Web-Based Decision Support System for the Upper Colorado River Basins

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To improve coordination and transparency of water management operations within the Upper Colorado River basin, Eastern Colorado Area Office developed a Web-Based Decision Support System that allows real-time sharing of a visual representation of the Upper Colorado River as it responds to actual and anticipated reservoir releases, diversions and return flows.

As manager of Green Mountain Reservoir, ECAO facilitates coordination meetings with stakeholders responsible for the management and operations of storage reservoirs and irrigation diversions in the Upper Colorado River basin from the Colorado River headwaters to the confluence with the Gunnison River in Grand Junction, Colorado.

Frequently, operation changes occur at multiple reservoirs and diversions. In the past, the projected flow at targeted locations based on these changes were roughly estimated by hand by the participants in the meetings. These estimates were difficult to determine in

real-time due to the various reservoirs and diversions, numerous tributaries, and transit times and losses associated with long river distances.

The DSS has improved the quality of discussion of the HUP meetings. The user-friendly web service allows to share modeling outputs in real-time, which has been extremely helpful to evaluate proposed operations.

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Web-Based Decision Support System for the Upper Colorado River Basins

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Acronyms and Abbreviations

CAMC2	Forecast point identifier for Cameo
CAMPALCO	Cameo to Palisade net diversion change time series identifier
CAWC2D	Windy Gap pump
CBRFC	Colorado Basin River Forecast Center
CGYC2	Forecast point identifier for Palisade
CRWCD	Colorado River Water Conservation District
CWCB	Colorado Water Conservation Board
DNR	Department of Natural Resources
DSS	Decision Support System
ECAO	Eastern Colorado Area Office
EGLC2	Forecast point identifier for Dotsero
GVWUA	Grand Valley Water User Association
HDB	Hydrologic Data Base
HUP	Historic User Pool
K	Attenuation parameter for routing model
KRMC2	Forecast point identifier for Kremmling
IMAP	Internet Message Access Protocol
MDA	Mail Delivery Agent
NCWCD	Northern Colorado Water Conservancy District
Lag	Time delay parameter for routing model
OFS	Operational Forecast System
OMID	Orchard Mesa Irrigation District
Q	Discharge
Reclamation	Bureau of Reclamation
TSTool	Time Series Tool
USFWS	U.S. Fish and Wildfire Service
WCAO	Western Colorado Area Office

Measurements

cfs	cubic feet per second
hrs	hours

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Executive Summary

To improve coordination and transparency of water management operations within the Upper Colorado River basin, Eastern Colorado Area Office (ECAO) developed a Web-Based Decision Support System (DSS) that allows real-time sharing of a visual representation of the Upper Colorado River flow as it responds to actual and anticipated reservoir releases, diversions and return flows.

As manager of Green Mountain Reservoir, ECAO facilitates coordination meetings with stakeholders responsible for the management and operations of storage reservoirs and irrigation diversions in the Upper Colorado River basin from the Colorado River headwaters to the confluence with the Gunnison River in Grand Junction, Colorado. These coordination meetings occur at least weekly during the irrigation season and is called the Historic User Pool (HUP) coordination call. A key aspect of these meetings is to share information regarding quantity and timing of reservoir releases, diversions, and return flows that impact flows in the 15-Mile Reach of the Colorado River. The 15-Mile Reach lies immediately upstream of the confluence with the Gunnison River and is identified as a critical stream reach for the recovery of Colorado River endangered fish. The U.S. Fish and Wildlife Service (USFWS) has defined a suite of recommended flows for this reach that are tiered to the hydrologic condition. Additionally, the HUP meetings identify and coordinate storage releases necessary for irrigation and replacement for out-of-priority diversions.

Building upon written statements of conditions and plans by some of the stakeholders, the meeting often includes stakeholders explaining those or other plans during a weekly HUP conference call. Frequently, operation changes occur at multiple reservoirs and diversions. In the past, the projected flow at targeted locations based on these changes were roughly estimated by hand by the participants in the call. These estimates were difficult to determine in real-time due to the various reservoirs and diversions, numerous tributaries, and transit times and losses associated with long river distances. This Science and Technology project answered the question: will a web based DSS improve coordination, transparency and efficiency of water management decisions in the Upper Colorado Basin?

The developed DSS provides a tool for immediately assessing and visually displaying the aggregate effects of operational changes at key locations within the basin including: Colorado River near Kremmling (KRMC2), Colorado River near Dotsero (EGLC2), Colorado River near Cameo (CAMC2) and Colorado River below Grand Valley Canal near Palisade (CGYC2).

The DSS relies on two major inputs: 1) Projected reservoir releases and net diversion changes in the Cameo to Palisade reach, and 2) Forecast local area streamflow. The regulated flows are provided by stakeholders, operators, and to a lesser extent, the Colorado Basin River Forecast Center (CBRFC). The forecast local area flow time series, provided by CBRFC, represent the hydrologic response of each individual sub-basin due to driving forces such as rainfall and temperature. Aggregating and routing algorithms simulate the total flow at the points of interest (KRMC2, EGLC2, CAMC2, CGYC2) in real time. Model outputs are disseminated to the stakeholder via a web service.

The DSS has proved to improve the quality of discussion of the HUP meetings. The user-friendly web service allows the sharing of modeling outputs in real-time, which has been extremely helpful to evaluate proposed operations at the time of the meetings. Also, ECAO has employed the DSS to evaluate the effect of different releases from Green Mountain Reservoir and make recommendations prior and after the meetings.

Introduction

Reclamation's Eastern Colorado Area Office (ECAO) is responsible for the management of Green Mountain Reservoir located in the Blue River, a tributary of the Upper Colorado River. As manager of this reservoir, ECAO facilitates the HUP coordination meetings with the stakeholders responsible for the management and operations of storage reservoirs and irrigation diversions in the Upper Colorado River basin from the Colorado River headwaters to the confluence with the Gunnison River in Grand Junction, Colorado (Figure 1).

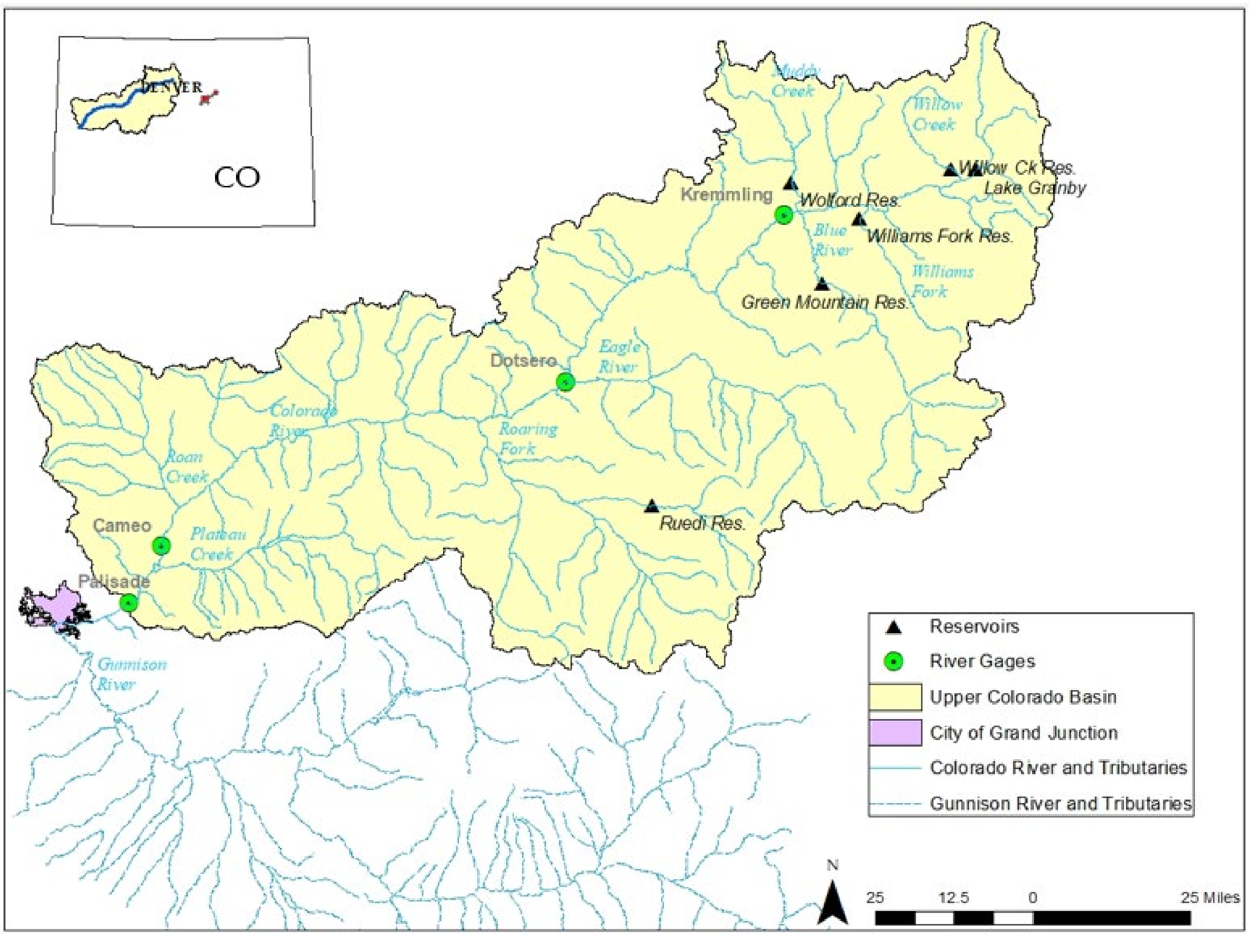


Figure 1. Map of the Upper Colorado River basin from the headwaters to just upstream from the confluence of the Colorado River with the Gunnison River including reservoirs and mainstem gages.

The HUP meetings occur on a weekly basis during the irrigation season. A key aspect of these meetings is to share information regarding quantity and timing of reservoir releases, diversions, and return flows that impact flows in the 15-Mile Reach of the Colorado River. The 15-Mile Reach lies immediately upstream of the confluence with the Gunnison River and is identified as a critical stream reach for the recovery of Colorado River endangered fish. The USFWS defines a suite of recommended flows for this reach that are tiered to the hydrologic conditions. Furthermore, the HUP meetings identify and coordinate storage releases necessary for irrigation and replacement of out-of-priority diversions.

Building upon written statements of conditions and plans by some of the stakeholders, the meeting often includes stakeholders explaining those or other plans during a weekly HUP conference call. Frequently, operation changes occur at multiple reservoirs and diversions. Historically, the projected flow at targeted locations based on these changes were roughly estimated by hand by the participants in the call. These estimates were difficult to determine in real-time due to the various reservoirs and diversions, numerous tributaries, and transit times and losses associated with long river distances. In an effort to improve the coordination and transparency of water management decisions and operations during the HUP meetings, ECAO developed a Decision Support System (DSS) to estimate, in real-time, streamflow projections along the Upper Colorado River main steam based on what-if reservoir outflow scenarios. The system is also used by ECAO for planning Green Mountain potential releases prior to the HUP meeting.

The DSS was conceptualized and developed as the integration of three major components:

1) Procedures to ingest model forcings to ECAO's Hydrologic Data Base (HDB) by hand and automatically.
2) A hydrologic model to simulate projected streamflow traces at four locations along the Upper Colorado River in real-time.
3) A website accessible by all stakeholders to display in graphical and tabular format the model inputs and outputs.

ECAO partnered with Colorado Basin River Forecast Center for the development of modeling routines. ECAO also partnered with the Colorado River Water Conservation District (CRWCD), the State of Colorado, Department of Natural Resources (DNR), Division of Water Resources and Colorado Water Conservation Board (CWCB), Denver Water Board (DWB), Grand Valley Water User Association (GVWUA), Orchard Mesa Irrigation District (OMID), Western Colorado Area Office (WCAO), U.S. Fish and Wildlife Service (USFWS), and Northern Colorado Water Conservancy District (NCWCD) to form a volunteer advisory board that provided in-kind contributions of time for review, providing data and testing participation.

Methods

This section describes the components of the DSS including modeling details and data collection and dissemination methods. The DSS consists of three major components: 1) Data Loaders, 2) Hydrologic Model, and 3) Online Dissemination Tool as shown in Figure 2. HDB is the data hub for the system. All system components communicate through HDB. The hydrologic model forcings are received from CBRFC and from the reservoir operators. Input data are saved in HDB, except for the CBRFC data file which is posted in CBRFC's website and downloaded and saved in ECAO's network.

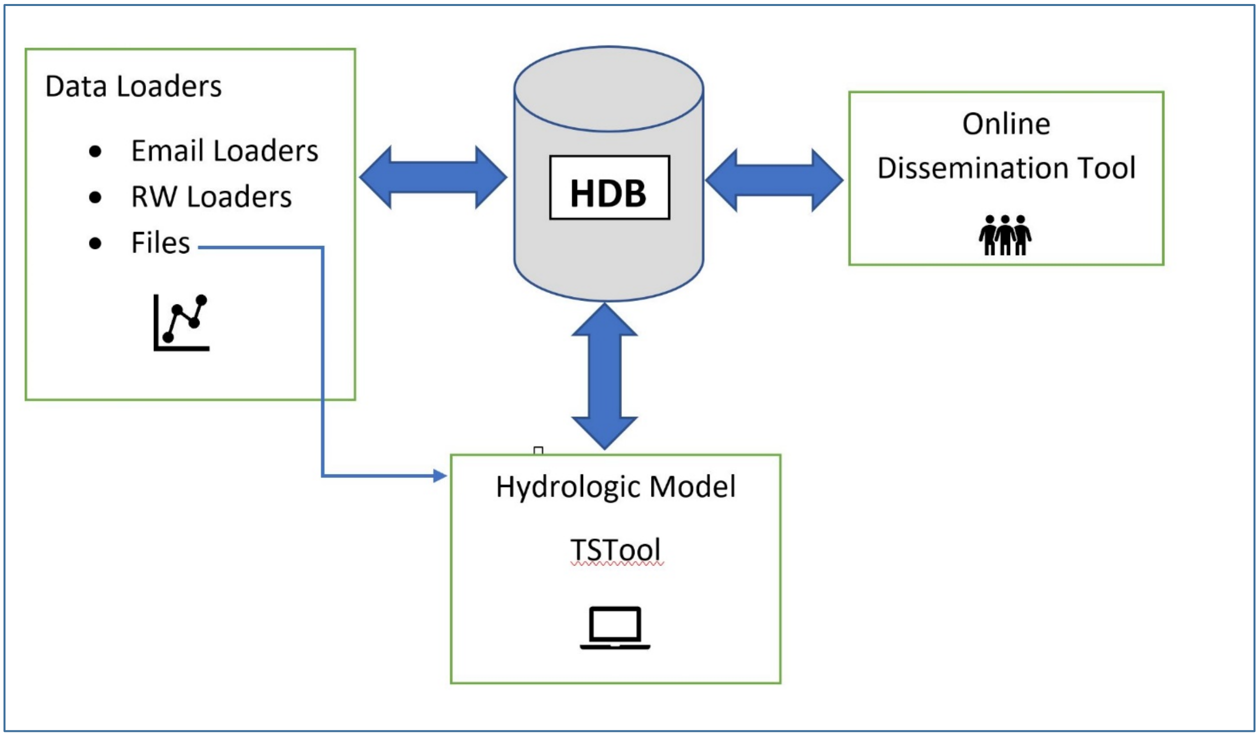


Figure 2. Major components of the DSS. All components are connected to HDB.

Data Loaders

Data loaders are the applications used to acquire the input data for the system and to save the data in HDB automatically. CBRFC's posts a comma-delimited file (hup_dss.csv) with the flow forecast times series in the CBRFC's web site (https://www.cbrfc.noaa.gov/outgoing/hup/). CBRFC keeps an archive of all files in this same website. Therefore, ECAO does not need to keep the historical records in HDB. A perl script was developed to download the file from CBRFC's website every morning and save it in ECAO's Linux server. Thus, the file is replaced every morning with a new updated file. The hydrologic model accesses this file from the server, reads it and processes the data.

Email Loader

This loader works using a delegated email account within Reclamations Bison Connect email system. The external client sends an email to the delegated account with a certain subject line and attached data file. The subject line and attached data file must always have the same naming convention. Filters within the delegated email account move incoming email to folders depending on the subject line and attached files. On the Linux server side, *Fetchmail* is running with a configuration that connects to the outlet.office365.com Internet Message Access Protocol (IMAP) server port 993 and fetches all mail within the folders defined in the delegated email account. *Fetchmail* is an open source software utility that saves the emails from the remote IMAP server to the user's local system (Linux server in this case).

This process is constantly running so as soon as a new email is received by the delegated account and is moved to the folders, Fetchmail will fetch it to the server. Once the email is on the server, a *.foward* file directs mail processing to a certain user account where *Procmail* processes the message for certain criteria. *Procmail* is what is called a mail delivery agent (MDA), which sorts the incoming mail to the locations specified in a *Procmail* configuration file. The *Procmail* configuration file contains the criteria for filtering the messages and the location to the processing scripts that ultimately load the data in the attached files to the Oracle database (HDB). There are normally two scripts that process the emails that *Procmail* has flagged for processing. The first, a Perl script, separates the email body and the attachments into directories. The second script is a TSTool command file that opens the attached file, reads the data, and writes the data to HDB. There are also some error files that get written from standard output for debugging purposes.

Of the six reservoirs in the system, four reservoirs are operated by Reclamation and two by external partners. DWB manages Williams Fork Reservoir and the CRWCD manages Wolford Reservoir. Emailed loaders were developed to parse and save automatically projected release data in HDB for the two reservoirs. However, only the Williams Fork loader is used. Wolford projected releases are assumed to be constant and equal to the current release most of the time and therefore, they are entered by hand as described in the following section.

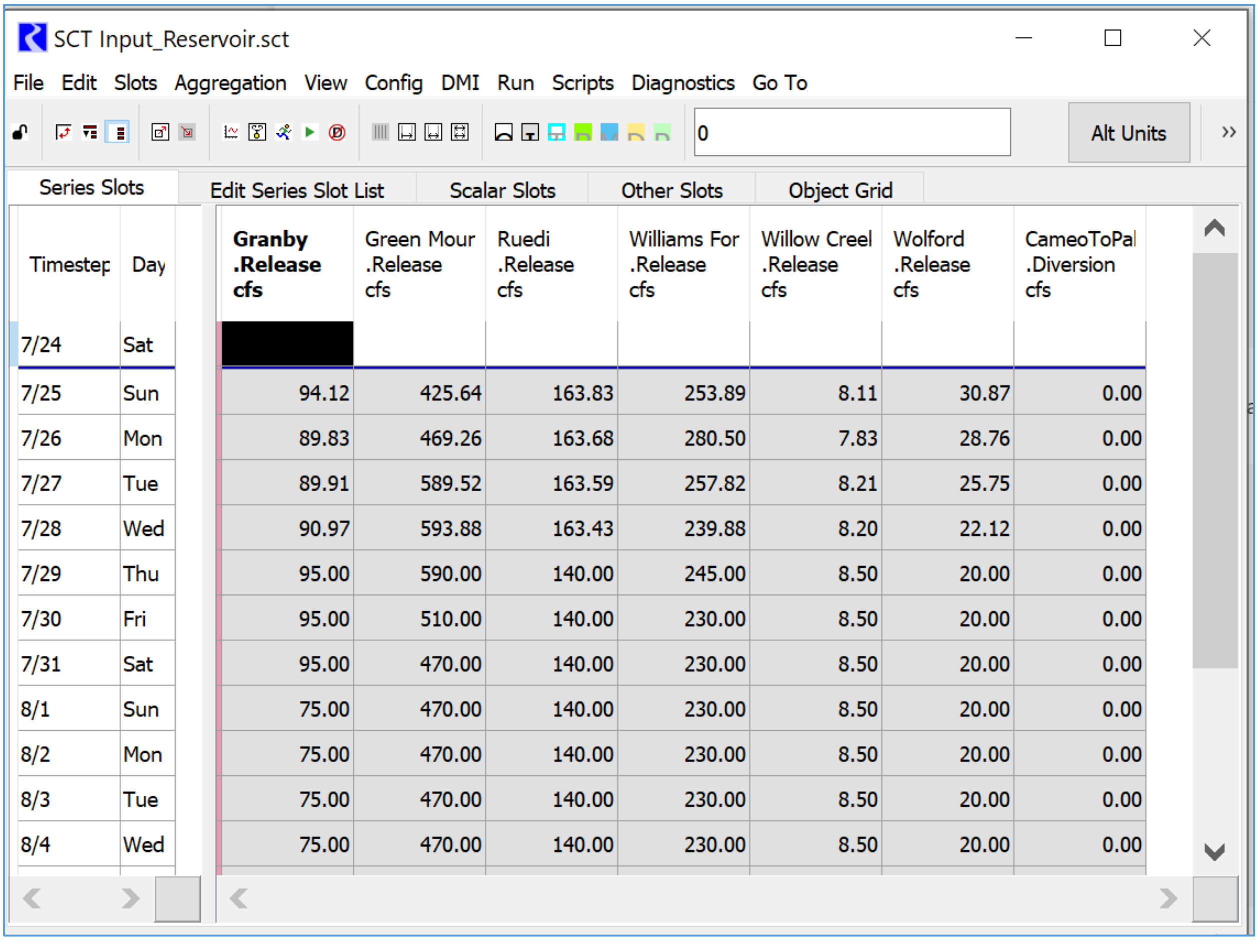
RiverWare Loader

The RiverWare loader allows preparation and saving of release and net diversion data to HDB in a proper format used by the DSS. The loader comprises a RiverWare model file, including Data Management Interfaces (DMI), and a Simulation Control Table (SCT) plus manual procedures including copying data from an HDB Poet script display table.

