This would provide more flexibility to account for changing conditions, such as the 2017 improvements to Stampede Dam that increased the surcharge space in the reservoir.

Alternative 3 – Dynamic Flood Risk Reduction Criteria

Alternative 3 was created by combining the actions that would provide the most flexibility for dynamic management based on the conditions occurring at the time. This alternative includes actions that emphasize real-time modeling based on forecasted conditions.

Under Alternative 3, reservoir refill and drawdown would be managed using the same dynamic forecast-informed model-based concept as described under Alternative 2. For downstream regulation goals, in addition to updating the flow threshold at the Reno gage, flow thresholds would be identified at the Vista and Wadsworth gages as well. Like the Reno gage threshold, the Vista and Wadsworth thresholds would be dynamic and capable of being adjusted based on changing conditions and flood mitigation projects. During a storm event, reservoir managers would operate dams to meet the limiting threshold depending on where the water is coming from. For example, if the precipitation is occurring in the upstream portion of the basin, the threshold at the Reno gage may provide the appropriate basis for reservoir management to avoid flooding impacts downstream. However, if the precipitation is occurring primarily downstream of Reno, the threshold at the Vista or Wadsworth gage would be the limiting threshold for releases from reservoirs. Releases that may not cause flows to exceed the threshold at the Reno gage would, when combined with precipitation flows downstream of Reno, cause flows to exceed the flooding threshold at the Vista or Wadsworth gage, so those releases would still need to be curtailed. This management would place a heavier emphasis on modeling in order to account for the three different flow threshold locations and the tributaries feeding into each.

Like Alternative 2, Alternative 3 would also update the joint flood space allocations between Boca and Stampede Reservoirs to have a wider range for the flood space in Boca.

Alternative 4 – Updating Flood Risk Management

Alternative 4 was created by combining the actions that focus on the objective of reducing flooding risk downstream and that are the easiest to implement. Under Alternative 4, reservoir refill and drawdown would be governed by a new expanded set of rule curves based on a range of scenarios or periods, including a new low snowmelt parameter in addition to the high snowmelt parameter. A model would help decide which curve should be used for a given year, accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, downstream regulation goal, and other antecedent conditions. The downstream regulation goal at the Reno gage would be updated as described under Alternative 2.

Like Alternative 2, Alternative 4 would also update the joint flood space allocations between Boca and Stampede Reservoirs to have a wider range for the flood space in Boca.

Alternative 5 – Hybrid Rule Curve

Alternative 5 was developed by combining the actions that addressed the most objectives, regardless of how well the action addressed each objective. This alternative includes a hybrid approach to reservoir management, with the dynamic model-based approach to reservoir refill from Alternative 2 combined with the expanded set of rule curves from Alternative 4 for reservoir drawdown. The downstream regulation goal at the Reno gage would be updated as described under Alternative 2. Like Alternative 2, Alternative 5 would also update the joint flood space allocations between Boca and Stampede Reservoirs to have a wider range for the flood space in Boca.

Follow-up Actions

The following sections describe the next steps to be taken based on the results of the alternative operational scenarios development process. This includes potential separate efforts to address proposed actions that were eliminated from consideration for the pilot study during screening as well as the remaining process for considering alternatives in the Water Management Options Pilot Study and potential Water Control Manual update.

Actions Eliminated from Alternative Operational Scenarios but Recommended for Separate Follow-up

Martis Creek Dam and Reservoir

During Workshop 1, participants identified problems and opportunities associated with the current operating state of Martis Creek Dam and the need for dam safety improvements to fulfill the dam's role in Basin flood control as outlined in the Water Control Manual. Currently, Martis Creek Dam cannot be operated to store water and limit downstream flows due to dam safety concerns. Not using Martis Creek Dam and Reservoir for flood control to its full capacity limits the ability to reduce peak flows downstream which can result in storing more flood water in the other flood control reservoirs during an event.

