SONOMA COUNTY WATER AGENCY

AND

MENDOCINO COUNTY RUSSIAN RIVER FLOOD CONTROL & WATER CONSERVATION IMPROVEMENT DISTRICT

TECHNICAL MEMORANDUM

DATE: DECEMBER 14, 2022

SUBJECT: LAKE MENDOCINO STORAGE AND RUSSIAN RIVER WATER SUPPLY PLANNING FOR 2022/2023

Background

On March 21, 2022, Sonoma County Water Agency (Sonoma Water) and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (Mendocino District) entered into a Memorandum of Understanding (MOU) concerning Lake Mendocino Storage Planning and Russian River Management. The MOU was developed in response to the regional drought that began in the spring of 2020 and establishes planning and management activities related to the shared water supplies in Lake Mendocino.

By May 2021, the State Water Resources Control Board (State Water Board) had issued notices of unavailable water in the upper Russian River and curtailments of all water rights occurred on August 2, 2021. The State Water Board followed up this action with the curtailments of a portion of the water rights in the lower Russian River on August 10, 2021. The arrival of an atmospheric river led to the suspension of all curtailments in the watershed on October 21, 2021. However, dry water supply conditions prevailed through much of the remainder of the wet season resulting in another year of water shortage and curtailments being issued after approval of the drought emergency regulation on June 1, 2022.

This technical memorandum is a documentation of the approach to assessing reservoir storage and water supply conditions in the upper Russian River for 2022 and 2023.

Purpose

In this technical memorandum, a methodology is documented along with the assumptions to evaluate water supply conditions that assists in allocation, planning and management of water supplies among

Lake Mendocino water uses under Sonoma Water's Permit 12947A, the Mendocino District's License 13898, and the Sonoma County Lake Mendocino Storage Reservation of 10,000-acre-feet available for post-1949 appropriative water rights along the mainstem of the Russian River.

Methodology

Sonoma Water shall utilize its Russian River reservoir/river operations model referred to as the Russian River System Model (RR ResSim) to perform updates to reservoir storage projections for Lake Mendocino on a monthly basis. RR ResSim simulates reservoir operations with a daily time step over an ensemble of hydrologic conditions. This process produces a range of storage projections that are statistically evaluated and presented based on end-of-year projected storage volumes. Additionally, to simulate the imports of Eel River water into the East Fork of the Russian River by the Potter Valley Project (PVP), a model referred to as the PVP ResSim model is used.

For each monthly projection update, the initial conditions are established by incorporating observed reservoir storage values, reservoir outflows, and PVP diversions. Starting with initial conditions, RR ResSim simulates the projection year using two hydrologic datasets: a) forecasted hydrology for the near-term conditions; and b) historical hydrology for the remainder of the year. A daily forecasted unimpaired streamflow dataset is developed by the California Nevada River Forecast Center (CNRFC) and is used for simulating the initial 30 days of the projection. The forecast dataset includes an ensemble of 42 potential future streamflows, representing a range of potential hydrologic outcomes for the next 30 days. The median ensemble member is selected to simulate the first 30 days of the projection. For the remainder of the projection RR ResSim uses a historical hydrologic dataset of unimpaired flows.

An ensemble of historical unimpaired streamflow hydrology is implemented to account for the variability and uncertainty in hydrology throughout the year. Over the projection period, multiple historical years are simulated with RR ResSim to establish the range of potential outcomes of reservoir storage in Lake Mendocino. The number of model scenarios that are simulated depends on the time of the year and the hydrologic conditions at the beginning of the projection.

For model simulations that start between June and January, all historical hydrologic years are included. The Russian River has highly variable precipitation in the early winter wet season and therefore all hydrologic years are evaluated to represent the range of potential outcomes based on the historical record.