Prior to the HUP meeting, the DSS operator opens the RiverWare loader and uses the import DMI to read time series from HDB containing projected reservoir release and net diversion data. The SCT (Figure 3) displays the imported data for review and allows manual entering or editing of projected data used by the DSS model.

The operator uses an HDB Poet template file to create a display table of observed data queried from HDB. These observed data are copied from the display table into the SCT, for five days of recent observations. The DSS's routing model uses observed data as initial conditions to route reservoir release data from the headwaters to the Palisade gage.

The operator of the DSS then uses the export DMI to place the data into HDB where they can later be used by the DSS. The editing and exporting process can be used during the HUP meeting to create new scenarios for consideration during decision making.



Timestep	Day	Granby .Release cfs	Green Mour .Release cfs	Ruedi .Release cfs	Williams For .Release cfs	Willow Creel .Release cfs	Wolford .Release cfs	CameoToPal .Diversion cfs
7/24	Sat							
7/25	Sun	94.12	425.64	163.83	253.89	8.11	30.87	0.00
7/26	Mon	89.83	469.26	163.68	280.50	7.83	28.76	0.00
7/27	Tue	89.91	589.52	163.59	257.82	8.21	25.75	0.00
7/28	Wed	90.97	593.88	163.43	239.88	8.20	22.12	0.00
7/29	Thu	95.00	590.00	140.00	245.00	8.50	20.00	0.00
7/30	Fri	95.00	510.00	140.00	230.00	8.50	20.00	0.00
7/31	Sat	95.00	470.00	140.00	230.00	8.50	20.00	0.00
8/1	Sun	75.00	470.00	140.00	230.00	8.50	20.00	0.00
8/2	Mon	75.00	470.00	140.00	230.00	8.50	20.00	0.00
8/3	Tue	75.00	470.00	140.00	230.00	8.50	20.00	0.00
8/4	Wed	75.00	470.00	140.00	230.00	8.50	20.00	0.00

Figure 3. RiverWare System Control Table used to read and write data from and to HDB.

Appendix A contains a summary of the time series defined in HDB for each of the loaders and a copy of the TSTool scripts use to read and load the data in HDB.

Hydrologic Model

ECAO worked in conjunction with CBRFC to develop a simplified hydrologic model to simulate the streamflow response to reservoir releases between the Kremmling gage and the Palisade gage (Figure 1). The hydrologic modeling tool for the HUP DSS consists of two main parts: 1) CBRFC's computation of adjusted *local* streamflow that do not account for reservoir releases; and 2) ECAO's computation of adjusted *total* streamflow that account for reservoir releases.

1) CBRFC adjusted *local* streamflow: The modeling of streamflow for the DSS relies on CBRFC's deterministic streamflow forecasts. CBRFC's hydrologic model for the Upper Colorado Basins is complex and accounts for snow accumulation and ablation and rainfall-runoff processes, multiple reservoir releases and depletions and return flow models. Stick diagrams of CBRFC's forecasting system implementation are available at: https://www.cbrfc.noaa.gov/wsup/guide/stickdiagrams/uc_abvkrem.pdf, https://www.cbrfc.noaa.gov/wsup/guide/stickdiagrams/uc_kremtoglen.pdf and,

https://www.cbrfc.noaa.gov/wsup/guide/stickdiagrams/uc_glentopowell.pdf.

CBRFC models the streamflow generated in each of the sub-basins shown in Figure 2 and issues official forecasts at the Kremmling, Dotsero, Cameo and Palisade gages. At each gage, the total simulated flow time series is adjusted to match the observed flow using an operation named Adjust-Q (533adjustq.pdf (noaa.gov)). With this adjustment, the bias between the simulation and the observed is not propagated to the next downstream gage. The forecast traces at these gages are called adjusted *total* streamflow time series.

Of particular interest to the stakeholders are the adjusted *total* streamflow forecast at the Cameo and Palisade gages located in the lower part of the study reach and just upstream of the 15-Mile Reach. Often is it difficult to achieve flow targets at the 15-Mile Reach due to major water diversions for the federal Grand Valley Project and at the private Grand Valley Irrigation Company, located between the Cameo and the Palisade gages.

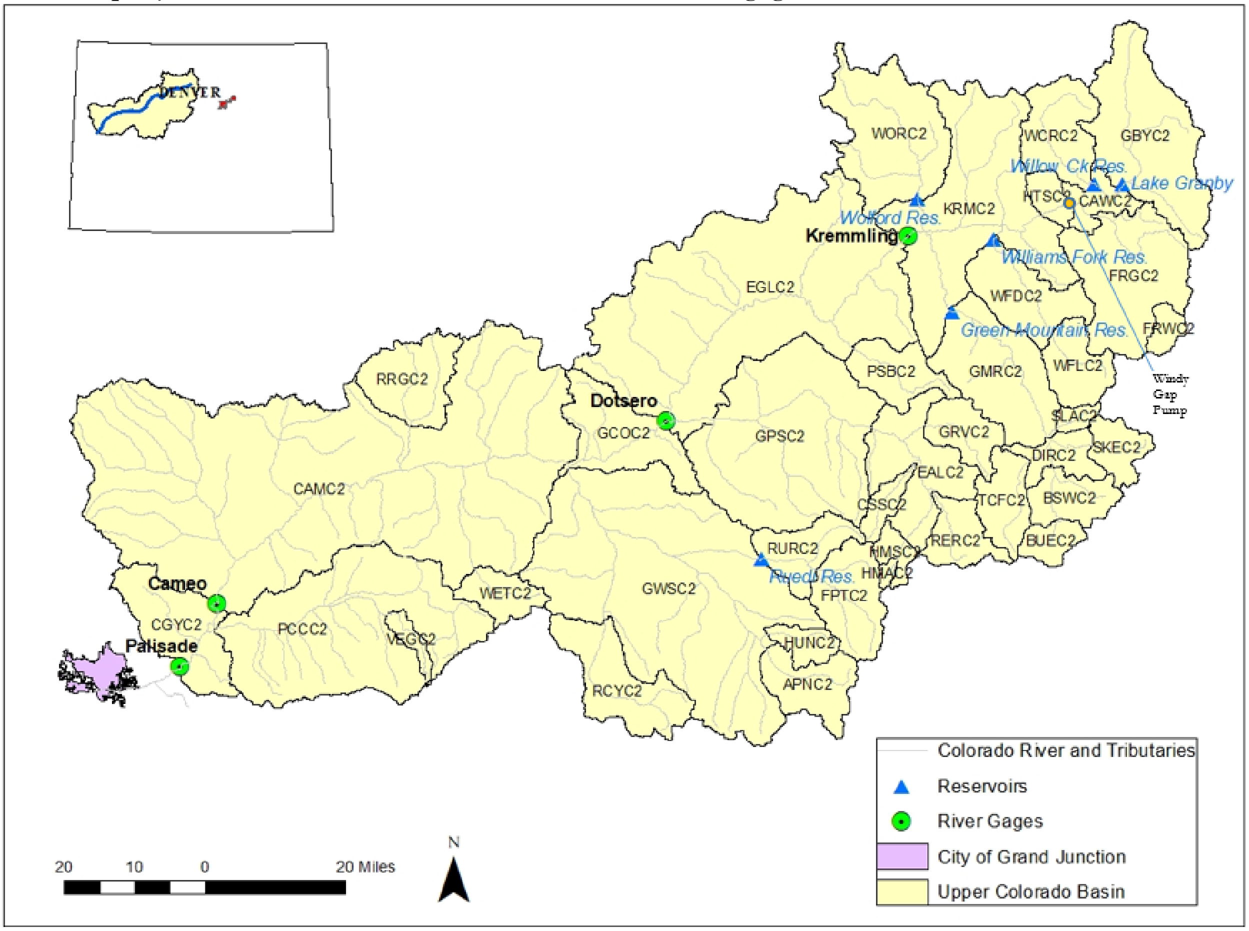


Figure 4. Sub-basin delineation of the Upper Colorado River Watershed as modeled by the CBRFCs official streamflow forecast system.

For this project, CBRFC developed a simplified hydrologic model that removes the effect of reservoir releases from the adjusted *total* streamflow time series at each of the gages. CBRFC's simplified forecast system implementation was performed using the National Weather Service River Forecast System (NWSRFS) models under the Flood Early Warning System (FEWS) platform.

These time series that do not account for the effect of reservoir releases are called adjusted *local* streamflow time series. Figure 5 depicts the configuration of the sub-basins modeled with the simplified approach. The adjusted *local* streamflow time series correspond to the flow generated in each one of the local areas above the main gages identified in the map. These adjusted *local* streamflow time series include the effect of diversions and return flows within those basins. Four adjusted *local* streamflow time series are issued by CBRFC and posted in a comma-delimited file in the CBRFC's web site.

- Kremmling (KRMC2):

KRMC2 adjusted local = KRMC2 adjusted total - **MBWC2 (Wolford) routed** - **BGMC2 (Green Mountain) routed** - **WFRC2 (Williams Fork) routed** - **CBGC2 (Granby) routed** - **WCKC2 (Willow Ck) routed** + **CAWC2D (Windy Gap pump) routed**

The Windy Gap pump term (CAWC2D) is water pumped from the Colorado River downstream from Granby and Willow Creek reservoirs to Granby reservoir. This term represents water exported from the local area to Granby reservoir.

- Dotsero (EGLC2):

EGLC2 adjusted local = EGLC2 adjusted total - **KRMC2 total adjusted routed**

- Cameo (CAMC2):

CAMC2 adjusted local = CAMC2 adjusted total - **EGLC2 total adjusted routed** - **RUDC2 (Ruedi) routed**

- Palisade (CGYC2):

CGYC2 adjusted local = CGYC2 adjusted total - **CAMC2 total adjusted routed**

2) ECAO adjusted *total* streamflow: ECAO implemented a simplified hydrologic model consistent with CBRFC's simplified model. ECAO is using the open source software TSTool, a time series manager developed for the State of Colorado (https://sites.google.com/site/cdssstaging/tstool/). TSTool includes a built-in routing model similar to the model used in the CBRFC's forecasting system (https://www.nws.noaa.gov/ohd/hrl/nwsrfs/users_manual/part2/_pdf/24lagk.pdf). During the HUP meetings, stakeholders propose different what-if release scenarios that are routed with a TSTool command file and aggregated to the adjusted *local* streamflow forecast traces to compute adjusted *total* streamflow time series. The adjusted *total* flow time series are computed as follows:

- Kremmling (KRMC2):

KRMC2 adjusted total = KRMC2 adjusted local + MBWC2 (Wolford) routed + BGMC2 (Green Mountain) routed + WFRC2 (Williams Fork) routed + CBGC2 (Granby) routed + WCKC2 (Willow Ck) routed

The Windy Gap pump term (CAWC2D routed) modeled in the CBRFC adjusted local streamflow is not included. It would always be zero because Windy Gap pumping is never in priority during the irrigation season when the DSS is used.

- Dotsero (EGLC2):

EGLC2 adjusted total = EGLC2 adjusted local + KRMC2 total adjusted routed

- Cameo (CAMC2):

CAMC2 adjusted total = CAMC2 adjusted local + EGLC2 total adjusted routed + RUDC2 (Ruedi) routed

- Palisade (CGYC2):

CGYC2 adjusted total = CGYC2 adjusted local + CAMC2 total adjusted routed + CAMPALCO net diversion change.

The Cameo to Palisade net diversion change (CAMPALCO) allows the simulation of any change in depletions in the basin between Cameo and Palisade. This time series is not associated with a particular diversion or return flow point but rather it represents a net change of depletion in the entire reach. Most of the time, this time series is set to zero. However, sometimes, it is set to a value different from zero, to evaluate the effect of depletion changes when planning different scenarios prior to the HUP meeting.

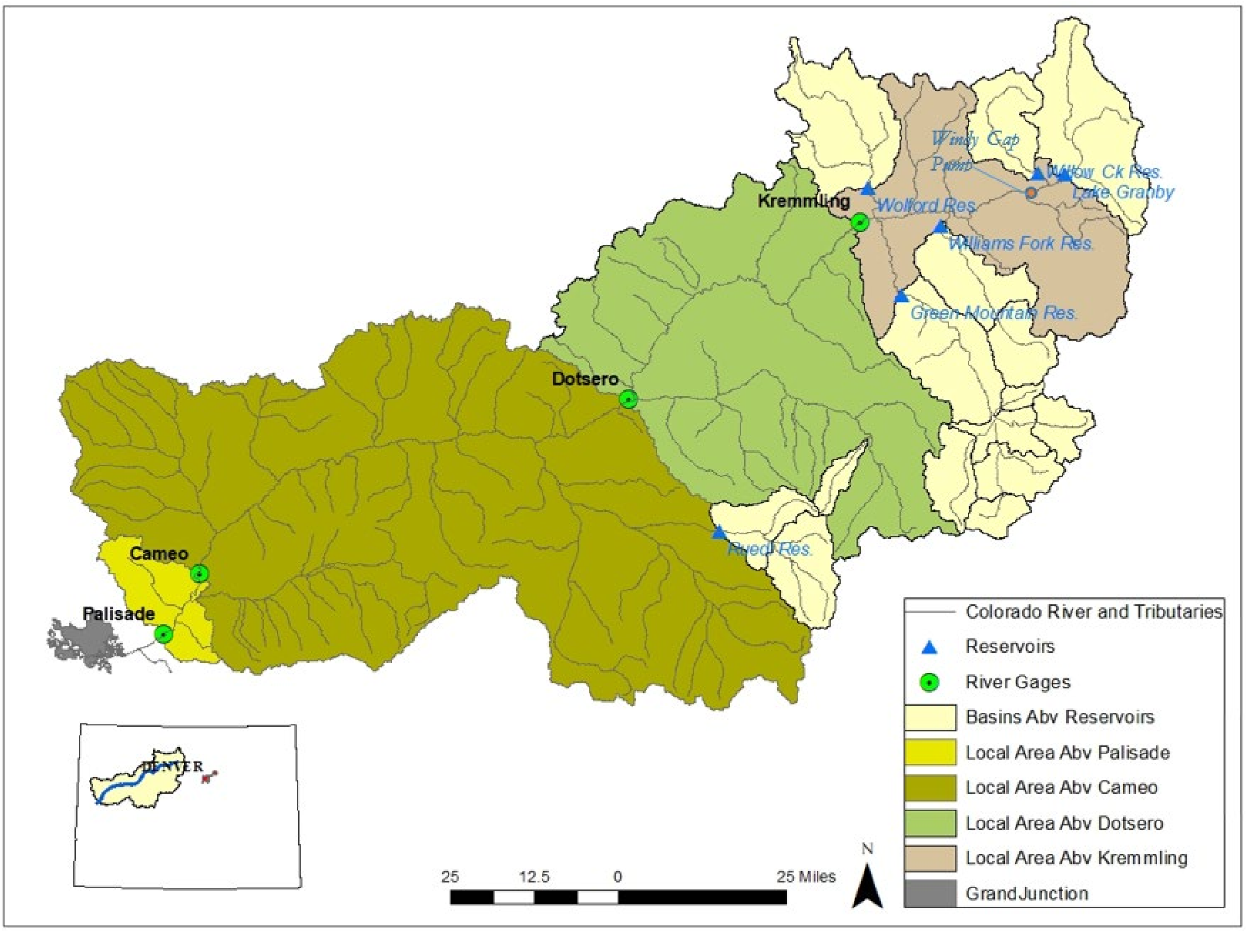


Figure 5. Sub-basin delineation of the Upper Colorado River watershed used for the HUP DSS hydrologic model.

The adjusted *total* flow time series are generated with routing parameters from the official forecast system, which are different from the routing parameters used in the simplified HUP DSS model. The reason for this is the difference in model configurations. For example, in the official forecast system, the Ruedi releases are routed together with simulated runoff from the sub-basins immediately downstream of the reservoir and up to the Cameo gage. This routing model uses routing parameters that vary with a wide range of flows. In the DSS model, Ruedi release is routed by itself using a constant routing time for all release values. Then the routed Ruedi release is superimposed to the simulated runoff from the sub-basin downstream of the reservoir. The computation of the adjusted *local* flow time series uses the adjusted *total* flow time series from the official forecast system and the routing flows from the DSS model. In the CBRFC's model equations (Section 1 above), the terms in **bold** print use DSS routing parameters. Sometimes, these discrepancies in routing parameters cause discontinuity in the simulated adjusted *local* flow time series. These discontinuities were used to adjust or calibrate the DSS routing parameters. Figure 6 depicts an example of such discontinuity in the adjusted *local* flow time series. The routing model for Ruedi was adjusted in the DSS to minimize the unrealistic simulation of flows on July 23rd.

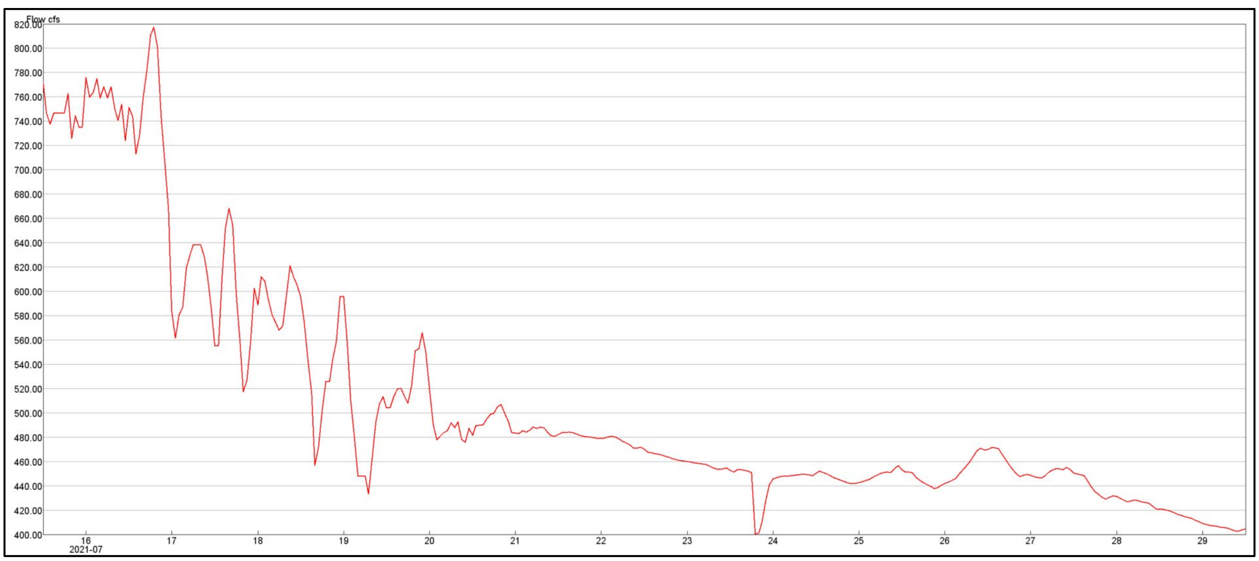


Figure 6. Cameo adjusted local flow for July 19, 2021 forecast. The drop in flow on July 23rd is caused by the discrepancy of routing parameters in the computation of this time series.

Routing Model and Parameters

The routing model utilized for this project is the Lag/K model. This is a storage routing method between flow-points developed for the National Weather Service River Forecast System (NWSRFS). The Lag parameter represents the flow delay in hours. The K parameter attenuates the lagged flow and is also measured in hours. CBRFC calibrated the Lag/K model of CBRFC's operational forecast system using historical flow records. For routing reaches in the DSS that coincide with routing reaches in the CBRFC official forecasting system, the CBRFC's routing parameters were adopted (Williams Fork to Kremmling, Wolford to Kremmling, Green Mountain to Kremmling, Kremmling to Dotsero and Cameo to Palisade). For those reaches in the DSS that do not coincide with the reaches in the official CBRFC's system, a subset of the CBRFC's routing parameters was developed and calibrated to the new DSS routing reaches (Granby to Kremmling, Willow Ck. to Kremmling, Ruedi to Cameo and Dotsero to Cameo).

The DSS was developed to help manage the flows during the irrigation season. CBRFC computed average monthly flows for each river reach of the DSS to estimate the range of expected flows during the irrigation season. Subsets of routing parameters from the official forecast system were selected from the original model parameters based on the expected monthly average flows during the irrigation season.

In some cases, a constant Lag value is sufficient to route all possible flows (e.g. Granby to Kremmling, Willow Creek to Kremmling, Ruedi to Cameo, Dotsero to Cameo). In other cases, a variable Lag is used. The variable lag is a function of flow. The first Lag value (Lag_1) is used for all flows less or equal than the first flow value (Q_1). The last Lag value (Lag_n) is used for all flow greater or equal than the last flow value (Q_n). Linear interpolation is used to determine Lag values for flows that fall in between points in the Lag-Q curve.

A single K parameter is used for each reach, applying for all possible flows. Table 1 summarizes the routing parameters used in the DSS.