Actions that could address this problem include securing funding necessary for the USACE to conduct necessary studies and potential dam safety improvements to operate Martis Creek Dam and Reservoir for flood control and examining whether it should be operated to meet a different downstream flow target other than the 14,000 cfs currently specified in the Water Control Manual The USACE will attempt to secure this funding and conduct the necessary studies and improvements outside of this Water Management Options Pilot Study. However, as part of modeling and studying the alternative operational scenarios, this pilot study will take into account the effects of Martis Creek Dam being fully operational versus continuing to be subject to dam safety restrictions to document potential benefits of rehabilitating the dam and making it fully operational.

Another opportunity identified related to Martis Creek Dam and Reservoir addresses the current lack of water supply storage in the reservoir. If the dam were fully operational and water supply storage were allowed, it could improve water managers' ability to satisfy existing or future downstream water demands. The USACE would need to determine if a reallocation study would be required and may need to enter a written agreement as described in the Truckee River Operating Agreement, Section 5.b.5 (2008). Therefore, this change could not be implemented simply by updating the Water Control Manual. Additionally, there is uncertainty at this time regarding how the water would be used, and by whom. At this time, the Technical Team determined that implementing this action would be outside the scope of the current pilot study; however, the team recommends further study of the possibility of reallocating storage to water supply in Martis Creek Reservoir and identifying one or more potential users for the water through a separate effort.

Improving Forecast Skill and Accuracy

Workshop participants identified a problem centering on the fact that, even with improvements over time, forecasts still do not have all of the information about on-the-ground conditions. To address this, participants identified actions including adding more SNOTEL stations[4] (e.g., located at existing precipitation gages) to better represent the basin at lower elevations, on south-facing slopes, and other aspects. Additional data could also be collected through measuring soil moisture and better tracking and understanding the year's snowpack conditions to improve forecasts or through incorporating vertically pointed radar. However, these actions are not appropriate for addressing through updates to the Water Control Manual and should be pursued through separate efforts. At the same time, the Water Control Manual updates would be designed to be flexible enough to incorporate these types of improvements in forecasting skill whenever they are implemented, so that flood control and water management in the Basin can continue to be optimized as better information becomes available.

Further Evaluation and Study of Alternative Operational Scenarios

As described in **Section 1**, Need for the Pilot Study, additional detail will be added to the alternative operational scenario concepts through further study and modeling as part of the Water Management Options Pilot Study and eventual Viability Assessment. The next steps are for the Technical Team to further define the alternatives, including identifying and gathering the information needed to simulate the alternatives in models, such as RiverWare,[5] and evaluate effects. Modelers will also engage in sensitivity analyses to determine the changes caused by certain individual actions that make up part of the alternatives, such as the dynamic model-based approach to reservoir refill. As part of this process, specific parameters, such as updated downstream regulation goals or reservoir refill and drawdown model inputs, will be identified. Specific data needs associated with alternative actions were identified during Workshop 2. These may or may not need to be addressed as part of the Water Management Options Pilot Study.

It is possible that additional actions may be eliminated from the alternatives through further study. For example, if the Technical Team determines through modeling that changing the joint allocation of flood storage between Boca and Stampede reservoirs would increase the potential for downstream flood damage or would decrease the number of days complying with the Floriston Rates[6] because of the need to maintain more flood space in Boca Reservoir, this action would be eliminated from the alternatives.

This study will then be documented in a Viability Assessment with recommended changes to the Water Control Manual. This Viability Assessment will be provided to the USACE for consideration.

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[4] SNOTEL means snow telemetry.

[5] RiverWare is a river and reservoir modeling tool that can be used to support planning and forecasting.

[6] Floriston Rates are the rates of flow of the Truckee River at Floriston, California, as actually measured at the U.S. Geological Survey stream gaging station near Farad, California. They currently vary between 300 and 500 cfs depending on Lake Tahoe elevation and season. The rates originated from the 1915 Truckee River General Electric Decree between Reclamation and the Truckee River General Electric Company. These rates varied by season. The 1935 Truckee River Agreement modified these rates by adding a reduced Floriston rate based on the elevation of Lake Tahoe, and it required that Lake Tahoe and Boca Reservoir be operated to meet these rates in order to supply water for irrigation and municipal purposes, as well as hydropower generation.