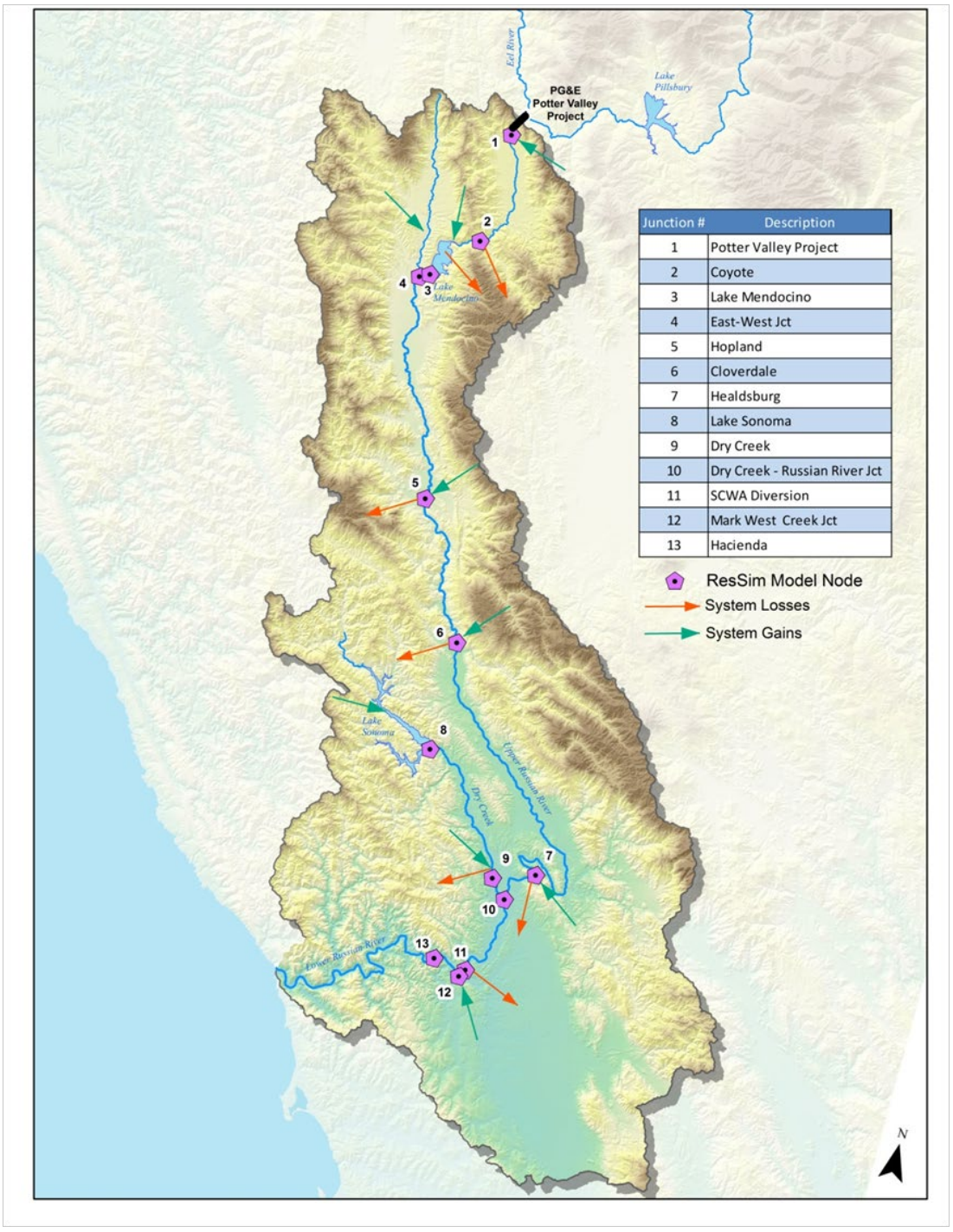
Between February and May typically most of the precipitation during the wet season has already occurred and therefore a subset of the hydrologic years is developed. The selection of hydrologic years for model simulations that begin between February and May is accomplished by analyzing observed and forecasted flows at the West Fork Russian River U.S. Army Corps of Engineers (USACE) stream gage (Russian River near Ukiah stream gage). The analysis identifies historical hydrologic years that are similar to the current forecasted stream flows. The West Fork is a mostly unimpaired tributary so the stream gage is used as a metric for unimpaired flows in that watershed and provides a reasonable representation of the watershed state in the Upper Russian River. Selection of similar historical hydrologic years is based on the CNFRC's West Fork 30-day ensemble flow forecast. The total 30-day flow volume for all the ensemble members is calculated and compared to the flow volume in historical years over the same 30-day period. Simulated historical hydrologic year with similar volumes compared to the flow forecast are selected for the model simulation.