Table 1: Summary of Lag/K Routing Parameters

From	**To**	**Lag_1 (hrs)**	**Q_1 (cfs)**	**Lag_2 (hrs)**	**Q_2 (cfs)**	**Lag_3 (hrs)**	**Q_3 (cfs)**	**Lag_4 (hrs)**	**Q_4 (cfs)**	**K (hrs)**
Williams Fork	Kremmling	12	75	10	150	7	700			3
Wolford	Kremmling	12	20	10	50	8	200			3
Granby	Kremmling	18								0
Willow Ck	Kremmling	17								0
Green Mtn.	Kremmling	8	200	6	700	5	1000			2
Ruedi	Cameo	28								0
Kremmling	Dotsero	24	500	20	1000	15	2000			1
Dotsero	Cameo	22								0
Cameo	Palisade	5	1500	4	2500	3	4000	2	8000	0

Prior to the irrigation season, the Coordinated Reservoir OperationS (CROS) event occurred in late May and early June of 2020 and that included a wide range of flows released from the reservoirs. CROS is a voluntary program to release inflow from selected reservoirs in the system to the Colorado River Basin to enhance endangered fish species habitat in the 15-Mile Reach without causing reduction of the reservoirs' yield and changes in the timing of reservoir filling. Green Mountain, Willow Creek, Williams Fork and Wolford reservoirs participated in CROS. The DSS routing parameters were first tested with this event.

The DSS hydrologic model computes all flows at a 1-hour time step. Projected release data are entered to the system as mean daily flows. The mean daily flow time series are disaggregated to 1-hour time step before routing the releases. The model applies reservoir gate changes at midnight, even though gate changes happen at different times of the day for each reservoir. This assumption was made because the time of gate changes are not consistent among reservoirs and unknown at the time of the meetings. For this test, two reservoir release scenarios were modeled: one that assumes reservoir release changes at midnight and another that uses actual reservoir release changes. Figure 7 shows the observed mean daily release time series during the CROS 2020 test period for all reservoirs in the system. Figure 8 shows the observed hourly release data during the CROS 2020 test period from all reservoirs.

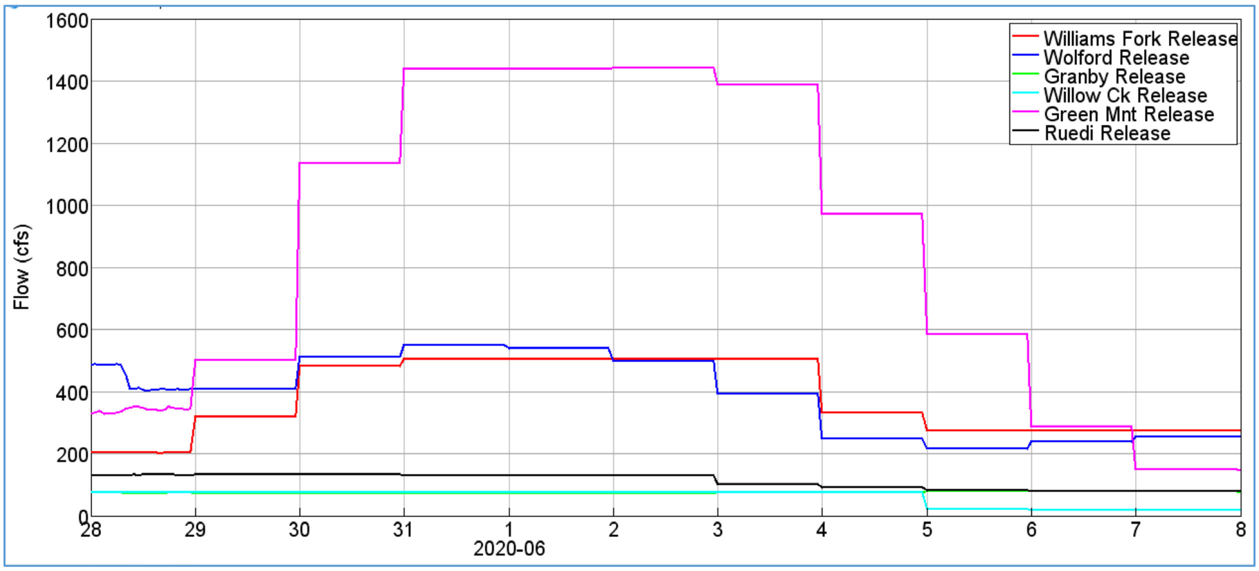


Figure 7. Observed mean daily releases from all reservoirs in the system, shown as if gate changes occurred at midnight for all reservoirs.

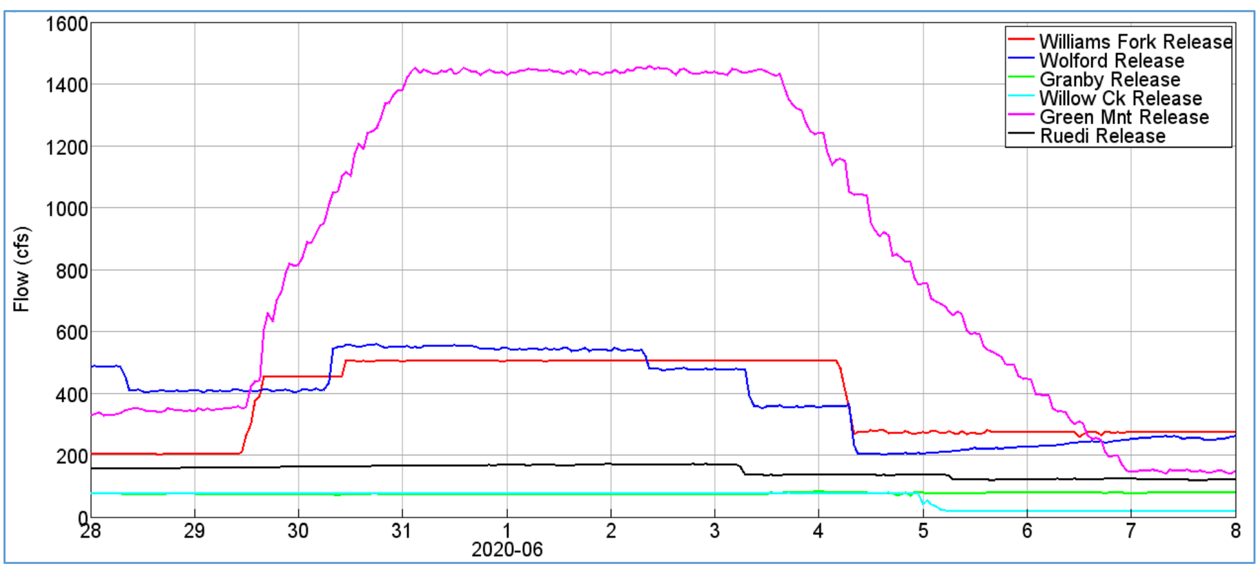


Figure 8 Observed hourly releases from all reservoirs in the system. This graph reflects the actual time of gate changes at each reservoir.

To evaluate the effect of assuming the gate changes at midnight for this event, the hydrologic model was run using May 29, 2020 adjusted *local* forecast traces from CBRFC plus release sets shown in Figure 7 and in Figure 8. The resulting adjusted *total* flow at the Kremmling gage are shown in Figure 9 and Figure 10. The observed flow at Kremmling is in yellow color and the simulated is in light grey. In both cases, the adjusted total flow simulation is delayed, causing under simulation of flows in the raising limb and over simulation in the falling part of the hydrograph. The actual hourly release data better fits the flows in the early part of the simulation, on May 29 and 30.

Table 2 shows the correlation coefficients (R^2) and Root Mean Square Errors (RMSE) resulting from the comparison of the simulated Kremmling adjusted *total* flow and Kremmling observed flow for both scenarios. These statistics indicate that the simulation with the actual hourly reservoir release time series is better than the simulation when assuming reservoir release changes at midnight.

Table 2. Statistics showing the goodness of fit of the simulated Kremmling flow when using reservoir gate changes at midnight and actual hourly release changes.

Metric	Reservoir gate changes at midnight	Actual hourly release changes
R^2	0.93	0.95
RMSE	224.2	190.7

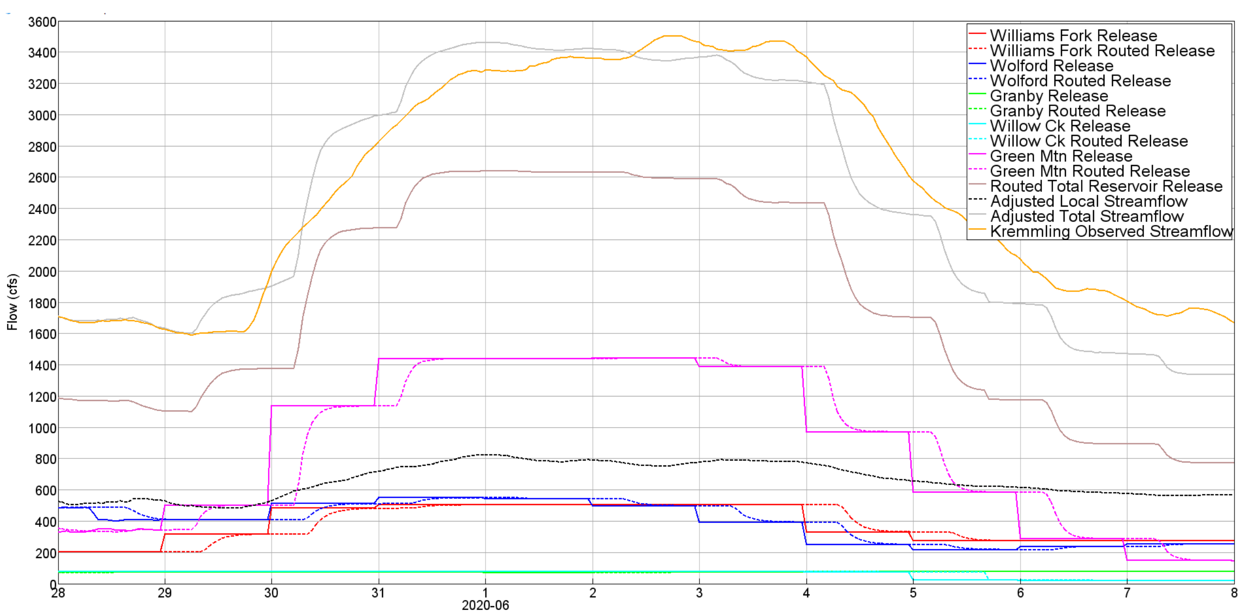


Figure 9. Modeled streamflow at the Kremmling gage using observed mean daily reservoir release time series disaggregated to hourly time steps. These results assume the reservoir flow changes at midnight.

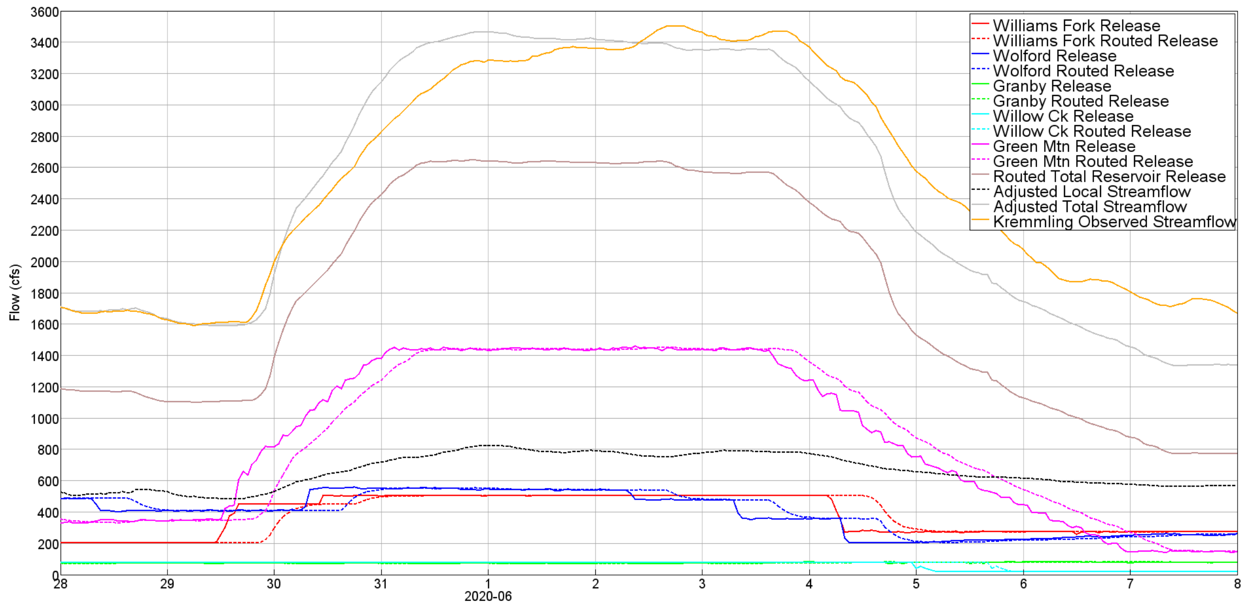


Figure 10. Modeled and observed streamflow at the Kremmling gage using observed hourly release time series from all reservoirs.

Figure 11, Figure 12 and Figure 13 show the modeling results at the Dotsero, Cameo and Palisade gages respectively, for the simulations using (a) assumed reservoir release changes at midnight and (b) actual releases. The timing of the adjusted *total* flow simulation improves at the downstream gages as compared to the results for the Kremmling gage. The simulated flow at these three downstream gages matches well the magnitude and timing of peaks as shown in Figure 11, Figure 12 and Figure 13. The last two days of the forecasts show increase in observed flow due to precipitation events that could not be predicted by the CBRFC's adjusted *local* streamflow forecast on May 29.

Table 3 summarizes the R^2 and RMSE for the Dotsero, Cameo and Palisade flow simulations. Both statistics are similar or very close between the two scenarios for all gages, meaning that both scenarios yielded similar results.

Despite minor differences, the results are very good and sufficient to meet the main objective of the system, which is to help guide decisions in the future. ECAO will continue working with CBRFC to refine the routing parameters. Currently, CBRFC is recalibrating all hydrologic models of the forecast system for the Upper Colorado Basin. Any improvements of routing parameters resulting from this recalibration effort will be incorporated into the DSS. In addition, the initial DSS routing parameters were incrementally improved during the irrigation season of 2021, based on unrealistic flow simulation events such as the one shown in Figure 6.

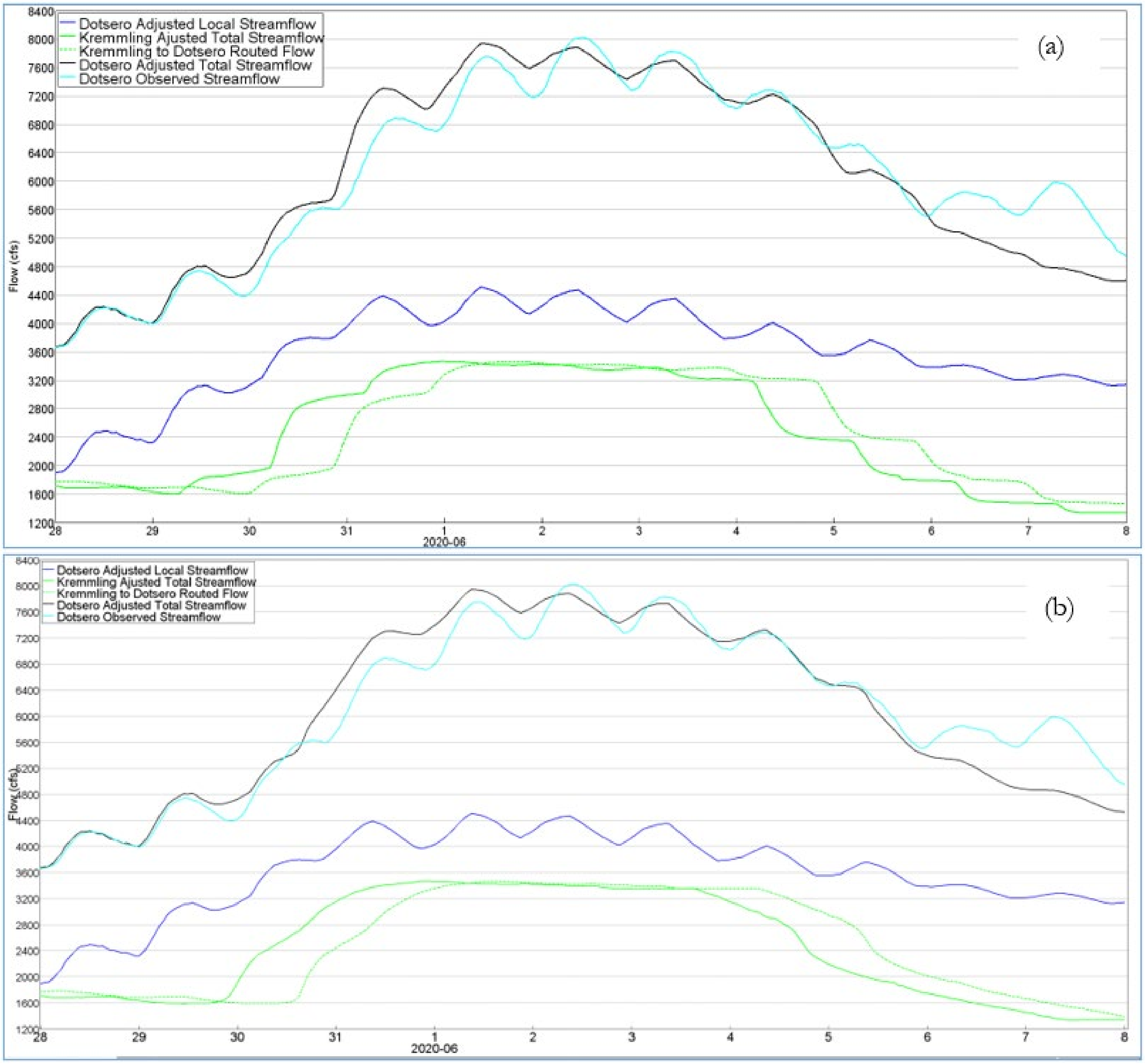


Figure 11 Modeled and observed streamflow at the Dotsero gage (a) reservoir releases changes at midnight and (b) observed hourly release time series from all reservoirs.

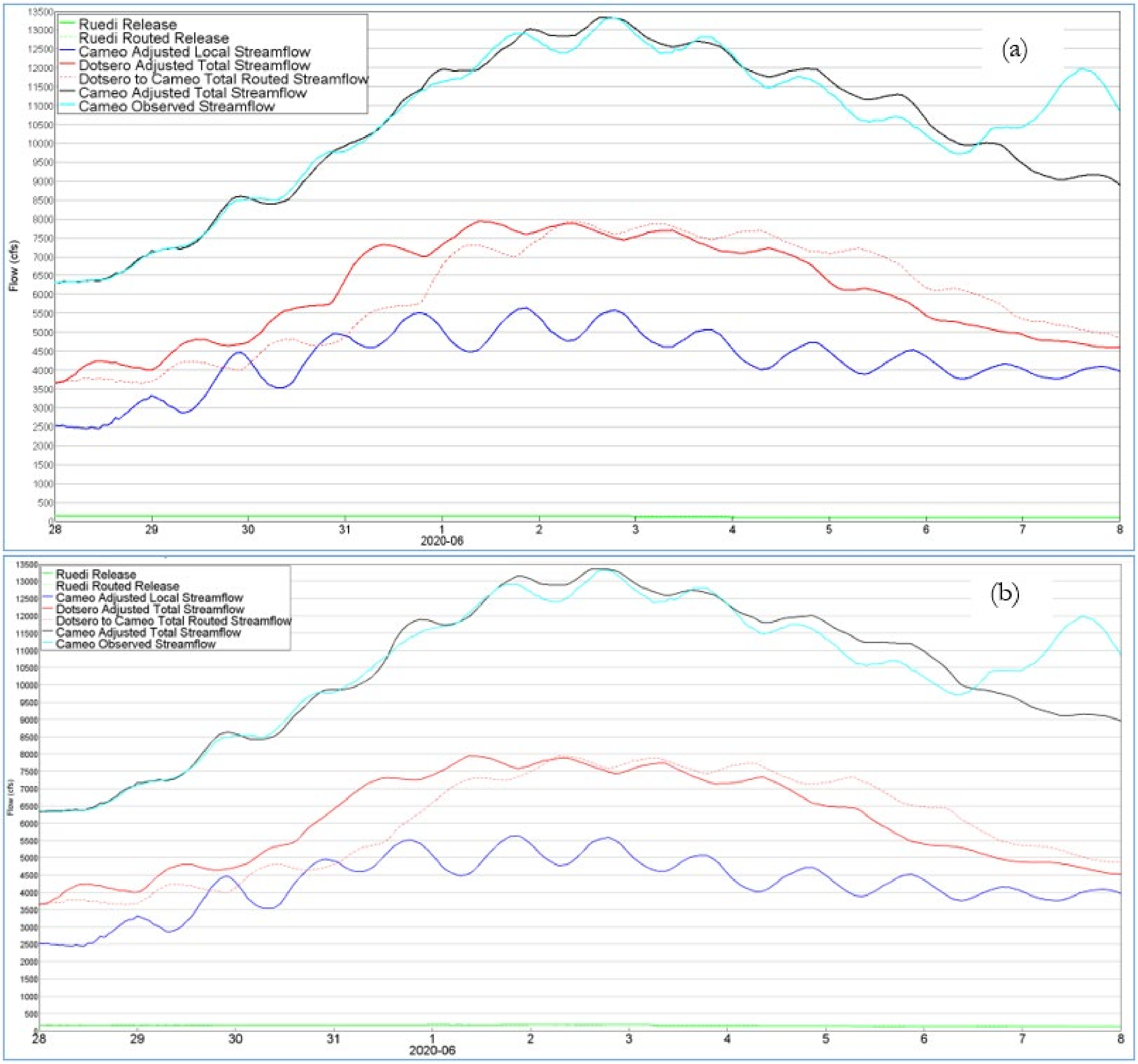


Figure 12 Modeled and observed streamflow at the Cameo gage using (a) reservoir releases changes at midnight and (b) observed hourly release time series from all reservoirs.

