WaterSMART

Basin Study Program – Applied Science Tools

BUREAU OF RECLAMATION

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Tools to Support Klamath River Operations

New forecasting and modeling tools provide flexibility to allow for changes in operations and infrastructure.

Location

The Bureau of Reclamation (Reclamation) Klamath Basin Area Office (KBAO) delivers water to the Klamath Project, supplying water to more than 230,000 acres of irrigated farmland along the border between Oregon and California, and manages water resources in the Upper Klamath River basin (Figure 1) to support multiple objectives.

Overview

The Klamath River basin has complex river management challenges, including Endangered Species Act (ESA) compliance, ongoing water rights adjudications, projected changes in the occurrence of droughts and floods, and potential dam

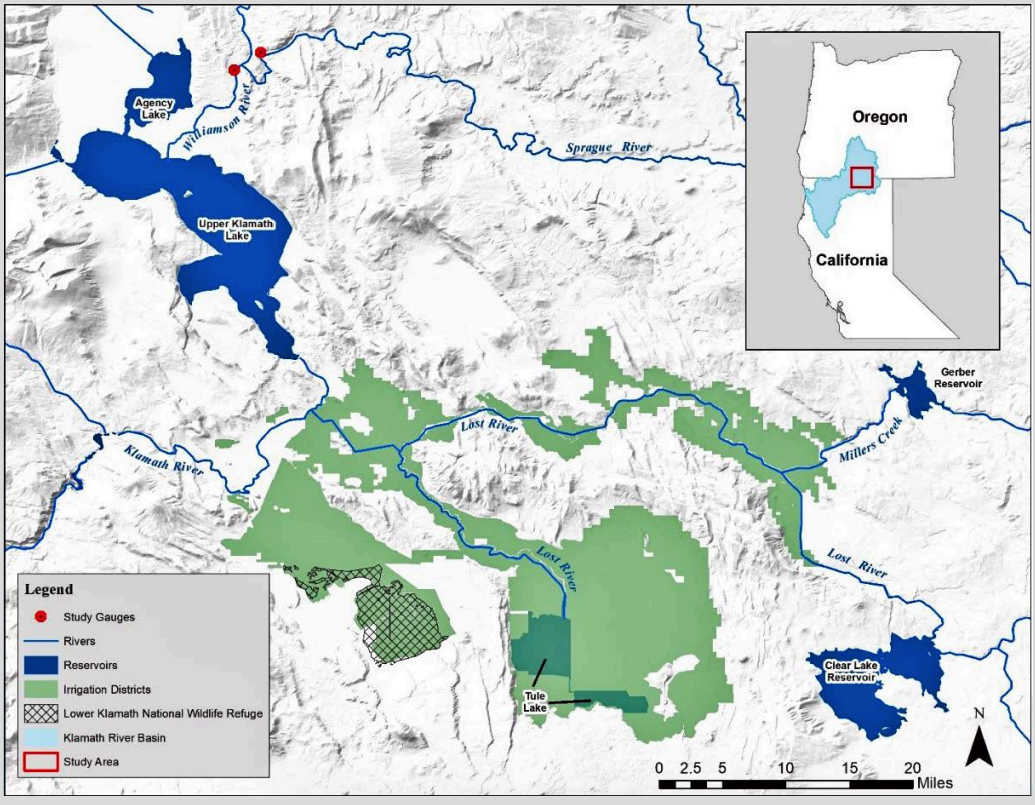

Figure 1. Map of Klamath River Operations Model area.

removals, all contributing to wide variability in water management outcomes. These conditions elevate the need for transparency with stakeholders and flexible modeling tools to effectively handle changing conditions in the Basin. Reclamation's Technical Service Center (TSC) and KBAO have worked together to develop tools to support the complex system operations needs in the Basin.

Reservoir Operations Pilot Study

Reclamation's KBAO, TSC, and California-Great Basin (CGB) Region partnered with the National Center for Atmospheric Research (NCAR) to conduct a Reservoir Operations Pilot Study (Pilot Study) to identify strategies to use multiple streamflow and water demands forecasts in a new operational framework. Reliable water supply forecasts are important to enable KBAO operators to navigate the complex basin hydrology and to address competing water demands. Regional precipitation in the upper Klamath River basin is highly variable, ranging from 10 to 70 inches per year. Recently, droughts leading to water shortages have created very challenging conditions for operators charged with meeting needs for endangered fish, agriculture and tribes. Additionally, up to 70 percent of irrigation season water supply is stored naturally as snowpack, requiring water managers to quantify snowmelt from the upper part of the basin as accurately as possible.