The USACE will lead the National Environmental Policy Act compliance and any other environmental compliance efforts needed to update the Water Control Manual if it chooses to pursue that course of action.

References

Truckee River Operating Agreement. September 2008. https://www.troa.net/documents/TROA_Sep2008/troa_final_09-08_full.pdf.

USACE [United States Army Corps of Engineers]. 1985. Truckee River Basin Reservoirs, Truckee River, Nevada and California, Water Control Manual, US Army Corps of Engineers Sacramento District, 1985.

Appendix A

Workshop Attending Agencies

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Appendix A. Workshop Attending Agencies

Representatives of the following agencies attended and participated in the alternative operational scenarios development workshops:

Technical Team / Cost share partners

- Reclamation
- Truckee Meadows Water Authority
- Federal Water Master
- California Department of Water Resources
- Pyramid Lake Paiute Tribe

Other key stakeholders

- National Oceanic and Atmospheric Administration, California Nevada River Forecast Center
- Nevada Division of Water Resources
- Truckee River Flood Management Authority
- USACE
- Washoe County Water Conservation District

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Appendix B

Alternative Operational Scenarios Matrix

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Truckee Basin Water Management Options Pilot Study Preliminary Range of Alternative Operational Scenarios

Element	No Action - Alternative 1	Problem/Opportunity	Alternative 2 Action - Optimizing Storage for Fisheries and Water Supply	Alternative 3 Action - Dynamic Flood Risk Reduction Criteria	Alternative 4 Action - Updating Flood Risk Management	Alternative 5 Action - Hybrid Rule Curve
Reservoir refill	Flood control space required between 10 April and 5 July varies according to predicted snowmelt runoff. Space not required for flood control may be filled for conservation purposes. If forecasted runoff is higher than volumes specified by the rule curves, then additional reservoir flood space must be maintained to accommodate the increased flood threat and refill is delayed.	**Current rule curves miss opportunities for storing inflow**	Run operations off of a model based on anticipated operations, forecasted precipitation & temperature, existing snowpack, water yield, etc. (e.g., management on Boise River below Lucky Peak), accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.	Run operations off of a model based on anticipated operations, forecasted precipitation & temperature, existing snowpack, water yield, etc. (e.g., management on Boise River below Lucky Peak), accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.	Expand the set of rule curves based on a range of scenarios or periods and let the model decide which curve should be used, accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, downstream regulation goal, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.	Run operations off of a model based on anticipated operations, forecasted precipitation & temperature, existing snowpack, water yield, etc. (e.g., management on Boise River below Lucky Peak), accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.
Normal flood operations	If the flow at the Reno gage exceeds 6,000 cfs the Water Master directs the reservoir operators reduce releases and begin to store inflow into the flood space until the flow at Reno drops below 6,000 cfs. After the storm passes, the Water Master then directs the operators to begin evacuating the stored flood water from the flood space as quickly as possible without exceeding the 6,000 cfs at the Reno gage.	**The set flow through Reno at 6000 cfs may no longer be the reasonable threshold governing operations**	Update the cfs threshold number based on flood control improvements since 1985 Dynamic flow threshold based on modeling that takes into account completed flood control projects. Threshold number could change over time as more updates are made.	Identify updated cfs threshold at Reno and incorporate thresholds at Vista, and Wadsworth and manage in a given storm based on the location that is going to be the limiting one based on where the water is coming from. Dynamic flow threshold based on modeling that takes into account completed flood control projects. Threshold number could change over time as more updates are made.	Update the cfs threshold number based on flood control improvements since 1985 Dynamic flow threshold based on modeling that takes into account completed flood control projects. Threshold number could change over time as more updates are made.	Update the cfs threshold number based on flood control improvements since 1985 Dynamic flow threshold based on modeling that takes into account completed flood control projects. Threshold number could change over time as more updates are made.