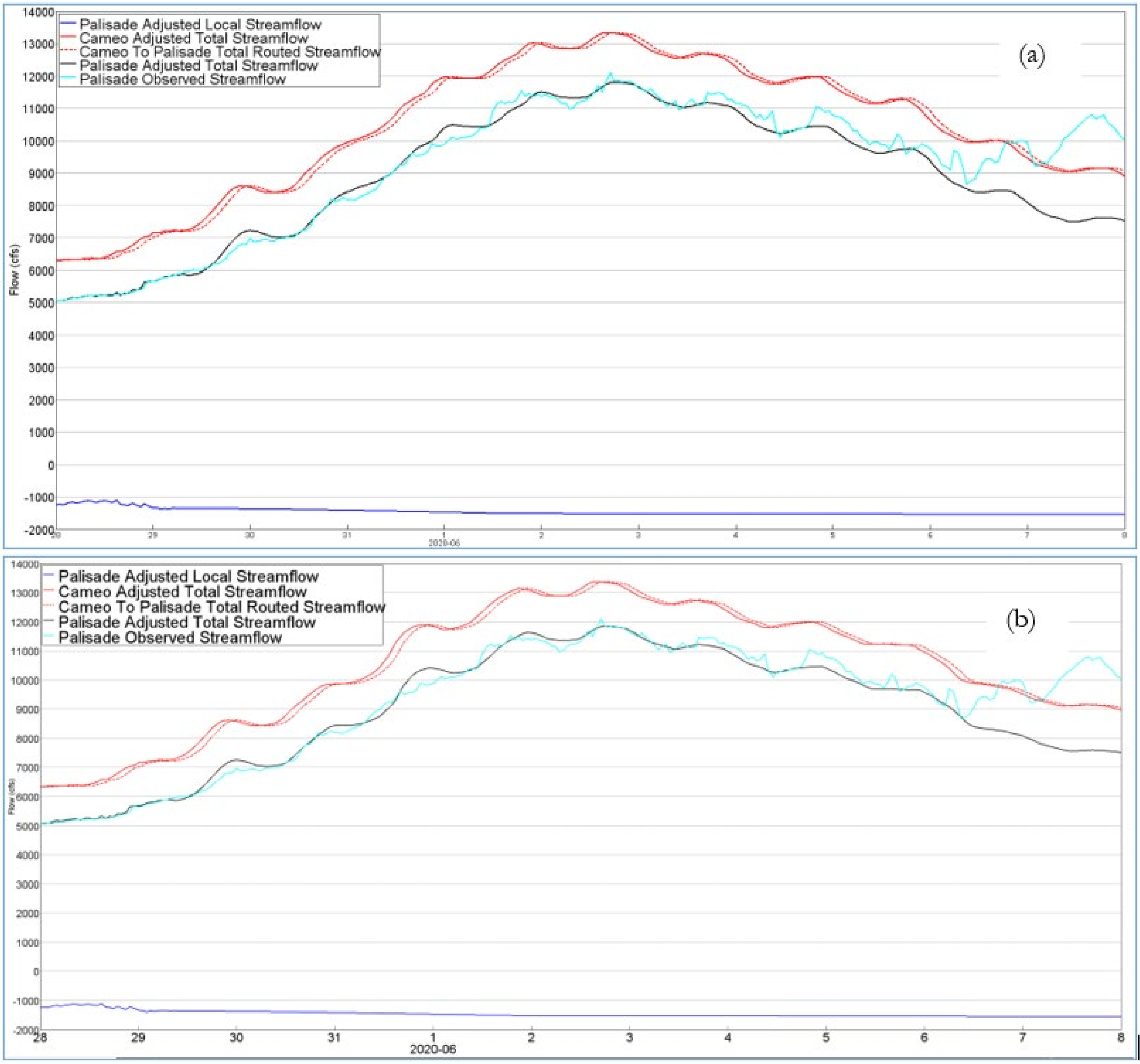


Figure 13 Modeled and observed streamflow at the Palisade gage using (a) reservoir releases changes at midnight and (b) observed hourly release time series from all reservoirs.

Table 3 Statistics showing the goodness of fit of the simulated flow at Dotsero, Cameo and Palisade when using reservoir gate changes at midnight and actual hourly release changes.

Gage	Metric	Reservoir gate changes at midnight	Actual hourly release changes
Dotsero	R^2	0.90	0.91
Dotsero	RMSE	394.5	378.7
Cameo	R^2	0.80	0.80
Cameo	RMSE	771.6	784.7
Palisade	R^2	0.77	0.77
Palisade	RMSE	833.4	838.6

Modeling Scenarios

The DSS has the capability of simulating three different flow traces: Native, Total-1 and Total-2. The Native simulation corresponds to the expected streamflow due to releases of reservoir inflow and any other water (replacement, augmentation, etc) that can be diverted by senior water rights in the Grand Valley. Native releases do not include additional releases for the fish in the 15-Mile Reach. Total-1 and Total-2 simulations correspond to the expected streamflow produced by total reservoir releases for two different what-if scenarios. The Total-1 and Total-2 simulations include fish water delivered to the 15-mile reach or water for the Grand Valley Powerplant in addition to the native flow.

The State of Colorado is responsible for the administration of Upper Colorado River flows. The Native streamflow simulation provides guidance to the State of how much water is available for diversion by senior water rights in the Grand Valley. This Native simulation does not reconcile with the water accounting performed by the State of Colorado. The State estimates 5% losses from total reservoir releases out of Granby, Willow Creek, Williams Fork, Green Mountain and Wolford reservoirs to the Dotsero gage and 10% on to the Cameo gage. Releases from Ruedi to the Cameo gage are charged a 7.5% loss. As mentioned before, the DSS computes the expected streamflow in the river by aggregating the routed reservoir releases to the adjusted *local* streamflow forecasts. The adjusted *local* streamflow forecasts come from a forecast trace that has been bias-adjusted. Therefore, the simulation has been already adjusted for any gains/losses in the river. It would not be appropriate to apply a river loss comparable to what the State does for accounting.

Before the HUP meetings, the DSS is executed to generate an initial run that includes a Native trace and a Total-1 simulation equal to the Total-2 simulation. During the meeting, the Native and Total-2 simulations are updated with new release scenarios proposed by meeting participants. New proposed changes are saved as Total-2 and compared against the initial Total-1 streamflow trace. The initial run is executed with one TSTool command file named InitialConditions.TSTool and the updates are generated with another TSTool command file named meeting.TSTool.

Model Assumptions

Modeling and forecasting necessarily incorporate assumptions to address data limitations and uncertainty in processes, and to make timely calculations possible. Below are the major model assumptions and foundational information which should be kept in mind when interpreting results and making decisions. Some have been previously mentioned:

Primary Use of the DSS: To expedite the assessment of operational reservoir changes in projected river flow and to disseminate results to stakeholders in real time. Results from this system do not replace CBRFC's official forecast.

Routing Parameters: Routing parameters are subsets of the routing parameters used in the official CBRFC's operational forecast system (OFS). This DSS includes different routing reaches that are consistent with the simplifications in the hydrologic model. For example, CBRFC's OFS routes Granby release up to the confluence of the Colorado River with the Fraser and adds the routed release to the flow generated in the basin above the confluence. In this DSS, Granby release is routed up to the Kremmling gage and then added to the runoff generated above Kremmling.

Timing of flow changes: The time of change of reservoir releases in the DSS is always at midnight, while real release changes occur throughout the day.

Simulation Period: The simulation period extends 10 days from the day the model is updated. The model is not updated automatically every day. Therefore, the future/projected data display in the Online Tool will always start at the current time and end 10 days after the date the system was last updated, sometimes presenting 10 days of projected outcomes but including fewer than 10 days from the current time. Ideally, decisions are made using simulation results updated on the current day.

Adjusted *Local* Flow: All assumptions included in the CBRFC's operational streamflow forecast model are included in the DSS.

- Streamflow forecast uses 7 days of forecast precipitation and 10 days of forecast temperatures.
- Diversions are assumed a) to stay at current levels, or to change to keep bypass flows b) constant or c) above minimum flow requirements.
- Unmeasured diversions are simulated using a consumptive use model calibrated to historical data from 1981 to 2015. For the Colorado near Palisade model simulation, the Grand Valley and Government Highline canal diversions are accounted for explicitly; future values are held at the last observed value. The model of return flows has been calibrated using historical data from 1981 to 2015. Return flows are estimated based on the time of year. Also, the model assumes water will be 'checked' as needed to allow the Grand Valley Irrigation Canal to take its full allotment. Return flows through the Palisade Pipeline are not accounted for.
- The computation of the adjusted local flow time series uses a simplified set of routing parameters for some river reaches. This computation also relies on adjusted total flow time series calculated with different routing parameters from those in the official CBRFC's forecast system. This discrepancy of routing parameters sometimes causes some discontinuities in the resulting time series.

Accounting – River Losses: The DSS does not include an accounting model. River losses as accounted by the State of Colorado are not currently included in the results. Physical losses in the river are accounted for by the simulation of hydrologic processes in the basin. The DSS hydrologic model uses CBRFC's forecast. This forecast relies in the simulation of basin runoff from snow and rainfall events using the Sacramento Soils Moisture Accounting Model (SAC-SMA). The runoff model simulates the movement of water through the soil by characterizing two different soil zones: 1) a shallow zone with fast response to runoff, and 2) a deeper zone that produces a slower runoff response (e.g. baseflow). In addition to the rainfall-runoff models, the routing model simulates the translation and attenuation of the flow wave in the river. Diversion and return flows are also simulated using consumptive use models and other routines. CBRFC's hydrologic models are calibrated to historical data. Model parameters are developed to match flow simulation to historical records as close as possible.

Time zone: All data are displayed in Mountain Standard Time (MST).

Appendix B contains the TSTool command files used to compute the flow time series along the river with associated descriptions.

Online Dissemination Tool

The third component of the DSS is the Online Dissemination Tool (https://www.usbr.gov/lc/region/g4000/riverops/ecaodss.html). It was designed to share with the stakeholders the input and output data from the system in real-time. This tool uses the HDB data service. The HDB data service allows online web access to the most up-to-date data in Reclamation's HDB databases. It is a Representational State Transfer (REST) Application Programming Interface (API) that relays data queries to HDBs within Reclamation and is available both internally and externally. REST APIs are widely accepted for serving data online and are arguably the standard when it comes to reliable online data services.

The HDB data service (HDB API) was initially developed for the Boulder Canyon Operations Office within the Lower Colorado region. It was developed using the C-Sharp programming language and the OpenAPI specification. The HDB API currently has the capability to serve data from all Reclamation HDBs. It resides on a Windows server in the Lower Colorado Region and is being maintained and developed continuously by Reclamation personnel. A wide array of data services is available within the Reclamation-internal network in support of HDB users Reclamation-wide. A subset of these data services is available to the public and for Reclamation software and web developers to support basic data queries and web development.

The HDB data service was configured to serve data from ECAO's HDB, where the modeling input and output time series are saved. The web service also displays publicly available data from the USGS, Denver Water and the Colorado River District.

Navigating the Online Dissemination Tool

The online tool is setup to display observed and projected time series in tabular and graphical format. A map of the Upper Colorado River from the headwater in the Rocky Mountain National Park to Grand Junction displays the location of reservoirs and main streamflow gages along the Colorado River (Figure 14). The green icons correspond to reservoirs and the red icons to streamflow gages. By clicking on the icons, callouts are displayed with the name of sites and options to **Query DSS Data** and observed data from different sources such as the USGS, Denver Water, Colorado River District or Reclamation.

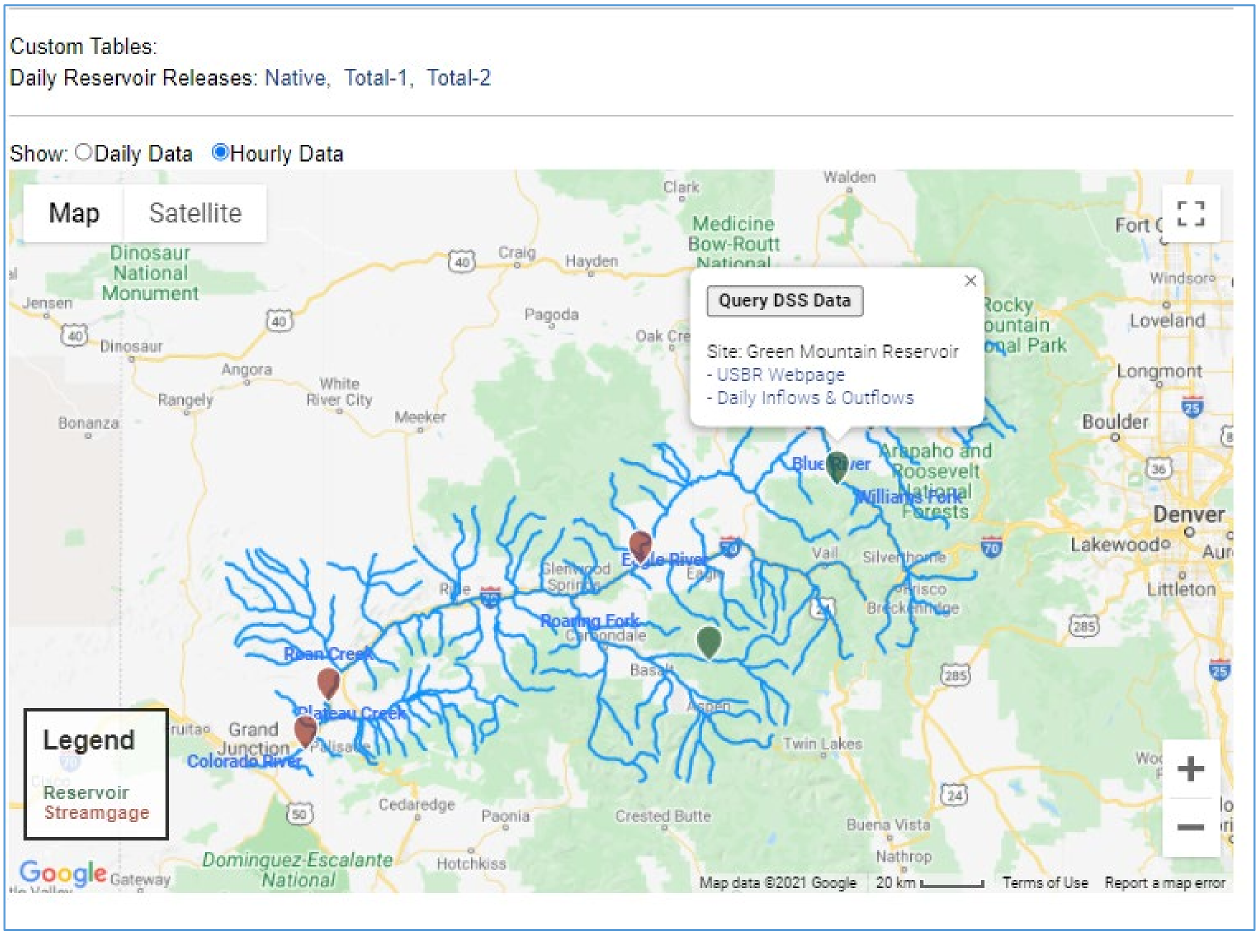


Figure 14. Map of the Upper Colorado River Basin as displayed in HDB web service. Green icons represent the location of reservoirs in the system. Red icons represent the location of main streamflow gages along the main stem of the Colorado River. By clicking on the icons, the name of the site is shown as well as links to access the available data for that site.

The web service allows display of two plots at the same time—a reservoir plot and a streamgage plot—to see the response in the river due to reservoir releases. Figure 15 shows an example of Green Mountain Reservoir releases and streamflow at the Cameo gage. In this example, there are three different releases from Green Mountain Reservoir and the associated streamflow response at Cameo. If the user wished to compare the displayed Cameo streamflow response with another reservoir release time series, the user would select another reservoir in the map and the first plot of the Green Mounatiin Reservoir data would be replaced with the newly-selected reservoir's data. The system allows only two plots at a time, one for reservoir release and another for streamflow at any of the four gages in the system.

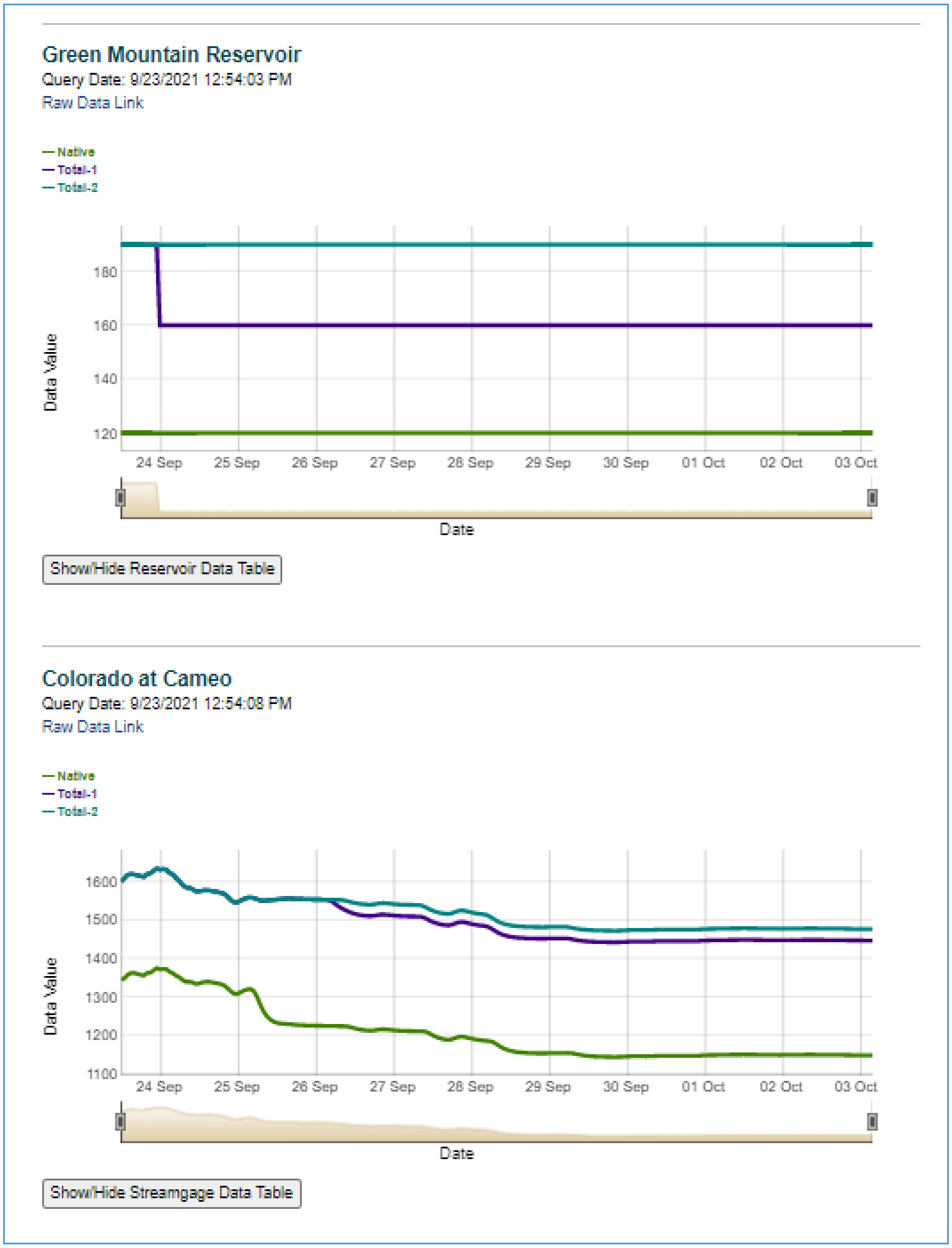


Figure 15. Plots of Green Mountain Reservoir release (top) and forecast flow at the Cameo streamgage. The lower trace (green) represents the native flow, the purple trace represents the total flow produced by the release Total-1 and the blue trace is generated by the release Total-2.

The user can select to display the modeled data in Daily or Hourly time step by choosing the desired time step radial botton located above the map (Figure 14). If the time step is changed after plots have been created, the user needs to query the DSS again using the map interface to update the results plots.

Above the main map under **Custom Tables,** there are three links to access the data pages containing the Native, Total-1 and Total 2 daily reservoir release time series (Figure 14).

How to Update the DSS

System Requirements for Eastern Area Colorado Office Users

Prior to updating the DSS, the user should install software for TSTool, Riverware, HDB Poet, and Putty.

TSTool is available from OpenCDSS TSTool Downloads (state.co.us). Any version works for this modeling effort.

Riverware is available from RiverWare—Download RiverWare, Applications & Libraries (colorado.edu). Riverware requires a license and the download site is password protected. Contact the CADSWES team to obtain the software. Any version works for this project.

HDB Poet is available from https://github.com/usbr/HdbPoet/releases. Any version works for this project.

Putty is available through Reclamation's Missouri Basin Regional Office. Contact Daren Critelli for the executable file and configuration to connect to ECAO's Linux server.