Model Description

The Russian River System Model was developed by Sonoma Water using the USACE Hydrologic Engineering Center (HEC) software ResSim code for use as a planning tool to simulate the water supply responses to various climatic conditions, levels of demand and operational criteria and the availability of water to meet downstream minimum instream flow requirements and demands. Based on specific demand assumptions, RR ResSim calculates the required reservoir releases from Lake Mendocino and Lake Sonoma to meet those demands and minimum instream flow requirements in Sonoma Water's water rights permits under a range of potential hydrologic conditions for USACE reservoir operations criteria. While the RR ResSim model is a watershed model, the upper Russian River component is run independently of conditions in the lower Russian River with Lake Mendocino release decisions governed by upper Russian River conditions. Lake Sonoma release decisions in the model are dependent on conditions in Dry Creek and the lower Russian River as well as the streamflow contributions from the upper Russian River.

The RR ResSim model divides the Russian River and Dry Creek with 13 primary model junctions as presented in Figure 1. The model junctions correspond with important system features such as Potter Valley Project imports, reservoir dam releases, major tributary confluences and stream gage locations. The model reaches are defined segments of the Russian River or Dry Creek between the model junctions. Within the contributing watersheds for each individual reach, there are unimpaired flows (gains) and demands (losses) associated with municipal and industrial (M&I) diversions and other distributed water demands that are accounted for.

Figure 1: Schematic for Russian River System Model



RR ResSim accounts for losses in the Russian River system attributing depletions due to diversions under Sonoma Water's water rights and all other depletions from the watershed. The model aggregates system losses by reach at each downstream junction. RR ResSim model simulates reservoir operations to meet downstream depletion requirements, the minimum instream flow requirements, and operational buffers.