Fall drawdown	The Flood Control Reservoirs must be drawn down to their mandated flood control storage levels by November 1st	**The current drawdown timing to have the reservoir down by Nov 1, can require water to be released faster than the demands below the reservoirs and in the lower river. This water could instead be conserved for later. It also makes it more difficult to meet instream flow requirements and could result in other biological impacts on factors such as temperature. This can also expose redds, Mountain Whitefish.**	Run operations off of a model based on anticipated operations, forecasted precipitation & temperature, existing snowpack, water yield, etc. (e.g., management on Boise River below Lucky Peak), accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.	Run operations off of a model based on anticipated operations, forecasted precipitation & temperature, existing snowpack, water yield, etc. (e.g., management on Boise River below Lucky Peak), accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.	Create a set of rule curves based on a range of scenarios or periods and let the model decide which curve should be used, accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.	Create a set of rule curves based on a range of scenarios or periods and let the model decide which curve should be used, accounting for operations forecasts, weather forecast, precipitation, current storage levels, climate seasonality, and other antecedent conditions Use pre-releases (drawing down the reservoir) within the flood storage space as needed to make corrections based on forecasts.
Flood space	Total maximum authorized flood control use space of 70,000 AF managed proportionally as listed below. Timing: Must be maintained from Nov 1 through at least April 10 Prosser – 20,000 AF Boca/Stampede – 30,000 AF (Boca minimum 8,000 AF of that) Martis Creek – 20,400 * 5,000 AF in Martis Creek Reservoir currently authorized/used as flood control use space but also contemplated in the WCM to be used in the future for conservation storage	**The WCM has not been updated to account for 2017 improvements to Stampede Dam**	Update Boca and Stampede flood space allocations and how they are split/operated jointly to have a wider range for the flood space in Boca (e.g., 5-40%) to provide more flexibility.	Update Boca and Stampede flood space allocations and how they are split/operated jointly to have a wider range for the flood space in Boca (e.g., 5-40%) to provide more flexibility.	Update Boca and Stampede flood space allocations and how they are split/operated jointly to have a wider range for the flood space in Boca (e.g., 5-40%) to provide more flexibility.	Update Boca and Stampede flood space allocations and how they are split/operated jointly to have a wider range for the flood space in Boca (e.g., 5-40%) to provide more flexibility.
Martis Creek Flood Operations	Control of flows in the Truckee River through the City of Reno to the design channel capacity of 14,000 cfs (Section 7-05 in WCM) – not currently operated to hold water back in flood conditions; passive flood storage/incidental flood control		Control of flows in the Truckee River through the City of Reno to the design channel capacity of 14,000 cfs (Section 7-05 in WCM) – not currently operated to hold water back in flood conditions; passive flood storage/incidental flood control	Control of flows in the Truckee River through the City of Reno to the design channel capacity of 14,000 cfs (Section 7-05 in WCM) – not currently operated to hold water back in flood conditions; passive flood storage/incidental flood control	Control of flows in the Truckee River through the City of Reno to the design channel capacity of 14,000 cfs (Section 7-05 in WCM) – not currently operated to hold water back in flood conditions; passive flood storage/incidental flood control	Control of flows in the Truckee River through the City of Reno to the design channel capacity of 14,000 cfs (Section 7-05 in WCM) – not currently operated to hold water back in flood conditions; passive flood storage/incidental flood control
Ramping Rates	Releases from the Truckee River Basin Reservoirs should not be increased or decreased by more than 1,000 cfs per hour (Section 7-14 in WCM)		Releases from the Truckee River Basin Reservoirs should not be increased or decreased by more than 1,000 cfs per hour (Section 7-14 in WCM)	Releases from the Truckee River Basin Reservoirs should not be increased or decreased by more than 1,000 cfs per hour (Section 7-14 in WCM)	Releases from the Truckee River Basin Reservoirs should not be increased or decreased by more than 1,000 cfs per hour (Section 7-14 in WCM)	Releases from the Truckee River Basin Reservoirs should not be increased or decreased by more than 1,000 cfs per hour (Section 7-14 in WCM)