The Riverware data loader for HDB and the hydrologic model are saved on ECAO's Linux Server at: \\ecahdb3.bor.doi.net\HUPDSS

Load data to HDB

1. Open the HDB Poet template file: \\ecahdb3.bor.doi.net\HUPDSS\RW_Loader\DailyReleaseData.hdb. This file shows the observed reservoir release data for the past five days.
2. Open RiverWare and the file \\ecahdb3.bor.doi.net\HUPDSS\RW_Loader\HUP_DSS_LOAD_8.0.1_2021.mdl.
3. Set the dates in the Run Control window. Click on the *Control* drop down menu and then select the *Run Control Panel* option. Set the Initial date to five days prior to today. Click on Synchronize Slots with Run Parameters. Then click the check box to Apply the Run Parameter edits.
4. Open Input_Reservoir.sct by clicking on the *Utilities* drop down menu and selecting SCT, then *Open SCT*. The SCT file is located in the same folder where the RiverWare file resides.

5. Load any data available in HDB for the selected period. For that, run the AllReservoirs_Model_Input DMI from the *DMI* menu. Enter the HDB credentials when prompted by the system.
   - Click on *Select* to choose the model from Model table: **15 HUP_DSS** as shown in Figure 16.

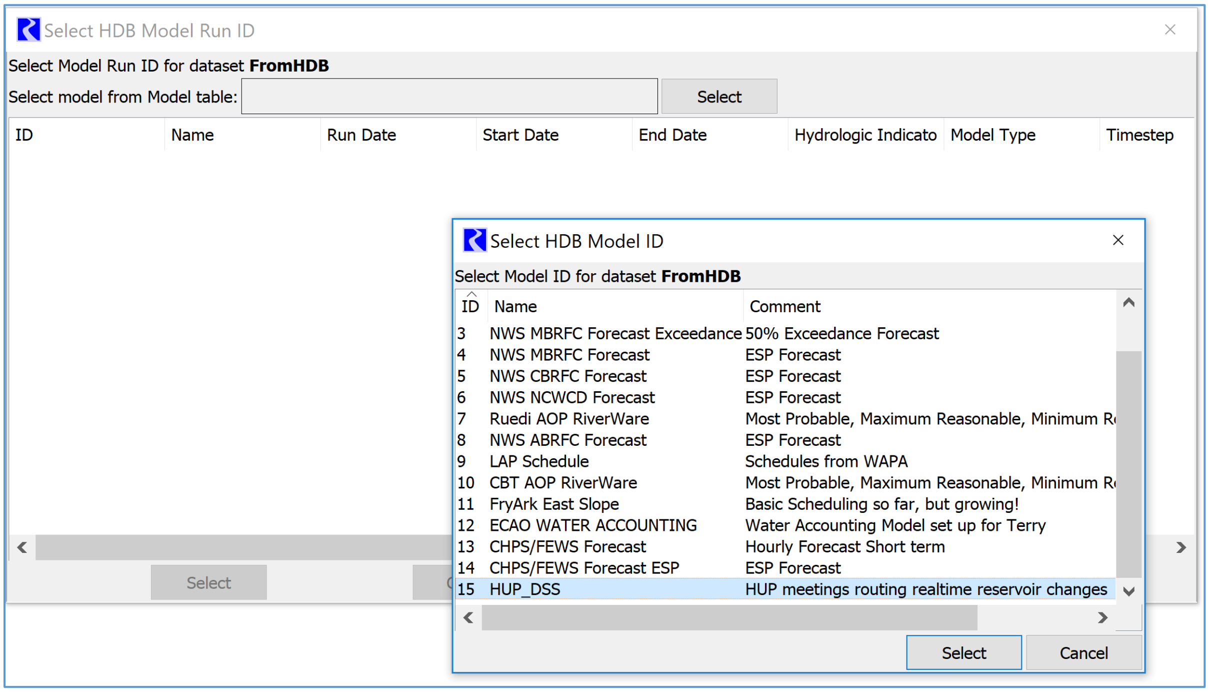


Figure 16. Selection of Model Table within RiverWare.

   - Select one of the three options available. The SCT will get populated with data already saved in HDB for the selected model ID (Figure 17).
     ID = 57008 corresponds to Native,
     ID = 57009 corresponds to Total 1 and
     ID = 57010 corresponds to Total 2

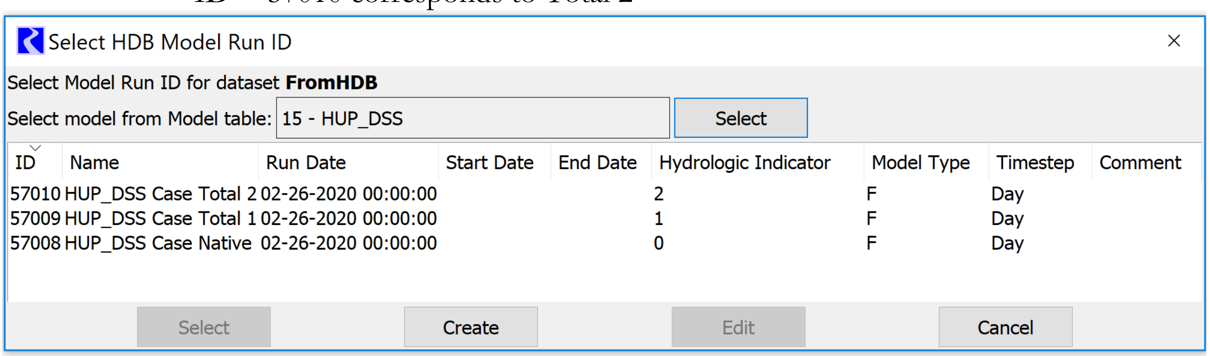
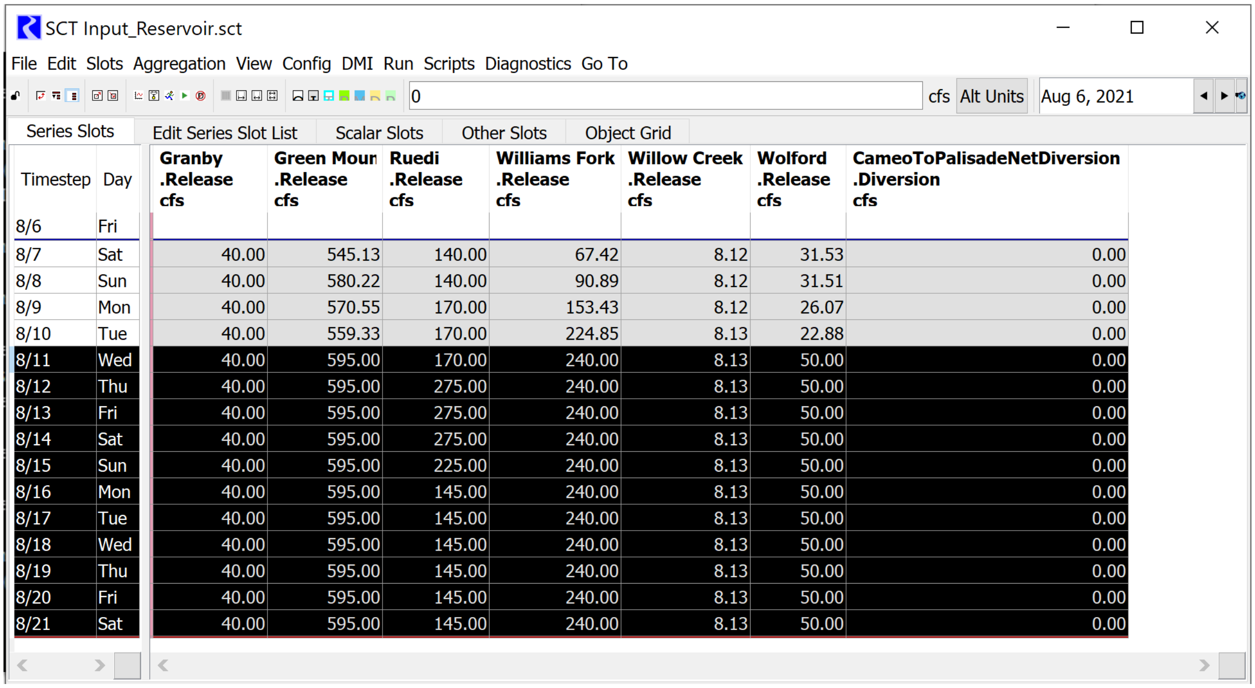


Figure 17. Model Run ID available for the HUP DSS.

6. Copy the data loaded using the HDB Poet file and Table display to the Input_Reservoir.sct using right-click -> Import Paste functionality. This step will populate the observed release data for all reservoirs. Populate by hand the CameoToPalisade.Diversion slot in the SCT. If there are not adjustments to depletions in the Cameo to Palisade reach, set the values to zero.

7. Populate the SCT with the projected release data for each reservoir and for the Cameo to Palisade net diversion time series. Figure 18 shows an example of the SCT. The data from 8/7 to 8/10 is observed and was obtained from HDB. The data from 8/11 on is forecast.



Timestep	Day	Granby .Release cfs	Green Moun .Release cfs	Ruedi .Release cfs	Williams Fork .Release cfs	Willow Creek .Release cfs	Wolford .Release cfs	CameoToPalisadeNetDiversion .Diversion cfs
8/6	Fri							
8/7	Sat	40.00	545.13	140.00	67.42	8.12	31.53	0.00
8/8	Sun	40.00	580.22	140.00	90.89	8.12	31.51	0.00
8/9	Mon	40.00	570.55	170.00	153.43	8.12	26.07	0.00
8/10	Tue	40.00	559.33	170.00	224.85	8.13	22.88	0.00
8/11	Wed	40.00	595.00	170.00	240.00	8.13	50.00	0.00
8/12	Thu	40.00	595.00	275.00	240.00	8.13	50.00	0.00
8/13	Fri	40.00	595.00	275.00	240.00	8.13	50.00	0.00
8/14	Sat	40.00	595.00	275.00	240.00	8.13	50.00	0.00
8/15	Sun	40.00	595.00	225.00	240.00	8.13	50.00	0.00
8/16	Mon	40.00	595.00	145.00	240.00	8.13	50.00	0.00
8/17	Tue	40.00	595.00	145.00	240.00	8.13	50.00	0.00
8/18	Wed	40.00	595.00	145.00	240.00	8.13	50.00	0.00
8/19	Thu	40.00	595.00	145.00	240.00	8.13	50.00	0.00
8/20	Fri	40.00	595.00	145.00	240.00	8.13	50.00	0.00
8/21	Sat	40.00	595.00	145.00	240.00	8.13	50.00	0.00

Figure 18. Example of SCT. The forecast period starts on August 11 and ends on August 21.

8. Run the DMI: **All Reservoirs Model Output 2 HDB** to save the data in HDB.
   - Click on Select to choose the model from Model table: 15 HUP_DSS as shown in Figure 16.
   - Select the model ID where the data should be saved
     ID = 57008 corresponds to Native,
     ID = 57009 corresponds to Total 1 and
     ID = 57010 corresponds to Total 2 and click Select.
   - Repeat this process for each Model ID (57008, 57009, 57010)

Keep the RiverWare file open all the time. RiverWare is used to load the initial model conditions to HDB and any edits or modifications to the initial conditions during the HUP meeting.

Execute the hydrologic model

9. Before running the hydrologic model, the user must check that the CBRFC file (usbr_hup.csv) has been updated and downloaded from the CBRFC's website to ECAO's Linux server. This file is updated daily between 8:00 am and 10:00 am. The file is downloaded automatically in \\ecahdb3.bor.doi.net\hdb\apps\TSTOOL\DSS\CBRFC.
10. Open Putty to log in ECAO's Linux server. From the command Window that will pop up, navigate to the /wrg/HUPDSS. From that directory run the following command to execute the hydrologic model: ./InitialConditions.sh. The InitialConditions code saves a trace for the Native scenario and saves the same results for the Total-1 and Total-2 scenarios.

11. Open any internet browser and launch the HDB webservice site at: Colorado Lakes and Reservoirs (usbr.gov) to check the results of the hydrologic model. Total-1 and Total-2 should be identical.
12. To make changes to the Initial conditions, repeat steps 5 through 11 and update the Native and Total-2 input data. From the Putty terminal window, execute the hydrologic model using the following command: ./meeting.sh. This command will update the Native and Total-2 traces only.
13. Check the updated results in the webservice. Total-2 will reflect the changes proposed during the HUP meeting and will be compared against the initial conditions represented in the Total-1 trace.
14. At any time, the ./InitialConditions.sh can be run to keep Total-1 and Total-2 traces the same.

Data

Table 4 summarizes the required files to execute the DSS model. Please contact Claudia Leon-Salazar at cleonsalazar@usbr.gov with any question about these files.

As explained in Section 2 of this report, the data hub for the DSS is HDB. In order to demonstrate how the hydrologic model works and provide a template for anyone to replicate this project modeling effort, the meeting.TSTool command file was modified to read data from files instead of HDB and output the results in TSTool plots. The files are setup to run the July 14, 2021 forecast. All files are in RISE under the Catalog Record: **Upper Colorado River Basin Water Operations Modeling from S&T Project 20047: Web-Based Decision Support System for the Upper Colorado River Basins**. The "DSS_Files_for_S&T_Project_20047.zip" file contains all time series loaded in RISE. These files are required to run an example of the hydrologic model. Table 5 lists all files contained in the compressed file (.zip). To use these files, the user should download all files to the same directory. Also, the user should download the CBRFC forecast file from: https://www.cbrfc.noaa.gov/outgoing/hup/2021/usbr_hup.20210714.csv, install TSTool, open the TSTool command file (HUPmeeting.TSTool) and run all commands. A README file is also available in RISE with details instructions of how to run the stand alone version of the model.

Table 4. List of files required to execute the hydrologic model for the DSS.

File Name	Description	Location	Size
usbr_hup.csv	CBRFC's forecast traces, updated daily and available at https://www.cbrfc.noaa.gov/outgoing/hup/	File is download daily to \\ecahdb3.bor.doi.net\hdb\apps\TSTOOL\DSS\CBRFC	16KB
InitialConditions.TSTool	TSTool command file with hydrologic model for initial conditions.	\\ecahdb3.bor.doi.net\HUPDSS	43KB
meeting.TSTool	TSTool command file with hydrologic model for updated conditions.	\\ecahdb3.bor.doi.net\HUPDSS	38KB
InitialConditions.sh	Shell file to run the InitialConditions.TSTool file in batch mode	\\ecahdb3.bor.doi.net\HUPDSS	1KB
meeting.sh	Shell file to run the InitialConditions.TSTool file in batch mode	\\ecahdb3.bor.doi.net\HUPDSS	1KB
TimeSeriesProperties.xlsx	Excel file that contains parametric data for the hydrologic model	\\ecahdb3.bor.doi.net\HUPDSS	11KB
DailyReleaseData.hdb	HDB Poet template file for historical reservoir release data.	\\ecahdb3.bor.doi.net\HUPDSS\RW_Loader	5KB
HUP_DSS_LOAD_8.0.1_2021.mdl	RiverWare file to load data to HDB.	\\ecahdb3.bor.doi.net\HUPDSS\RW_Loader	126KB
Input_Reservoir.sct	SCT to enter data within RiverWare	\\ecahdb3.bor.doi.net\HUPDSS\RW_Loader	7KB

Table 5 List of files uploaded to RISE.

File Name	File Description	File Format	Size
DSS_Files_for_S&T_Project_20047.zip	Compressed file containing all files listed in this table.	zip	1,438KB
HUPmeeting.TSTool	TSTool command file contains modeling code	Text	25KB
TimeSeriesProperties.xlsx	Contains times series properties required by the model (e.g. start and end dates)	Excel	11KB
InputDailyTimeSeries.dv	Contains daily projected reservoir release time series. These are input time series for the model.	Text, date-value	11KB
InputHourlyTimeSeries.dv	Contains hourly observed reservoir release time series. These are input time series for the model.	Text, date-value	13KB
ObservedStreamflow_Hourly.dv	Contains observed streamflow data used to compare against modeled time series.	Text, date-value	7,344KB
AbvKremmlingSimulation.tsp	Plot template file to plot model outputs	Text	3KB
AbvDotseroSimulation.tsp	Plot template file to plot model outputs	Text	2KB
AbvCameoSimulation.tsp	Plot template file to plot model outputs	Text	2KB
AbvPalisadeSimulation.tsp	Plot template file to plot model outputs	Text	2KB

After running the command file, four plots will pop up showing the results as shown in the following figures.

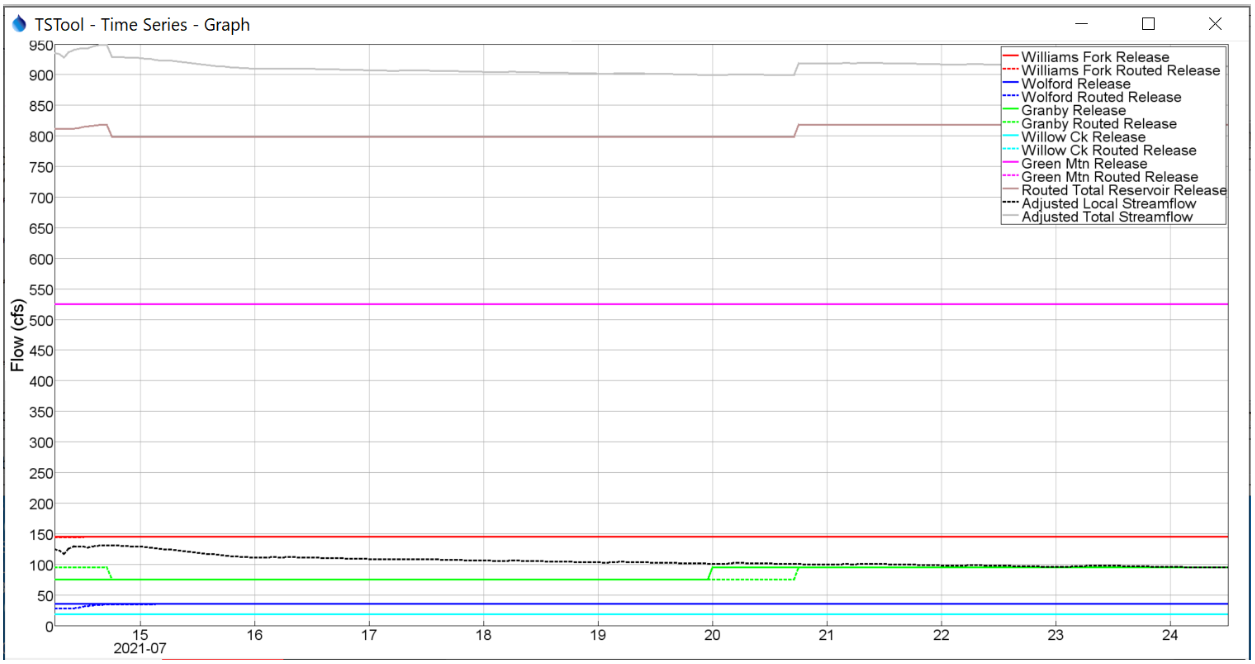


Figure 19. Kremmling adjusted total flow (light grey), reservoir release time series and routed releases above the Kremmling gage. The CBRFC's adjusted local flow trace is the dashed black line.

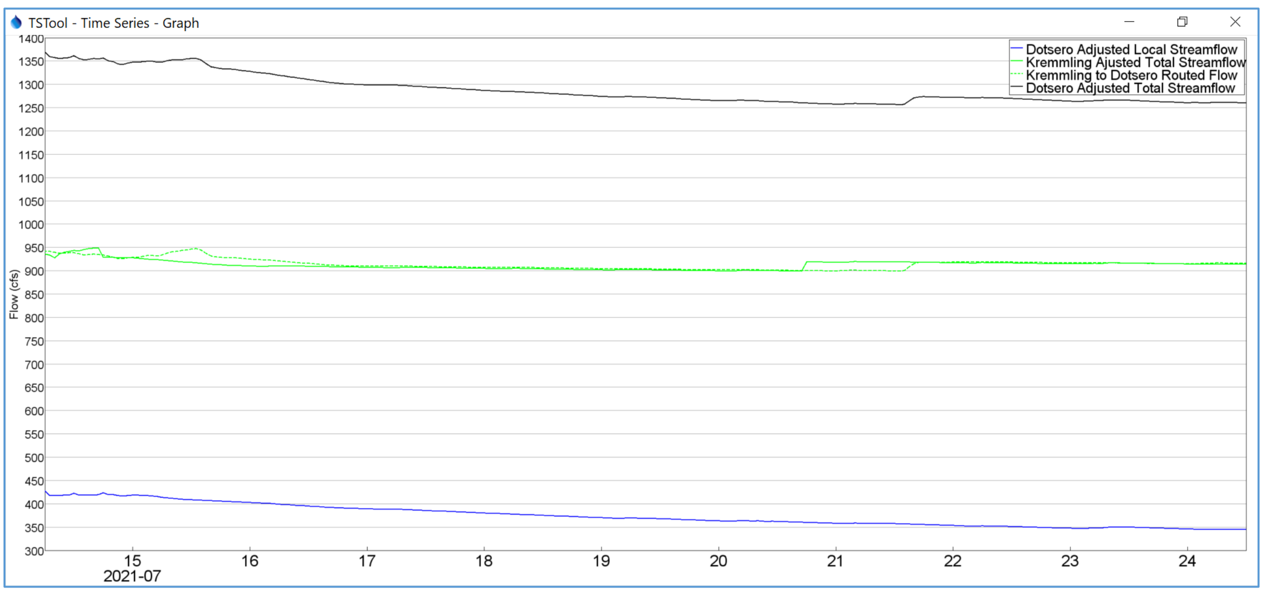


Figure 20. Dotsero adjusted total flow (black line) and all components that make up for the total flow.