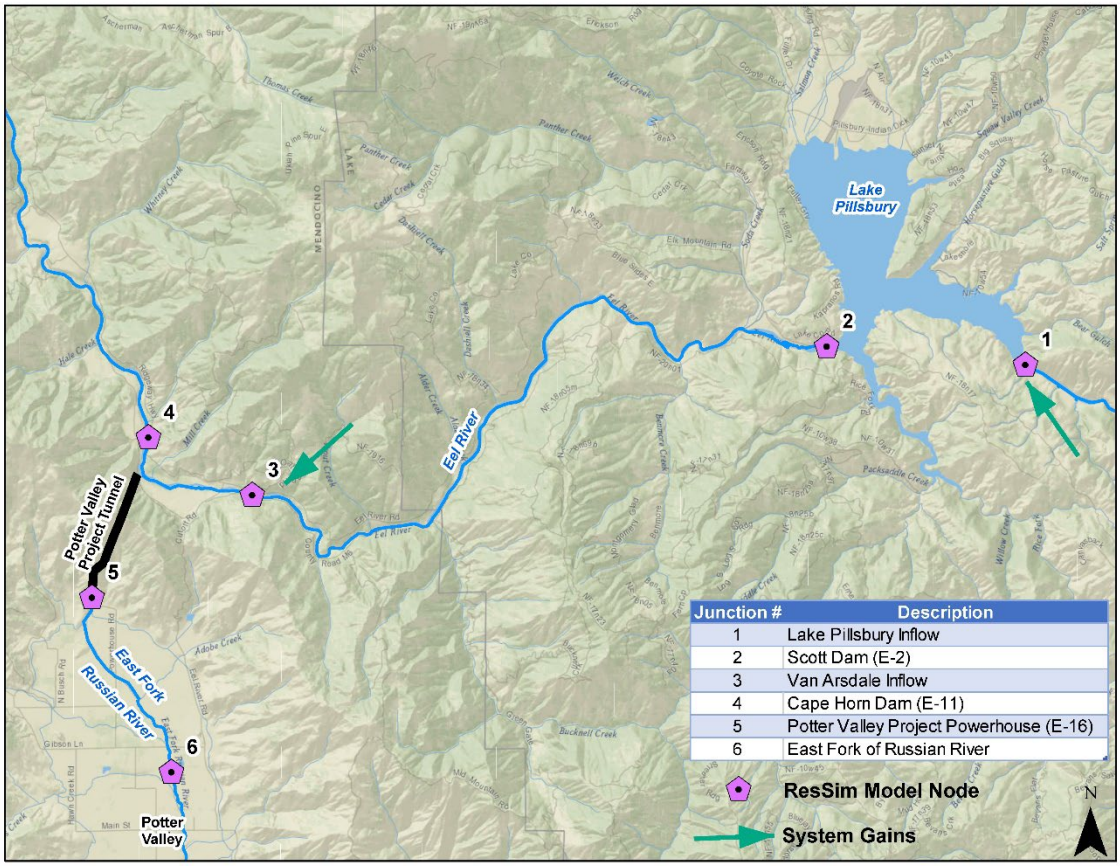
Hydrology

Unimpaired flows are the "natural" flows, unaffected by man-made influences, such as water demands, or reservoir operations. These unimpaired flows, which form the basis of the hydrology in the model, were synthetically derived by the U.S. Geological Survey using their Basin Characterization Model with historical weather, climate and hydrologic data inputs. RR ResSim incorporates 107 years of hydrologic data (WY1911 - WY2017) represented as daily unimpaired tributary flows into the Russian River and Dry Creek. As described above in the *Methodology* section, depending on the time of year and current flow forecasts, a subset of the complete hydrologic record may be used for model simulation.

Potter Valley Project Imports

Projected PVP imports (or diversions) by Pacific Gas & Electric (PG&E) are simulated using the PVP ResSim model. The PVP ResSim model was developed by the Water Supply Working Group as part of Congressman Jared Huffman's PVP Ad Hoc group. It was used to develop operational alternatives to PVP that met the Ad Hoc's objective of a Two-Basin solution. The model encompasses the Lake Pillsbury watershed down to the outlet of Cape Horn Dam (Van Arsdale Reservoir) along the Eel River (Figure 2). It simulates operations of Scott Dam (Lake Pillsbury) and Cape Horn Dam, as well as the inter-basin transfers of Eel River water to the East Fork Russian River for the PVP hydroelectric facility for a given set of physical and operational constraints based on the project's license from the Federal Energy Regulatory Commission (FERC) and water supply contracts with the Potter Valley Irrigation District (PVID). Similar to the RR ResSim model, it incorporates daily hydrology from WY1911 – WY2017. The hydrologic record was developed by Western Hydrologics using observed flows from gages at the reservoir outlets and the changes in storage at the reservoirs.

Figure 2: Schematic of Potter Valley Project ResSim Model



Since October 2021, PVP normal operations have been interrupted by the failure of the transformer bank at the PVP powerhouse. PG&E has announced its intent to repair and restart power generation, but to date there has been no schedule set for project completion. Without discretionary releases for power generation, the simulation of PVP operations is solely dependent on minimum flow requirements for the East Fork Russian River and PVID contract deliveries. Under normal operations, additional PVP transfers are used to increase power production when Lake Pillsbury storage levels are high during the late fall through early spring.

On July 27, 2022, FERC issued an order approving a temporary variance on the license flow requirements. The temporary variance reduced the minimum instream flow requirement on East Fork Russian River to 5 cfs (~300 ac-ft/month) until Lake Pillsbury storage reaches 36,000 ac-ft. The temporary variance also limits PVID contract deliveries to 12,000 ac-ft from during the diversion season (April 15 – Oct 15). The full historical hydrologic years in the PVP ResSim are used to determine for each simulation when the FERC temporary variance would expire and PVP operations return to the standard terms of its FERC license.