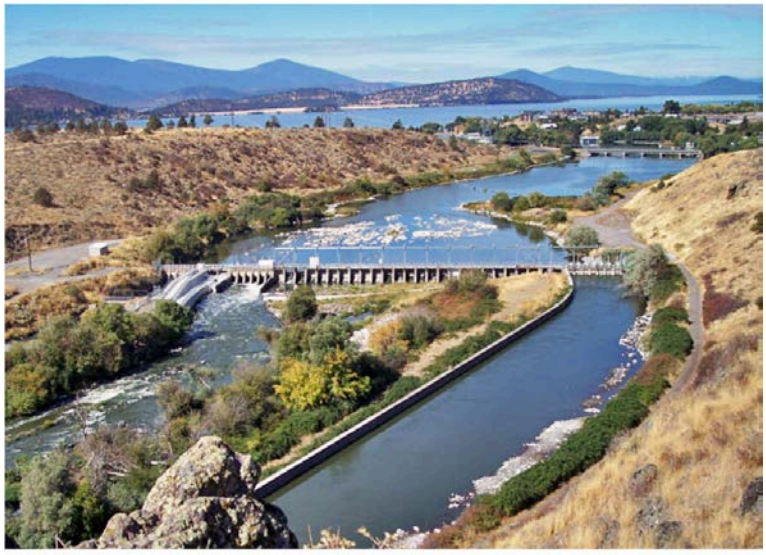

Figure 2. Link River Dam, Klamath Falls, Oregon.

KBAO currently uses a median, or "most likely" water supply forecast for Upper Klamath Lake to predict likely irrigation season water supply according to the current Biological Opinion. The Pilot Study examined whether using multiple streamflow forecasts to identify a range of scenarios (ensemble forecasts) could better inform water managers what to expect early in the season to support operational decisions. Pilot Study partners successfully developed ensemble forecasts of irrigation season water supply and demonstrated that these forecasts—together with water demand forecasts—can be used with a water operations model to assess impacts to water deliveries. The Pilot Study partners further determined that limitations with the existing water operations model precluded full use of the ensemble forecasts for risk-based decision making, motivating the development of a new water operations model.

Operations Model Capabilities and Benefits

Water managers at KBAO are required to make highly consequential decisions with short lead times that balance competing objectives and adhere to water management policy. Further, Klamath Project operations under drought conditions require collaborative coordination between KBAO, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and stakeholders, including water users and tribes. Coordinating operations requires flexible tools that allow different operational scenarios to be explored and incorporated. The existing spreadsheet-

based model is difficult to change and lacks the computing and reporting capabilities to meet the needs of operators and stakeholders.

The Klamath River Operations Model (KROM), developed by the TSC and the University of Colorado Center for Advanced Decision Support for Water and Environmental Systems in collaboration with KBAO, has the capability to make use of ensemble water supply forecasts, which is anticipated as the basin moves toward a risk-based management approach. The use of RiverWare software will also allow water managers to explore operational scenarios and trade-offs between management objectives including fish and wildlife goals, irrigation purposes, and flood control. The KROM has the computing ability and flexibility to support efficient, real-time decision making for KBAO, including assessment of various operational approaches and the resulting impacts to Upper Klamath Lake, the Klamath River, and available water supply for Klamath Project irrigators.

One of the greatest benefits of using the KROM for daily operations is the improved transparency with stakeholders, including the NMFS, and USFWS. The KROM can be used to efficiently generate water supply reports that reduce the potential for miscommunication regarding operations. KBAO can also allow these entities to run model scenarios themselves, significantly improving transparency regarding operational status and decision making.

Implementing the KROM for daily operations will result in a significant savings in staffing resources by automating water supply accounting and reporting and reducing reporting errors. The provision of a stable platform through KROM, with fewer data related errors will also reduce operational mistakes and regulatory violations.

Next Steps

The KROM is currently being tested and will be adopted by KBAO for the 2021 irrigation season. With the flexibility of the RiverWare software, discussions are ongoing between the study team, including KBAO, NMFS, and USFWS on further development of the KROM for use in support of ESA consultation. The use of a consistent modeling platform to support both daily water management and development of new operational policy eliminates the need for multiple modeling platforms. Moreover, use of the RiverWare-based model to compare different operating scenarios can assist in the development of new operating policies. The approach used to develop the KROM can also be used by other Reclamation offices in need of a more flexible and transparent operations model.

Additional Information

Useful Links

Applied Science Grants
https://www.usbr.gov/watersmart/appliedscience/

Pilot Study Final Report Press Release
https://www.usbr.gov/watersmart/pilots

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