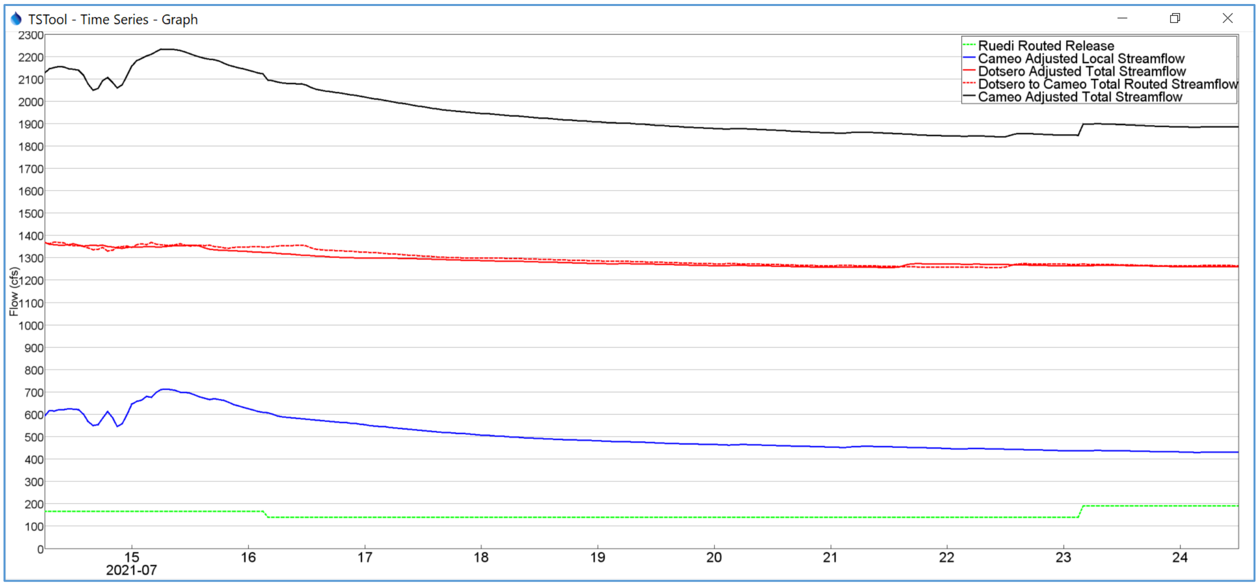


Figure 21. Cameo adjusted total flow (black line) and all flow components that make up for the total flow at Cameo.

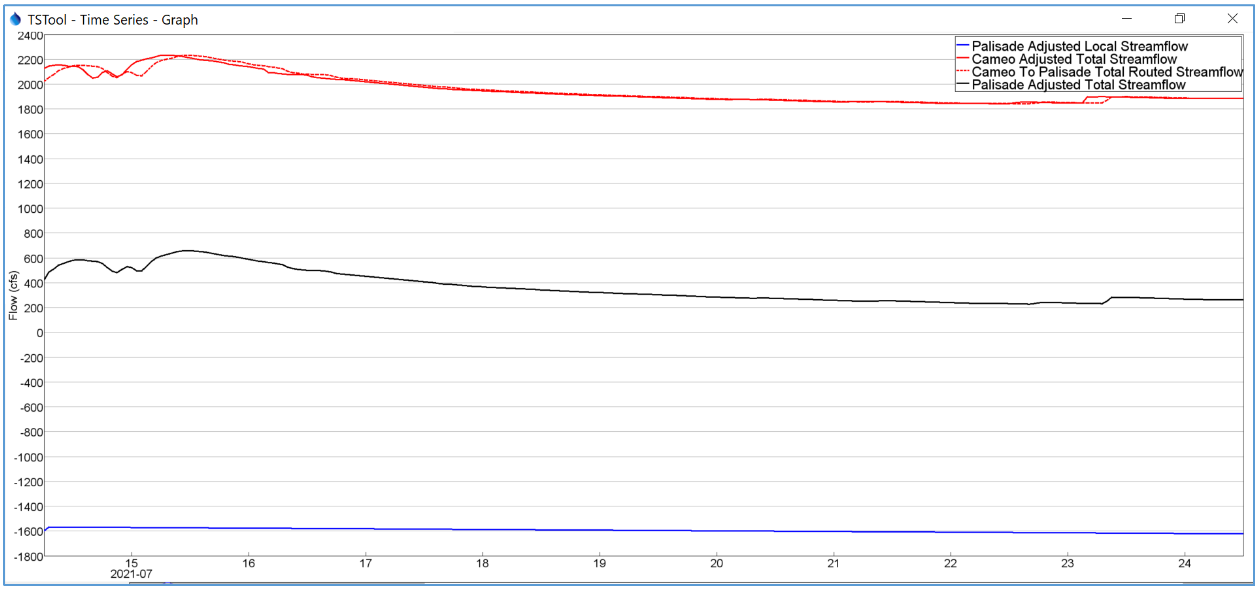


Figure 22. Palisade adjusted total flow (black line) and all flow components that make up for the total flow at Palisade. The Palisade adjusted total flow is less than the Cameo adjusted total flow due to depletions in this reach.

Results

ECAO designed and implemented the DSS to guide operational decisions in the Upper Colorado River Basin. ECAO relied on four major system components that were already used in ECAO's office to assemble the DSS: ECAO HDB, data loaders, a modeling tool and a web service tool. ECAO HDB serves as the data hub for the system. All other components plugged to the database.

The Collaborative Conservation and Adaptation Strategy Toolbox (CCAST) team published a detailed description of the DSS as a Case Study (Decision-Support System to Balance Flows for Water Users and Endangered Fishes in the Upper Colorado River Basin (arcgis.com)) that demonstrate the usefulness of the tool to improve transparency and confidence in the decisions to manage the river.

Results from the system were updated daily during different times of the year to help manage the following cases:

- CROS
- The April Hole, a short period of low flows in the 15-Mile reach during the month of April due to early start of irrigation diversions and delayed snowmelt.
- 2020 and 2021 irrigation seasons.

Below is comparison of the CBRFC official forecast with the DSS forecast for August 25, 2021 (Figure 23, Figure 24, and Figure 25). The CBRFC forecast was generated by maintaining constant reservoir releases into the future period. The DSS forecast incorporates changes in reservoir releases as discussed and agreed by the stakeholders. The resulting forecast displays potential changes in the 15-Mile reach flow due to the proposed changes in reservoir releases and CBRFC's local adjusted forecast traces. Green Mountain Reservoir releases were increased from 380 cfs to 475 cfs in two steps on August 26th and 27th. Ruedi Reservoir release was increased from 208 cfs to 232 cfs on August 26th and then to 257 cfs on September 2nd. This proposed scenario was evaluated in subsequent days. The releases out of Green Mountain Reservoir were modified from this original proposal and increased even more than 475 cfs. The releases out of Ruedi were maintained as planned.

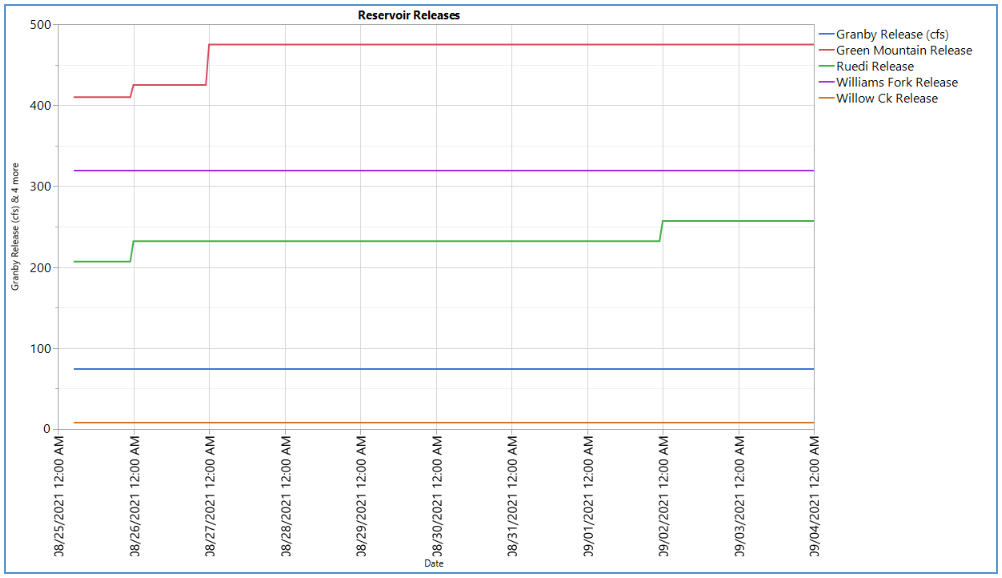


Figure 23. Proposed reservoir releases on August 25, 2021.

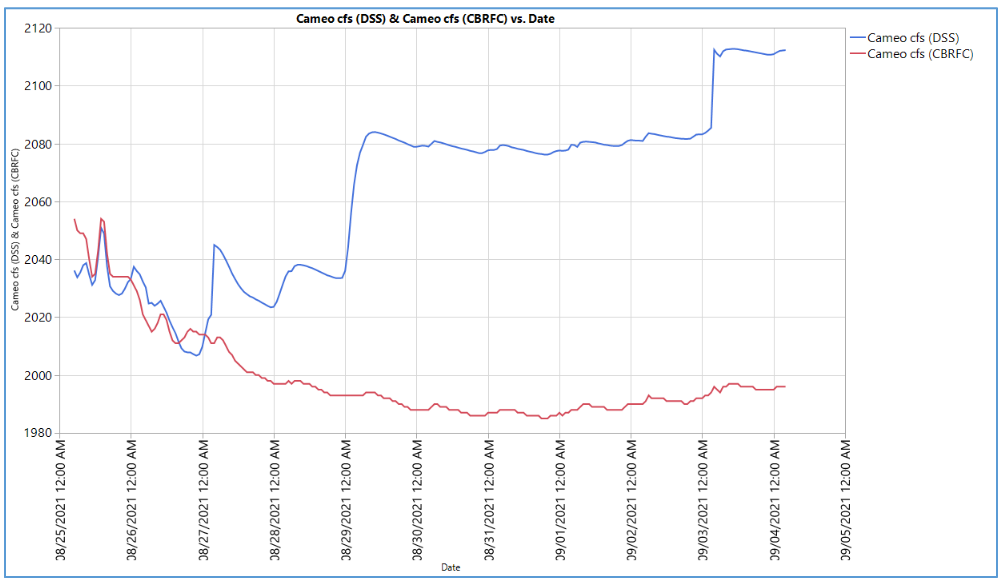


Figure 24. Expected flow at the Cameo gage in response to the proposed reservoir releases on August 25, 2021. Also shown, is the CBRFC forecast generated by maintaining constant reservoir releases.

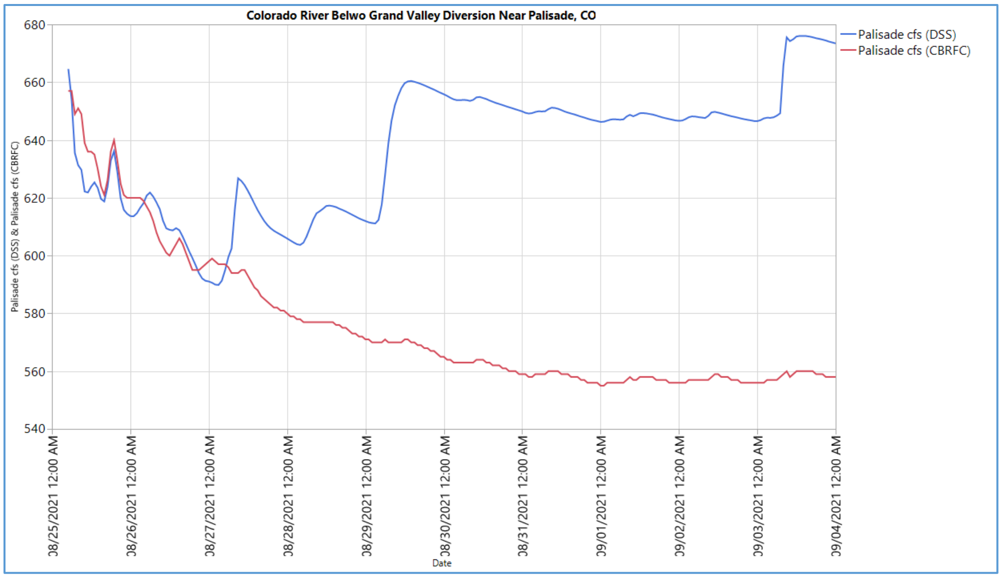


Figure 25. Expected flow at the Palisade gage in response to the proposed reservoir releases on August 25, 2021. Also shown, is the CBRFC forecast generated by maintaining constant reservoir releases.

Discussion

The system has improved the quality of discussion of the HUP meetings. It has also proven to be helpful for making future reservoir release recommendations to manage the flows in the river. The user-friendly interface, developed to share outputs, has been well received by the stakeholders.

The concepts developed in the DSS could be transferable to other highly managed basins, where the evaluation of different scenarios is recommended to manage conflicting interests from different stakeholders.

ECAO plans to continue using the DSS and implement incremental improvements as we learn more about the system performance. Routing parameters will be evaluated and adjusted as necessary. In particular, the routing of Ruedi reservoir release to the Cameo gage needs improvements.

The net diversion change time series for the Cameo to Palisade reach was not tested and discussed with the stakeholders. In the future, ECAO plans to test the performance of this time series. Also, ECAO plans to incorporate the explicit simulation of irrigation diversions in the Grand Valley. For this last task, ECAO will work with the irrigators to define the type of information and data they are able to share. Also, ECAO will coordinate with CBRFC to incorporate the irrigations in the modeling scheme.

Appendix A

Table A-1: Time series defined in ECAO HDB. The Site DataType ID are unique identifiers in the database.

Site Name	Data Type	HDB Site DataType ID
Granby	Release	100605
Willow Creek	Release	100521
Williams Fork	Release	104923
Wolford	Release	104924
Green Mountain	Release	100516
Ruedi	Release	101070
Kremmling	Gage Inflow	100383
Dotsero	Gage Inflow	100350
Cameo	Gage Inflow	100379
Palisade	Gage Inflow	100384
CameoToPalisadeNetDiversion	Diversion	104988

TSTool command file for loading Williams Fork projected release data in HDB

```
#
# Read native and total projected Williams Fork release in daily time step from spreadsheet.
# The total projected release will be saved in two time series (duplicated).
# This will be the initial condition
#
#This command reads the data from the WilliamsFork_ProjectedRelease.xlsx spreadsheet and creates a table
# within TSTool
#
ReadTableFromExcel(TableID="WilliamsFork",InputFile="WilliamsFork_ProjectedRelease.xlsx",Worksheet="WF",ExcelColumnNames=FirstRowInRange)
#
#These commands reads the data from the Excel spreadsheets and convert the data in time series
#
TableToTimeSeries(TableID="WilliamsFork",DateTimeColumn="Date",LocationID="TC[3:3]",ValueColumn="TC[3:3]",Interval=Day,Units="cfs")
#
TableToTimeSeries(TableID="WilliamsFork",DateTimeColumn="Date",LocationID="TC[4:4]",ValueColumn="TC[4:4]",Interval=Day,Units="cfs")
#
# These commands write the data in HDB, using the Site Data Type ID.
#
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="WF_native_cfs..WF_native_cfs.Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="WF_Total_cfs..WF_Total_cfs.Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="WF_Total_cfs..WF_Total_cfs.Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
```

Appendix B

The TSTool command files read observed and projected reservoir data from HDB, CBRFC adjusted local inflow time series from a comma-delimited-file, and time series properties from an Excel spreadsheet. Below is a description of the main components of the TSTool command file.

The period of record of the modeling is controlled in an Excel spreadsheet named TimeSeriesProperties.xlsx. This file contains two worksheets named Properties and ManualEnteredDate. The Properties workbook does not require user inputs. The equations are set up to update the dates automatically.

The ManualEnteredDate workbook was developed for testing purposes and allows to run past events. In the ManualEnteredDate workbook, the date of the start of the forecast is entered by hand and all other properties are automatically updated.

All time series are required to have complete records for the same time period. The period of record is defined by the length of the CBRFC's time series, which always start five days before the forecast date (T_0) and end 10 days after T_0. The Excel file, TimeSeriesProperties.xlsx, defines the start and end of the period of record use in the simulation.

The CBRFC data for the five days prior to T_0 corresponds to observed flow data. Because the travel time from the upper basins to the Palisade gage is about five days, it is necessary to prepend the observed flow to the forecast, so a complete time series is available for the routing model.

The **HourlyOutputStart** and **HourlyOutputEnd** properties are used to set the period of record of the observed and projected reservoir release data so it matches the period of record of CBRFC time series.

The **DailyOutputStart**, **DailyOutputEnd**, **HourlyOutputStart1** and **HourlyOutputEnd1** are properties used to output the time series to HDB. CBRFC time series are in Zulu time and prior to any calculation the time series are shifted backward by seven hours to Mountain Standard Time (MST), leaving the last 7 hours of the original time series empty. The original time series is then filled by repeating the last value forward for the last seven hours. These last seven hours of data are not correct and therefore, results for that last seven hours are not saved in the database. The **DailyOutputStart**, **DailyOutputEnd**, **HourlyOutputStart1** and **HourlyOutputEnd1** are used to define the output period of record of daily and hourly time series saved in HDB and they exclude the last 7 hours of values.

The TSTool command file includes the following seven sections:

Part I: reads the time series properties from the Excel file, reads the observed and projected release data from HDB, creates complete time series from five days prior to T_0 to 10 days after T_0 by concatenating the observed and projected time series, and routes the complete release time series to the Kremmling gage. The release from Ruedi Reservoir is routed to the Cameo gage.

Part II: reads the flow forecast time series from a .csv file provided by CBRFCand adjusts the forecast time series from Zulu time to MST.

Part III: computes the total flow at the Kremmling gage using the equation in section Hydrologic Model Part 2 of this report.

Part IV: computes the total flow at the Dotsero gage using the equation in section *Hydrologic Model Part 2* of this report.

Part V: computes the total flow at the Cameo gage using the equation in section *Hydrologic Model Part 2* of this report.

Part VI: computes the total flow at the Palisade gage using the equation in section *Hydrologic Model Part 2* of this report.

Part VII: outputs the resulting time series to HDB in hourly and daily time steps.