System Reach Losses and Demands

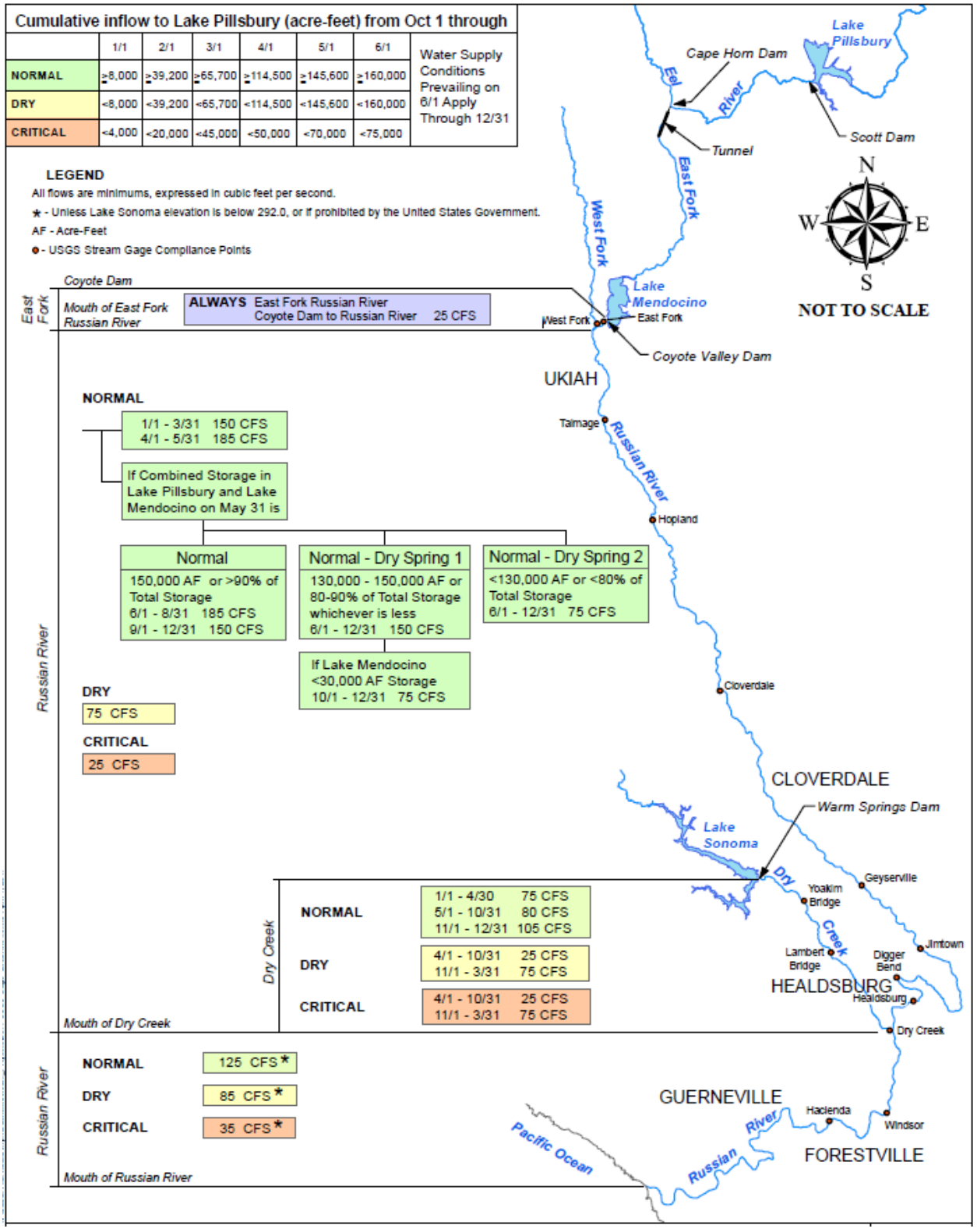
Reach losses, or depletions, in RR ResSim are categorized as either diversions under Sonoma Water's water rights or all other depletions from the watershed. System reach losses not associated with Sonoma Water diversions were estimated through an analysis of historical M&I data, streamflow gage data, unimpaired flow data, and climate data from 2002 to 2013. The depletions lump together losses from: a) evapotranspiration by riparian vegetation, b) aquifer recharge, c) agricultural diversions, and d) other M&I diversions. These reach loss patterns were adjusted for the months of July through October to match the total loss based on flow gage data observed in 2020. Because the model calculates the reservoir releases necessary to meet minimum instream flow requirements, all water uses in the watershed are satisfied by simulated reservoir releases.

Model demands for Sonoma Water are estimated based on river diversions from 2020 that totally approximately 55,000 acre-feet for the year. From July 1, 2022 through October 31, 2022, Sonoma Water diversions were projected based on meeting the diversion reduction term (Term 12) of the June 2022 Temporary Urgency Change Order that called for a reduction of 20% on 2020 diversions over the same period.

Minimum Instream Flow Requirements

Sonoma Water's water rights permits establish the minimum instream flow requirements in the Russian River and Dry Creek based on the determination of a water supply condition. This methodology was developed under Decision 1610. There are three main water supply conditions—Normal, Dry, and Critical—defined by Decision 1610 that are determined based on criteria for the calculated cumulative inflow into Lake Pillsbury from October 1 to the first day of each month from January to June. Decision 1610 defines cumulative inflow for Lake Pillsbury as the algebraic sum of releases from Lake Pillsbury, change in storage and lake evaporation. Decision 1610 further specifies two variations of the Normal water supply condition, commonly known as Dry Spring 1 and Dry Spring 2. These conditions provide for lower required minimum flows in the Upper Russian River during times when the combined storage in Lake Pillsbury and Lake Mendocino on May 31 is unusually low. The water supply condition criteria and minimum instream flow requirements are shown in Figure 3.