InitialConditions.TSTool Command File

```
################################# READ RELEASE DATA FROM HDB ##########################################
#
# Part I: Read daily projected release for all reservoirs. Change time step from daily to hour
#       Append observed data to have a complete time series for rounting.
#       Included a fillInterpolate command to fill in any missing observed data. Sometimes transmission of data
#       fails. Routing command does not work if data are missing
#
#######################################################################################################
####################
#
# The period of record for the analysis should match CBRFC's time series POR
# The following command reads the dates from an Excel file.
# The ManualEnteredDate tab uses user defined dates and is used for testing
# The Properties tab is automatically populated with CBRFC's time series POR
#
# Use the following command for the call
#
SetWorkingDir(WorkingDir="/wrg/HUPDSS")
#
ReadPropertiesFromExcel(InputFile="TimeSeriesProperties.xlsx",Worksheet="Properties",PropertyCellMap="OutputEnd:C3,OutputStart:C2",DateTimeProperties=
"OutputEnd,OutputStart")
#
# Read in native and total projected Williams Fork release in daily time step from HDB and change the time step from day to hour
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0",Alias="WF_native")
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 1",HydrologicIndicator="1",Alias="WF_Total")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104923-57008.HDB.release.Day.WLFRESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs,AllowMissingConsecutive=26)
FillRepeat(TSList=AllMatchingTSID,TSID="104923-57008",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104923-57009.HDB.release.Day.WLFRESCO.HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="104923-57009",FillDirection=Forward)
#
# Read observed release
#
```

```
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=104918,Alias="WF_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="WF_Complete_Nat",NewTSID="WF_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WF_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="104923-57008")
#
NewTimeSeries(Alias="WF_Complete_Total_1",NewTSID="WF_Complete_Total_1...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WF_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="104923-57009")
FillFromTS(TSList=AllMatchingTSID,TSID="WF_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="WF_Obs")
#
# Route Williams Fork release to Kremmling gage using CBRFC parameter set.
# Lag is variable with flow but K is constant. Therefore, provided one K value for all flows below 1000
#
VariableLagK(TSID="WF_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="75,12;150,10;700,7",K="0,3;10000,3",NewTSID="WilliamsForkNatLag...Hour",Alias="WilliamsForkNatLag")
VariableLagK(TSID="WF_Complete_Total_1",FlowUnits="cfs",LagInterval="Hour",Lag="75,12;150,10;700,7",K="0,3;10000,3",NewTSID="WilliamsForkTotalLag...Hour",Alias="WilliamsForkTotalLag")
#
# Read native and total projected Wolford release in daily time step from HDB and change the time step from day to hour
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0")
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104924-57008.HDB.release.Day.WOLRESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="104924-57008",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104924-57009.HDB.release.Day.WOLRESCO.HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="104924-57009",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100436,Alias="WOL_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="WOL_Complete_Nat",NewTSID="WOL_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WOL_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="104924-57008")
#
```

```
NewTimeSeries(Alias="WOL_Complete_Total_1",NewTSID="WOL_Complete_Total_1...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WOL_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="104924-57009")
FillFromTS(TSList=AllMatchingTSID,TSID="WOL_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="WOL_Obs")
#
# Route Wolford release to Kremmling gage using CBRFC parameter set.
# Lag is variable with flow but K is constant. Therefore, provided one K value for all flows below 3000
#
VariableLagK(TSID="WOL_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="20,12;50,10;200,8",K="0,3;10000,3",NewTSID="WolfordNatlLag...Hour",
Alias="WolfordNatLag")
VariableLagK(TSID="WOL_Complete_Total_1",FlowUnits="cfs",LagInterval="Hour",Lag="20,12;50,10;200,8",K="0,3;10000,3",NewTSID="WolfordTotalLag...H
our",Alias="WolfordTotalLag")
#
# Read native and total projected release for all Reclamation reservoirs from HDB (Lake Granby, Willow Ck, Green Mountain, Ruedi)
#
# Lake Granby
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0")
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 1",HydrologicIndicator="1")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100605-57008.HDB.release.Day.GRARESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100605-57008",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100605-57009.HDB.release.Day.GRARESCO.HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100605-57009",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100382,Alias="GRA_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="GRA_Complete_Nat",NewTSID="GRA_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GRA_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="100605-57008")
#
NewTimeSeries(Alias="GRA_Complete_Total_1",NewTSID="GRA_Complete_Total_1...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GRA_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="100605-57009")
FillFromTS(TSList=AllMatchingTSID,TSID="GRA_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="GRA_Obs")
#
# Route Lake Granby release to Kremmling gage using CBRFC parameter set.
```

```
# There is no K value. K set to zero for all flows
#
VariableLagK(TSID="GRA_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="0,18;10000,18",K="0,0",NewTSID="GRARESCONatLag...Hour",Alias="
GRARESCONatLag")
VariableLagK(TSID="GRA_Complete_Total_1",FlowUnits="cfs",LagInterval="Hour",Lag="0,18;10000,18",K="0,0",NewTSID="GRARESCOTotalLag...Hour",Al
ias="GRARESCOTotalLag")
#
# Willow Ck Reservoir
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0")
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 1",HydrologicIndicator="1")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100521-57008.HDB.release.Day.WILRESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100521-57008",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100521-57009.HDB.release.Day.WILRESCO.HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100521-57009",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100471,Alias="WCK_Obs")
#
# Append projected data to observed before routing
#
NewTimeSeries(Alias="WCK_Complete_Nat",NewTSID="WCK_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WCK_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="100521-57008")
#
NewTimeSeries(Alias="WCK_Complete_Total_1",NewTSID="WCK_Complete_Total_1...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WCK_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="100521-57009")
FillFromTS(TSList=AllMatchingTSID,TSID="WCK_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="WCK_Obs")
#
# Route Willow Ck release to Kremmling gage using CBRFC parameter set.
# There is no K value. K set to zero for all flows
#
VariableLagK(TSID="WCK_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="0,17;10000,17",K="0,0",NewTSID="WCNatLag...Hour",Alias="WCNatL
ag")
VariableLagK(TSID="WCK_Complete_Total_1",FlowUnits="cfs",LagInterval="Hour",Lag="0,17;10000,17",K="0,0",NewTSID="WCTotalLag...Hour",Alias="W
CTotalLag")
#
```

```
# Green Mt. Reservoir
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0")
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 1",HydrologicIndicator="1")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100516-57008.HDB.release.Day.GRERESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100516-57008",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100516-57009.HDB.release.Day.GRERESCO.HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100516-57009",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100349,Alias="GM_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="GM_Complete_Nat",NewTSID="GM_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GM_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="100516-57008")
#
NewTimeSeries(Alias="GM_Complete_Total_1",NewTSID="GM_Complete_Total_1...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GM_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="100516-57009")
FillFromTS(TSList=AllMatchingTSID,TSID="GM_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="GM_Obs")
#
# Route GM release to Kremmling gage using CBRFC parameter set.
# Lag is variable with flow but K is constant. Therefore, provided one K value for all flows below 1000
#
VariableLagK(TSID="GM_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="200,8;700,6;1000,5",K="0,2;10000,2",NewTSID="GMNatLag...Hour",Alias
="GMNatLag")
VariableLagK(TSID="GM_Complete_Total_1",FlowUnits="cfs",LagInterval="Hour",Lag="200,8;700,6;1000,5",K="0,2;10000,2",NewTSID="GMTotalLag...Hour"
,Alias="GMTotalLag")
#
# Ruedi Reservoir
#
reservoir:101070-57008.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Native-0-2020-02-26 00:00~ReclamationHDB-ECO
reservoir:101070-57009.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26 00:00~ReclamationHDB-ECO
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:101070-57008.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="101070-57008",FillDirection=Forward)
```

```
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:101070-57009.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="101070-57009",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=101070,Alias="Ruedi_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="Ruedi_Complete_Nat",NewTSID="Ruedi_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="101070-57008")
#
NewTimeSeries(Alias="Ruedi_Complete_Total_1",NewTSID="Ruedi_Complete_Total_1...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="101070-57009")
FillFromTS(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Total_1",IndependentTSList=AllMatchingTSID,IndependentTSID="Ruedi_Obs")
#
# Route Ruedi release to the Cameo gage using CBRFC parameter set.
# Contant Lag and zero K from Ruedi to Cameo.
#
LagK(TSID="Ruedi_Complete_Nat",Alias="RuediNatLag",Lag=28,K=0)
LagK(TSID="Ruedi_Complete_Total_1",Alias="RuediTotalLag",Lag=28,K=0)
#
#Read Native and Total-1 net diversion change between Cameo and Palisade
#
#Native
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104988,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Alias="CAMPALCO_Native")
ChangeInterval(TSList=AllMatchingTSID,TSID="reach:104988-57008.HDB.net diversion.Day.CAMPALCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs,AllowMissingConsecutive=26)
FillRepeat(TSList=AllMatchingTSID,TSID="104988-57008",FillDirection=Forward)
#
#Total-1
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104988,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Alias="CAMPALCO_Total-1")
ChangeInterval(TSList=AllMatchingTSID,TSID="104988-57009.HDB.net diversion.Day.CAMPALCO.HUP_DSS-HUP_DSS Case Total 1-1-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs,AllowMissingConsecutive=26)
FillRepeat(TSList=AllMatchingTSID,TSID="104988-57009",FillDirection=Forward)
#####################################################################################
```

```
############################## READ CBRFC LOCAL FORECAST###############################################
#
# Part II:
# Read forecasted local flow at Kremmling, Dotsero, Cameo and Palisade from CBRFC file - Hourly time step
#
####################################################################################################
###################################
#
ReadTableFromDelimitedFile(TableID="CBRFC_Flow",InputFile="../hdb/apps/TSTOOL/DSS/CBRFC/usbr_hup.csv",SkipLines="2",HeaderLines="1",DateTimeColumns="TC[1]")
ReadTableFromDelimitedFile(TableID="CBRFC_Flow_2",InputFile="../hdb/apps/TSTOOL/DSS/CBRFC/usbr_hup.csv",SkipLines="1",HeaderLines="2",DateTimeColumns="TC[1]")
#
ReadTableFromDelimitedFile(TableID="CBRFC_Flow",InputFile="C:\Users\cleonsalazar\Downloads\usbr_hup.csv",SkipLines="2",HeaderLines="1",DateTimeColumns="TC[1]")
#
ReadTableFromDelimitedFile(TableID="CBRFC_Flow_2",InputFile="C:\Users\cleonsalazar\Downloads\usbr_hup.csv",SkipLines="1",HeaderLines="2",DateTimeColumns="TC[1]")
JoinTables(TableID="CBRFC_Flow",TableToJoinID="CBRFC_Flow_2",JoinColumns="KRMC2L_F:CFS,EGLC2L_F:CFS_2,CAMC2L_F:CFS_2_2,CGYC2L_F:CFS_2_2_2",IncludeColumns="datetime(GMT)",JoinMethod=JoinAlways)
TableToTimeSeries(TableID="CBRFC_Flow",DateTimeColumn="TC[6]",LocationID="TC[2:5]",ValueColumn="TC[2:5]",Interval=Hour,Units="cfs",Alias="%A")
#
#CBRFC time series are in zulu time.  Shifting the time series 7 hours backward.
#After shifting the times series backward by 7 hours, the end of the POR of the new shifted time series remained the same. Then
# we need to fill in forward the last 7 hours by repeating the last value.  This last 7 hour period will be truncated in the output
#
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="KRMC2L_F..KRMC2L_F.Hour",ShiftData="7,1.0")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="EGLC2L_F..EGLC2L_F.Hour",ShiftData="7,1.0")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CAMC2L_F..CAMC2L_F.Hour",ShiftData="7,1.0")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CGYC2L_F..CGYC2L_F.Hour",ShiftData="7,1.0")
FillRepeat(TSList=AllMatchingTSID,TSID="KRMC2L_F..KRMC2L_F.Hour",FillDirection=Forward)
FillRepeat(TSList=AllMatchingTSID,TSID="EGLC2L_F..EGLC2L_F.Hour",FillDirection=Forward)
FillRepeat(TSList=AllMatchingTSID,TSID="CAMC2L_F..CAMC2L_F.Hour",FillDirection=Forward)
FillRepeat(TSList=AllMatchingTSID,TSID="CGYC2L_F..CGYC2L_F.Hour",FillDirection=Forward)
#
Copy(TSID="KRMC2L_F..KRMC2L_F.Hour",NewTSID="KRMC2_ADJ_TOTAL_NEW_Native...Hour",Alias="KRMC2_ADJ_TOTAL_NEW_Native")
Copy(TSID="KRMC2L_F..KRMC2L_F.Hour",NewTSID="KRMC2_ADJ_TOTAL_NEW...Hour",Alias="KRMC2_ADJ_TOTAL_NEW")
#
####################################################################################################
############################### KREMLING ##########################################################
```

```
# Part III: Compute NEW Kremmling adjusted total flow AND total routed reservoir release flow
# KRMC2_ADJ_TOTAL_NEW = KRMC2_ADJ_LOC + WOLFORD REL LAG + GM REL LAG + WILLIAMS FK REL LAG + GRANBY REL LAG + WILLOW CK REL LAG - WINDY GAP PUMPING
# ASSUME NOT PUMPING WINDY GAP DURING IRRIGATION SEASON. IT IS ALWAYS ZERO.
#
##############################################################################################
#
# Compute total native routed releases
#
# Williams Fork
#
Copy(TSID="WilliamsForkNatLag",NewTSID="TOTAL_Nat_LAG_ABV_KRM...Hour",Alias="TOTAL_Nat_LAG_ABV_KRM")
Add(TSID="TOTAL_Nat_LAG_ABV_KRM",AddTSList=SpecifiedTSID,AddTSID="WolfordNatLag,GRARESCONatLag,WCNatLag,GMNatLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="TOTAL_Nat_LAG_ABV_KRM",Alias="TOTAL_Nat_LAG_ABV_KRM_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# Compute total routed releases
#
Copy(TSID="WilliamsForkTotalLag",NewTSID="TOTAL_Rel_LAG_ABV_KRM...Hour",Alias="TOTAL_Rel_LAG_ABV_KRM")
Add(TSID="TOTAL_Rel_LAG_ABV_KRM",AddTSList=SpecifiedTSID,AddTSID="WolfordTotalLag,GRARESCOTotalLag,WCTotalLag,GMTotalLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="TOTAL_Rel_LAG_ABV_KRM",Alias="TOTAL_Rel_LAG_ABV_KRM_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# Compute new total adjusted flow at Kremmling. This is the time series that will be routed to Dotsero and added to the
# Local adjusted flow at Dotsero supplied by CBRFC
#
# With native release only
#
Add(TSID="KRMC2_ADJ_TOTAL_NEW_Native",AddTSList=SpecifiedTSID,AddTSID="TOTAL_Nat_LAG_ABV_KRM",HandleMissingHow="SetMissingIfAnyMissing")
FillRepeat(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",Alias="KRMC2_ADJ_TOTAL_NEW_Native_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# With total release = native + sheparded release
#
Add(TSID="KRMC2_ADJ_TOTAL_NEW",AddTSList=SpecifiedTSID,AddTSID="TOTAL_Rel_LAG_ABV_KRM",HandleMissingHow="SetMissingIfAnyMissing")
FillRepeat(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",FillDirection=Forward)
```

ChangeInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",Alias="KRMC2_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
##
DOTSERO
Part IV. Compute new total adjusted flow at Dotsero.
First route the total adjusted flow from Kremmling to Dotsero and add the local adjusted flow at Dotsero from CBRFC
#
##
#
Copy(TSID="EGLC2L_F..EGLC2L_F.Hour",NewTSID="EGLC2_ADJ_TOTAL_NEW_Native...Hour",Alias="EGLC2_ADJ_TOTAL_NEW_Native")
Copy(TSID="EGLC2L_F..EGLC2L_F.Hour",NewTSID="EGLC2_ADJ_TOTAL_NEW...Hour",Alias="EGLC2_ADJ_TOTAL_NEW")
#
Route total native flow from Kremmling to Dotsero
#
VariableLagK(TSID="KRMC2_ADJ_TOTAL_NEW_Native",FlowUnits="cfs",LagInterval="Hour",Lag="0,24;500,24;1000,20;2000,15",K="1,1;2000,1",NewTSID="KRMC2_EGLC2_NatLag...Hour",Alias="KRMC2_EGLC2_NatLag")
#
Route total flow from Kremmling to Dotsero
#
VariableLagK(TSID="KRMC2_ADJ_TOTAL_NEW",FlowUnits="cfs",LagInterval="Hour",Lag="0,24;500,24;1000,20;2000,15",K="1,1;2000,1",NewTSID="KRMC2_EGLC2_TotalLag...Hour",Alias="KRMC2_EGLC2_TotalLag")
#
New Native Total Adjusted at Dotsero = Local Adjusted at Dotsero + Native routed from Kremmling to Dotsero
#
Add(TSID="EGLC2_ADJ_TOTAL_NEW_Native",AddTSList=AllMatchingTSID,AddTSID="KRMC2_EGLC2_NatLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native",Alias="EGLC2_ADJ_TOTAL_NEW_Native_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
New Total Adjusted = Local Adjusted at Dotsero + Total routed from Kremmling to Dotsero
#
Add(TSID="EGLC2_ADJ_TOTAL_NEW",AddTSList=AllMatchingTSID,AddTSID="KRMC2_EGLC2_TotalLag",HandleMissingHow="SetMissingIfOtherMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",Alias="EGLC2_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
##
CAMEO
Part V. Compute new total adjusted flow at Cameo
First route the total adjusted flow at Dotsero to Cameo and Ruedi Res release to Cameo and add the local adjusted flow at Dotsero from CBRFC

```
##########################################################################################################
#
Copy(TSID="CAMC2L_F..CAMC2L_F.Hour",NewTSID="CAMC2L_ADJ_TOTAL_NEW_Native...Hour",Alias="CAMC2L_ADJ_TOTAL_NEW_Native")
Copy(TSID="CAMC2L_F..CAMC2L_F.Hour",NewTSID="CAMC2L_ADJ_TOTAL_NEW...Hour",Alias="CAMC2L_ADJ_TOTAL_NEW")
#
# Route total native flow from Dotsero to Cameo
#
LagK(TSID="EGLC2_ADJ_TOTAL_NEW_Native",Alias="EGLC2_CAMC2L_NatLag",Lag=22,K=0)
#
# Route total flow from Dotsero to Cameo
#
LagK(TSID="EGLC2_ADJ_TOTAL_NEW",Alias="EGLC2_CAMC2L_TotalLag",Lag=22,K=0)
#
# New Native Total Adjusted at Cameo = Local Adjusted at Cameo + Native routed from Dotsero to Cameo + Routed Ruedi release To Cameo
#
Add(TSID="CAMC2L_ADJ_TOTAL_NEW_Native",AddTSList=SpecifiedTSID,AddTSID="RuediNatLag,EGLC2_CAMC2L_NatLag",HandleMissingHow="Set
MissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native",Alias="CAMC2L_ADJ_TOTAL_NEW_Native_DAY",NewInterval=D
ay,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# New Total Adjusted = Local Adjusted at Cameo + Total routed from Dotsero to Cameo
#
Add(TSID="CAMC2L_ADJ_TOTAL_NEW",AddTSList=SpecifiedTSID,AddTSID="RuediTotalLag,EGLC2_CAMC2L_TotalLag",HandleMissingHow="SetMissi
ngIfOtherMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",Alias="CAMC2L_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScal
e=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
##########################################################################################################
######################################### PALISADE ###################################################
#
# Part VI: Compute new total adjusted flow at Palisade
# Total Adjusted Simulated flow Palisade = Palisade Local Adj Sim + Total Cameo Routed
# The Palisade Local time series from CBRFC includes diversions and return flows.
# We are including a net diversion change time series to simulate net changes of diversion/return flows.
# No explicit diversions are simulated. Only
# net diversion changes in the Caemo to Palisade reach are assumed.
# CGYC2 total ADJSIM = CGYC2 adjusted local flow (from Cody) + CAMC2 LAGK + NetDivChange
# Eventually, the plan is to simulate the diversions explicitly. Right now, the irrigators/farmers are not providing forecast diversion data
#
##########################################################################################################
#
```

```
Copy(TSID="CGYC2L_F..CGYC2L_F.Hour",NewTSID="CGYC2L_ADJ_TOTAL_NEW_Native...Hour",Alias="CGYC2L_ADJ_TOTAL_NEW_Native")
Copy(TSID="CGYC2L_F..CGYC2L_F.Hour",NewTSID="CGYC2L_ADJ_TOTAL_NEW...Hour",Alias="CGYC2L_ADJ_TOTAL_NEW")
#
# Route total native flow from Cameo to Palisade
#
VariableLagK(TSID="CAMC2L_ADJ_TOTAL_NEW_Native",FlowUnits="cfs",LagInterval="Hour",Lag="1500,5;2500,4;4000,3;8000,2",K="0,0;8000;0",NewTSI
D="CAMC2L_CGYC2L_NatLag...Hour",Alias="CAMC2L_CGYC2L_NatLag")
#
# Route total flow from Cameo to Palisade
#
VariableLagK(TSID="CAMC2L_ADJ_TOTAL_NEW",FlowUnits="cfs",LagInterval="Hour",Lag="1500,5;2500,4;4000,3;8000,2",K="0,0;8000;0",NewTSID="CA
MC2L_CGYC2L_TotalLag...Hour",Alias="CAMC2L_CGYC2L_TotalLag")
#
# New Native Total Adjusted at Palisade = Local Adjusted at Palisade (including div and return flow) + Total Native routed from Cameo to Palisade + net diversion
change
#
Add(TSID="CGYC2L_ADJ_TOTAL_NEW_Native",AddTSList=SpecifiedTSID,AddTSID="104988-
57008,CAMC2L_CGYC2L_NatLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native",Alias="CGYC2L_ADJ_TOTAL_NEW_Native_DAY",NewInterval=D
ay,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# New Total Adjusted = Local Adjusted at Palisade (including div and return flow) + Total routed from Cameo to Palisade + net diversion change
#
Add(TSID="CGYC2L_ADJ_TOTAL_NEW",AddTSList=SpecifiedTSID,AddTSID="104988-
57009,CAMC2L_CGYC2L_TotalLag",HandleMissingHow="SetMissingIfOtherMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",Alias="CGYC2L_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScal
e=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#####################################################################################################
######################################### OUTPUT TO HDB #############################################
#
# Part VII: Writing time series to HDB
#
#####################################################################################################
# Writing hourly
#
# Save hourly time series but truncate POR by 7 hours at the end. See comment in Section II.
#
ReadPropertiesFromExcel(InputFile="TimeSeriesProperties.xlsx",Worksheet="Properties",PropertyCellMap="OutputEnd:C7,OutputStart:C6",DateTimeProperties=
"OutputEnd,OutputStart")
#
# Kremling Native
```

```
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DS
S Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Dotsero Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Cameo Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_D
SS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Palisade Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_D
SS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Kremling Total 1 and 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Dotsero Total 1 and 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Cameo Total 1 and 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
```

```
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Palisade Total 1 and 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Williams Fork Release
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104923-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104923-57009",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104923-
57008",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104923-
57009",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104923-
57009",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Wolford
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104924-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104924-57009",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104924-
57008",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104924-
57009",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104924-
57009",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Granby
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100605-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100605-57009",ShiftData="-1,1")
```

```
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100605-
57008",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100605-
57009",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100605-
57009",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Willow Creek
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100521-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100521-57009",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100521-
57008",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100521-
57009",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100521-
57009",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Green Mountain
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100516-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100516-57009",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100516-
57008",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100516-
57009",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100516-
57009",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Ruedi
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="101070-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="101070-57009",ShiftData="-1,1")
```

```
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="101070-57008",SiteDataTypeID=101070,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="101070-57009",SiteDataTypeID=101070,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="101070-57009",SiteDataTypeID=101070,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Writing daily
#
# Use the following command for the call
#
ReadPropertiesFromExcel(InputFile="TimeSeriesProperties.xlsx",Worksheet="Properties",PropertyCellMap="OutputEnd:C5,OutputStart:C4",DateTimeProperties="OutputEnd,OutputStart")
#
# Kremling Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Dotsero Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Cameo Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Palisade Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Kremling Total 1 and 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Dotsero Total 1 and 2
```

```
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Cameo Total 1 and 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Palisade Total 1 and 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 1",HydrologicIndicator="1",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
```