Figure 3: Russian River Basin Minimum Instream Flow Requirements



Due to the modified PVP operations and drought conditions, Sonoma Water has twice submitted Temporary Urgency Change Petitions (TUCP) in 2022. Sonoma Water's first request was to reduce the Decision 1610 minimum instream flow requirements, which was approved in the June 2022 Temporary Urgency Change Order. For model simulations spanning the period of the order, June 17, 2022 through December 13, 2022, the minimum instream flow requirements of 25 cfs was established for the upper Russian River and 35 cfs for the lower Russian River. Subsequently, Sonoma Water submitted TUCPs on October 28, 2022 requesting to modify the hydrologic index such that Lake Mendocino storage thresholds determine the water supply condition that establishes the minimum instream flow requirements. The changes under these TUCPs would begin the day the previous June 2022 order expires and update the water supply condition determination based on the thresholds. These pending changes are expected to end June 11, 2023. For model simulations spanning the period of the anticipated order, RR ResSim establishes minimum instream flow requirements based on the proposed Lake Mendocino storage thresholds. For all other time periods of the simulation, RR ResSim uses the Decision 1610 defined methodology to establish minimum instream flows.

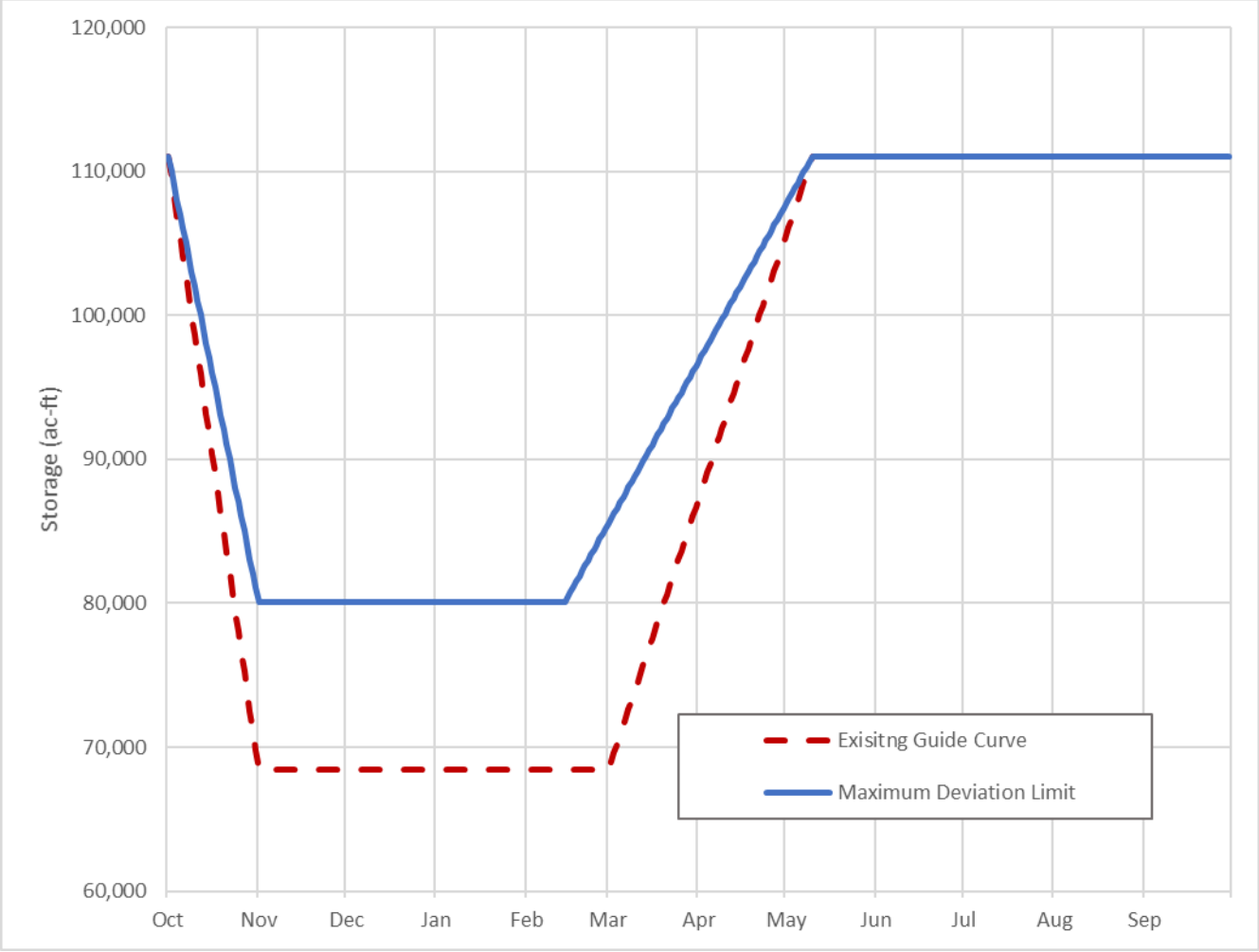
Reservoir Operations

RR ResSim simulates the operations of the reservoirs for water supply and determines transitions to flood control operations that are managed by the USACE. Sonoma Water operates the reservoir when it is below the flood control pool with operational decisions based on downstream demands and compliance with minimum instream flow requirements. The USACE makes operational decisions based on criteria in each reservoir's Water Control Manual. For these projections, USACE flood control operations are not considered.

RR ResSim simulates operations incorporating the reservoir rule curves of the Water Control Manual that delineate the storage levels between the water supply pool and flood control pool. For Lake Mendocino, the storage rule curve varies seasonally with a low storage of 68,400 acre-feet set over the wet season from November 1 through March 1. During the dry season, the storage rule curve is at its highest storage of 111,000 acre-feet from May 11 through October 1. The complete storage rule is shown on Figure 4. Lake Sonoma has a static year-round storage level of 245,000 acre-feet that delineates the water supply and flood control pools.

The Lake Mendocino Forecast Informed Reservoir Operations (FIRO) project has developed tools and protocols that have allowed additional encroachments of the water supply pool into the flood control pool. Currently, Lake Mendocino is operating under a Planned Major Deviation (Deviation) of the Coyote Valley Dam/Lake Mendocino Water Control Manual that was approved by the USACE in February 2021. The Deviation was approved to remain in effect through Water Year (WY) 2026 at the request of the Lake Mendocino FIRO Steering Committee. The Deviation allows USACE flood control managers to store up to an additional 11,650 acre-feet of water in the flood control pool at their discretion.

Figure 4: Lake Mendocino Storage Guide Curve



Operational Goals

The identification of operational goals are meant to establish a baseline to assess the adequacy of Lake Mendocino storage to meet projected downstream demands including minimum instream flow requirements. These downstream demands include:

i) Diversions and rediversions by the Mendocino District under License 13898
ii) Diversions and rediversions by Sonoma Water under Permit 12947A
iii) Rediversions by post-1949 water-right holders in Sonoma County under the 10,000 acre-foot storage reservation

On the basis of water right priorities, diversions and rediversions under the Mendocino District's License 13898 and Sonoma Water's Permit 12947A have equal priorities. However, diversions under Sonoma Water's Permit 12947A are conditioned with a lower priority if the water is exported outside of the Russian River Valley per Term 22 of Permit 12947A. Exports under Permit 12947A are also assigned a lower priority than post-1949 water-right holders under the 10,000 acre-foot storage reservation. In Term 23 of Permit 12947A, post-1949 water-right holders access to the 10,000 acre-foot storage reservation is conditioned on the availability of water to meet minimum instream flow requirements.

Diversions by Sonoma Water with end uses within the Russian River watershed, on an annual basis, are approximately 45% of the total diversions.

Only minimum instream flow requirements in the upper Russian River are considered by the RR ResSim model for simulating Lake Mendocino releases.

For these model simulations, all diversions and rediversions by Sonoma Water are assumed to be satisfied by natural flows and releases from Warm Springs Dam. Therefore, the priority of rights to Lake Mendocino storage from highest to lowest are:

1) Minimum instream flow requirements
2) Diversions and rediversions by the Mendocino District under License 13898
3) Rediversions by post-1949 water-right holders in Sonoma County under the 10,000 acre-foot storage reservation

Projections of Lake Mendocino storage are evaluated based on end of water year storage. The ensemble forecast approach produces a predicted range of potential end of year storage values. Median and 10th-percentile values are reviewed for assessing potential alert or action activities.