meeting.TSTool Command File

```
################################################################################################################
################################### READ RELEASE DATA FROM HDB ##########################################
#
# Part I: Read daily projected releasE for all reservoirs. Change time step from daily to hour
#
################################################################################################################
#
# The period of record for the analysis should match CBRFC's time series POR
# The following command reads the dates from an Excel file.
# The ManualEnteredDate tab uses user defined dates and is used for testing
# The Properties tab is automatically populated with CBRFC's time series POR
#
# Use the following command for the call
#
SetWorkingDir(WorkingDir="/wrg/HUPDSS")
ReadPropertiesFromExcel(InputFile="TimeSeriesProperties.xlsx",Worksheet="Properties",PropertyCellMap="OutputEnd:C3,OutputStart:C2",DateTimeProperties=
"OutputEnd,OutputStart")
#
# Read in native Williams Fork release in daily time step from HDB and change the time step from day to hour
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0",Alias="WF_native")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104923-57008.HDB.release.Day.WLFRESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs,AllowMissingConsecutive=26)
FillRepeat(TSList=AllMatchingTSID,TSID="104923-57008",FillDirection=Forward)
#
# Read in total projected Williams Fork release in daily time step from HDB and change the time step from day to hour
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 2",HydrologicIndicator="2",Alias="WF_Total")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104923-57010.HDB.release.Day.WLFRESCO.HUP_DSS-HUP_DSS Case Total 2-2-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="104923-57010",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=104918,Alias="WF_Obs")
#
```

```
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="WF_Complete_Total_2",NewTSID="WF_Complete_Total_2...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WF_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="104923-57010")
FillFromTS(TSList=AllMatchingTSID,TSID="WF_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="WF_Obs")
#
NewTimeSeries(Alias="WF_Complete_Nat",NewTSID="WF_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WF_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="104923-57008")
#FillInterpolate(TSList=AllMatchingTSID,TSID="WF_Complete_Nat",MaxIntervals=15)
#
# Route Williams Fork release to Kremmling gage using CBRFC parameter set.
# Lag is variable with flow but K is constant. Therefore, provided one K value for all flows below 1000
#
VariableLagK(TSID="WF_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="75,12;150,10;700,7",K="0,3;10000,3",NewTSID="WilliamsForkNatLag...Hour",Alias="WilliamsForkNatLag")
VariableLagK(TSID="WF_Complete_Total_2",FlowUnits="cfs",LagInterval="Hour",Lag="75,12;150,10;700,7",K="0,3;10000,3",NewTSID="WilliamsForkTotalLag...Hour",Alias="WilliamsForkTotalLag")
#
# Read total projected Wolford release in daily time step from HDB and change the time step from day to hour
#
#
# Read native and total projected Wolford release in daily time step from HDB and change the time step from day to hour
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104924-57008.HDB.release.Day.WOLRESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="104924-57008",FillDirection=Forward)
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:104924-57010.HDB.release.Day.WOLRESCO.HUP_DSS-HUP_DSS Case Total 2-2-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="104924-57010",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100436,Alias="WOL_Obs")
#
# Append observed data to projected data before routing
#
```

```
NewTimeSeries(Alias="WOL_Complete_Nat",NewTSID="WOL_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WOL_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="104924-57008")
#FillInterpolate(TSList=AllMatchingTSID,TSID="WOL_Complete_Nat",MaxIntervals=15)
#
NewTimeSeries(Alias="WOL_Complete_Total_2",NewTSID="WOL_Complete_Total_2...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WOL_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="104924-57010")
FillFromTS(TSList=AllMatchingTSID,TSID="WOL_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="WOL_Obs")
#
# Route Wolford release to Kremmling gage using CBRFC parameter set.
# Lag is variable with flow but K is constant. Therefore, provided one K value for all flows below 3000
#
VariableLagK(TSID="WOL_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="20,12;50,10;200,8",K="0,3;10000,3",NewTSID="WolfordNatlLag...Hour",
Alias="WolfordNatLag")
VariableLagK(TSID="WOL_Complete_Total_2",FlowUnits="cfs",LagInterval="Hour",Lag="20,12;50,10;200,8",K="0,3;10000,3",NewTSID="WolfordTotalLag...H
our",Alias="WolfordTotalLag")
#
# Read total projected release for all Reclamation reservoirs from HDB (Lake Granby, Willow Ck, Green Mountain, Ruedi)
#
# Lake Granby
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100605-57008.HDB.release.Day.GRARESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100605-57008",FillDirection=Forward)
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 2",HydrologicIndicator="2")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100605-57010.HDB.release.Day.GRARESCO.HUP_DSS-HUP_DSS Case Total 2-2-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100605-57010",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100382,Alias="GRA_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="GRA_Complete_Total_2",NewTSID="GRA_Complete_Total_2...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GRA_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="100605-57010")
FillFromTS(TSList=AllMatchingTSID,TSID="GRA_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="GRA_Obs")
```

```
#
NewTimeSeries(Alias="GRA_Complete_Nat",NewTSID="GRA_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GRA_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="100605-57008")
#FillInterpolate(TSList=AllMatchingTSID,TSID="GRA_Complete_Nat",MaxIntervals=15)
#
# Route Lake Granby release to Kremmling gage using CBRFC parameter set.
# There is no K value. K set to zero for all flows
#
VariableLagK(TSID="GRA_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="0,18;10000,18",K="0,0",NewTSID="GRARESCONatLag...Hour",Alias="
GRARESCONatLag")
VariableLagK(TSID="GRA_Complete_Total_2",FlowUnits="cfs",LagInterval="Hour",Lag="0,18;10000,18",K="0,0",NewTSID="GRARESCOTotalLag...Hour",Al
ias="GRARESCOTotalLag")
#
# Willow Ck Reservoir
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100521-57008.HDB.release.Day.WILRESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100521-57008",FillDirection=Forward)
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 2",HydrologicIndicator="2")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100521-57010.HDB.release.Day.WILRESCO.HUP_DSS-HUP_DSS Case Total 2-2-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100521-57010",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100471,Alias="WCK_Obs")
#
# Append projected data to observed before routing
#
NewTimeSeries(Alias="WCK_Complete_Total_2",NewTSID="WCK_Complete_Total_2...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WCK_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="100521-57010")
FillFromTS(TSList=AllMatchingTSID,TSID="WCK_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="WCK_Obs")
#
NewTimeSeries(Alias="WCK_Complete_Nat",NewTSID="WCK_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="WCK_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="100521-57008")
#FillInterpolate(TSList=AllMatchingTSID,TSID="WCK_Complete_Nat",MaxIntervals=15)
#
```

```
# Route Willow Ck release to Kremmling gage using CBRFC parameter set.
# There is no K value. K set to zero for all flows
#
VariableLagK(TSID="WCK_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="0,17;10000,17",K="0,0",NewTSID="WCNatLag...Hour",Alias="WCNatL
ag")
VariableLagK(TSID="WCK_Complete_Total_2",FlowUnits="cfs",LagInterval="Hour",Lag="0,17;10000,17",K="0,0",NewTSID="WCTotalLag...Hour",Alias="W
CTotalLag")
#
# Green Mt. Reservoir
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100516-57008.HDB.release.Day.GRERESCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100516-57008",FillDirection=Forward)
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Total 2",HydrologicIndicator="2")
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:100516-57010.HDB.release.Day.GRERESCO.HUP_DSS-HUP_DSS Case Total 2-2-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="100516-57010",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=100349,Alias="GM_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="GM_Complete_Total_2",NewTSID="GM_Complete_Total_2...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GM_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="100516-57010")
FillFromTS(TSList=AllMatchingTSID,TSID="GM_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="GM_Obs")
#
NewTimeSeries(Alias="GM_Complete_Nat",NewTSID="GM_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="GM_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="100516-57008")
#FillInterpolate(TSList=AllMatchingTSID,TSID="GM_Complete_Nat",MaxIntervals=15)
#
# Route GM release to Kremmling gage using CBRFC parameter set.
# Lag is variable with flow but K is constant. Therefore, provided one K value for all flows below 1000
#
VariableLagK(TSID="GM_Complete_Nat",FlowUnits="cfs",LagInterval="Hour",Lag="200,8;700,6;1000,5",K="0,2;10000,2",NewTSID="GMNatLag...Hour",Alias
="GMNatLag")
```

```
VariableLagK(TSID="GM_Complete_Total_2",FlowUnits="cfs",LagInterval="Hour",Lag="200,8;700,6;1000,5",K="0,2;10000,2",NewTSID="GMTotalLag...Hour"
,Alias="GMTotalLag")
#
# Ruedi Reservoir
#
reservoir:101070-57008.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Native-0-2020-02-26 00:00~ReclamationHDB-ECO
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:101070-57008.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Native-0-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="101070-57008",FillDirection=Forward)
#
reservoir:101070-57010.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Total 2-1-2020-02-26 00:00~ReclamationHDB-ECO
ChangeInterval(TSList=AllMatchingTSID,TSID="reservoir:101070-57010.HDB.release.Day.RUERESCO-HUP_DSS-HUP_DSS Case Total 2-1-2020-02-26
00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
FillRepeat(TSList=AllMatchingTSID,TSID="101070-57010",FillDirection=Forward)
#
# Read observed release
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Hour",SiteDataTypeID=101070,Alias="Ruedi_Obs")
#
# Append observed data to projected data before routing
#
NewTimeSeries(Alias="Ruedi_Complete_Total_2",NewTSID="Ruedi_Complete_Total_2...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="101070-57010")
FillFromTS(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Total_2",IndependentTSList=AllMatchingTSID,IndependentTSID="Ruedi_Obs")
#
NewTimeSeries(Alias="Ruedi_Complete_Nat",NewTSID="Ruedi_Complete_Nat...Hour",Units="cfs")
FillFromTS(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Nat",IndependentTSList=AllMatchingTSID,IndependentTSID="101070-57008")
#FillInterpolate(TSList=AllMatchingTSID,TSID="Ruedi_Complete_Nat",MaxIntervals=15)
#
# Route Ruedi release to the Cameo gage using CBRFC parameter set.
# Contant Lag and zero K from Ruedi to Cameo.
#
LagK(TSID="Ruedi_Complete_Nat",Alias="RuediNatLag",Lag=28,K=0)
LagK(TSID="Ruedi_Complete_Total_2",Alias="RuediTotalLag",Lag=28,K=0)
#
#Read Native and Total-2 net diversion change between Cameo and Palisade
#
#Native
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104988,ModelName="HUP_DSS",ModelRunName="HUP_DSS
Case Native",HydrologicIndicator="0",Alias="CAMPALCO_Native")
```

```
ChangeInterval(TSList=AllMatchingTSID,TSID="reach:104988-57008.HDB.net diversion.Day.CAMPALCO.HUP_DSS-HUP_DSS Case Native-0-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs,AllowMissingConsecutive=26)
FillRepeat(TSList=AllMatchingTSID,TSID="104988-57008",FillDirection=Forward)
#
#Total-2
#
ReadReclamationHDB(DataStore="ReclamationHDB-ECO",Interval="Day",SiteDataTypeID=104988,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Alias="CAMPALCO_Total-2")
ChangeInterval(TSList=AllMatchingTSID,TSID="reach:104988-57010.HDB.net diversion.Day.CAMPALCO.HUP_DSS-HUP_DSS Case Total 2-2-2020-02-26 00:00",Alias="%L",NewInterval=Hour,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs,AllowMissingConsecutive=26)
FillRepeat(TSList=AllMatchingTSID,TSID="104988-57010",FillDirection=Forward)
##########################################################################################################
########################## READ CBRFC LOCAL FORECAST ##################################################
#
# Part II:
# Read forecasted local flow at Kremmling, Dotsero, Cameo and Palisade from CBRFC file - Hourly time step
#
##########################################################################################################
#
ReadTableFromDelimitedFile(TableID="CBRFC_Flow",InputFile="../hdb/apps/TSTOOL/DSS/CBRFC/usbr_hup.csv",SkipLines="2",HeaderLines="1",DateTimeColumns="TC[1]")
ReadTableFromDelimitedFile(TableID="CBRFC_Flow_2",InputFile="../hdb/apps/TSTOOL/DSS/CBRFC/usbr_hup.csv",SkipLines="1",HeaderLines="2",DateTimeColumns="TC[1]")
#
ReadTableFromDelimitedFile(TableID="CBRFC_Flow",InputFile="C:\Users\cleonsalazar\Downloads\usbr_hup.csv",SkipLines="2",HeaderLines="1",DateTimeColumns="TC[1]")
#
ReadTableFromDelimitedFile(TableID="CBRFC_Flow_2",InputFile="C:\Users\cleonsalazar\Downloads\usbr_hup.csv",SkipLines="1",HeaderLines="2",DateTimeColumns="TC[1]")
JoinTables(TableID="CBRFC_Flow",TableToJoinID="CBRFC_Flow_2",JoinColumns="KRMC2L_F:CFS,EGLC2L_F:CFS_2,CAMC2L_F:CFS_2_2,CGYC2L_F:CFS_2_2_2",IncludeColumns="datetime(GMT)",JoinMethod=JoinAlways)
TableToTimeSeries(TableID="CBRFC_Flow",DateTimeColumn="TC[6]",LocationID="TC[2:5]",ValueColumn="TC[2:5]",Interval=Hour,Units="cfs",Alias="%A")
#
#CBRFC time series are in zulu time.  Shifting the time series 7 hours backward because all other time series are in MST
#After shifting the times series backward by 7 hours, the end of the POR of the new shifted time series remained the same. Then
# we need to fill in forward the last 7 hours by repeating the last value.  This last 7 hour period will be truncated in the output
#
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="KRMC2L_F..KRMC2L_F.Hour",ShiftData="7,1.0")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="EGLC2L_F..EGLC2L_F.Hour",ShiftData="7,1.0")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CAMC2L_F..CAMC2L_F.Hour",ShiftData="7,1.0")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CGYC2L_F..CGYC2L_F.Hour",ShiftData="7,1.0")
```

```
FillRepeat(TSList=AllMatchingTSID,TSID="KRMC2L_F..KRMC2L_F.Hour",FillDirection=Forward)
FillRepeat(TSList=AllMatchingTSID,TSID="EGLC2L_F..EGLC2L_F.Hour",FillDirection=Forward)
FillRepeat(TSList=AllMatchingTSID,TSID="CAMC2L_F..CAMC2L_F.Hour",FillDirection=Forward)
FillRepeat(TSList=AllMatchingTSID,TSID="CGYC2L_F..CGYC2L_F.Hour",FillDirection=Forward)
#
################################################################################################
###################################### KREMLING #################################################
# Part III: Compute NEW Kremmling adjusted total flow AND total routed reservoir release flow
# KRMC2_ADJ_TOTAL_NEW = KRMC2_ADJ_LOC + WOLFORD REL LAG + GM REL LAG + WILLIAMS FK REL LAG + GRANBY REL LAG + WILLOW CK REL LAG - WINDY GAP PUMPING
# ASSUME NOT PUMPING WINDY GAP DURING IRRIGATION SEASON. IT IS ALWAYS ZERO.
#
################################################################################################
#
Copy(TSID="KRMC2L_F..KRMC2L_F.Hour",NewTSID="KRMC2_ADJ_TOTAL_NEW_Native...Hour",Alias="KRMC2_ADJ_TOTAL_NEW_Native")
Copy(TSID="KRMC2L_F..KRMC2L_F.Hour",NewTSID="KRMC2_ADJ_TOTAL_NEW...Hour",Alias="KRMC2_ADJ_TOTAL_NEW")
#
# Williams Fork
#
# Compute total native routed releases
#
Copy(TSID="WilliamsForkNatLag",NewTSID="TOTAL_Nat_LAG_ABV_KRM...Hour",Alias="TOTAL_Nat_LAG_ABV_KRM")
Add(TSID="TOTAL_Nat_LAG_ABV_KRM",AddTSList=SpecifiedTSID,AddTSID="WolfordNatLag,GRARESCONatLag,WCNatLag,GMNatLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="TOTAL_Nat_LAG_ABV_KRM",Alias="TOTAL_Nat_LAG_ABV_KRM_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# Compute total routed releases
#
Copy(TSID="WilliamsForkTotalLag",NewTSID="TOTAL_Rel_LAG_ABV_KRM...Hour",Alias="TOTAL_Rel_LAG_ABV_KRM")
Add(TSID="TOTAL_Rel_LAG_ABV_KRM",AddTSList=SpecifiedTSID,AddTSID="WolfordTotalLag,GRARESCOTotalLag,WCTotalLag,GMTotalLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="TOTAL_Rel_LAG_ABV_KRM",Alias="TOTAL_Rel_LAG_ABV_KRM_DAY",NewInterval=Day,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# Compute new total adjusted flow at Kremmling. This is the time series that will be routed to Dotsero and added to the
# Local adjusted flow at Dotsero supplied by CBRFC
#
# With native release only
#
```

```
Add(TSID="KRMC2_ADJ_TOTAL_NEW_Native",AddTSList=SpecifiedTSID,AddTSID="TOTAL_Nat_LAG_ABV_KRM",HandleMissingHow="SetMissingIf
AnyMissing")
FillRepeat(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",Alias="KRMC2_ADJ_TOTAL_NEW_Native_DAY",NewInterval=Day,
OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# With total release = native + sheparded release
#
Add(TSID="KRMC2_ADJ_TOTAL_NEW",AddTSList=SpecifiedTSID,AddTSID="TOTAL_Rel_LAG_ABV_KRM",HandleMissingHow="SetMissingIfAnyMissi
ng")
FillRepeat(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",FillDirection=Forward)
ChangeInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",Alias="KRMC2_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScale=
MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
###############################################################################################
####################################### DOTSERO ################################################
# Part IV. Compute new total adjusted flow at Dotsero.
# First route the total adjusted flow at Kremmling to Dotsero and add the local adjusted flow at Dotsero from CBRFC
#
###############################################################################################
#
Copy(TSID="EGLC2L_F..EGLC2L_F.Hour",NewTSID="EGLC2_ADJ_TOTAL_NEW_Native...Hour",Alias="EGLC2_ADJ_TOTAL_NEW_Native")
Copy(TSID="EGLC2L_F..EGLC2L_F.Hour",NewTSID="EGLC2_ADJ_TOTAL_NEW...Hour",Alias="EGLC2_ADJ_TOTAL_NEW")
#
# Route total native flow from Kremmling to Dotsero
#
VariableLagK(TSID="KRMC2_ADJ_TOTAL_NEW_Native",FlowUnits="cfs",LagInterval="Hour",Lag="0,24;500,24;1000,20;2000,15",K="1,1;2000,1",NewTSID
="KRMC2_EGLC2_NatLag...Hour",Alias="KRMC2_EGLC2_NatLag")
#
# Route total flow from Kremmling to Dotsero
#
VariableLagK(TSID="KRMC2_ADJ_TOTAL_NEW",FlowUnits="cfs",LagInterval="Hour",Lag="0,24;500,24;1000,20;2000,15",K="1,1;2000,1",NewTSID="KRM
C2_EGLC2_TotalLag...Hour",Alias="KRMC2_EGLC2_TotalLag")
#
# New Native Total Adjusted at Dotsero = Local Adjusted at Dotsero + Native routed from Kremmling to Dotsero
#
Add(TSID="EGLC2_ADJ_TOTAL_NEW_Native",AddTSList=AllMatchingTSID,AddTSID="KRMC2_EGLC2_NatLag",HandleMissingHow="SetMissingIfAny
Missing")
ChangeInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native",Alias="EGLC2_ADJ_TOTAL_NEW_Native_DAY",NewInterval=Day,
OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
```

```
# New Total Adjusted = Local Adjusted at Dotsero + Total routed from Kremmling to Dotsero
#
Add(TSID="EGLC2_ADJ_TOTAL_NEW",AddTSList=AllMatchingTSID,AddTSID="KRMC2_EGLC2_TotalLag",HandleMissingHow="SetMissingIfOtherMissi
ng")
ChangeInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",Alias="EGLC2_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScale=
MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
#################################################################################################
#################################### CAMEO ######################################################
# Part V. Compute new total adjusted flow at Cameo
# First route the total adjusted flow at Dotsero to Cameo and Ruedi Res release to Cameo and add the local adjusted flow at Dotsero from CBRFC
#################################################################################################
#
Copy(TSID="CAMC2L_F..CAMC2L_F.Hour",NewTSID="CAMC2L_ADJ_TOTAL_NEW_Native...Hour",Alias="CAMC2L_ADJ_TOTAL_NEW_Native")
Copy(TSID="CAMC2L_F..CAMC2L_F.Hour",NewTSID="CAMC2L_ADJ_TOTAL_NEW...Hour",Alias="CAMC2L_ADJ_TOTAL_NEW")
#
# Route total native flow from Dotsero to Cameo
#
LagK(TSID="EGLC2_ADJ_TOTAL_NEW_Native",Alias="EGLC2_CAMC2L_NatLag",Lag=22,K=0)
#
# Route total flow from Dotsero to Cameo
#
LagK(TSID="EGLC2_ADJ_TOTAL_NEW",Alias="EGLC2_CAMC2L_TotalLag",Lag=22,K=0)
#
# New Native Total Adjusted at Cameo = Local Adjusted at Cameo + Native routed from Dotsero to Cameo + Routed Ruedi release To Cameo
#
Add(TSID="CAMC2L_ADJ_TOTAL_NEW_Native",AddTSList=SpecifiedTSID,AddTSID="RuediNatLag,EGLC2_CAMC2L_NatLag",HandleMissingHow="Set
MissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native",Alias="CAMC2L_ADJ_TOTAL_NEW_Native_DAY",NewInterval=D
ay,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# New Total Adjusted = Local Adjusted at Cameo + Total routed from Dotsero to Cameo
#
Add(TSID="CAMC2L_ADJ_TOTAL_NEW",AddTSList=SpecifiedTSID,AddTSID="RuediTotalLag,EGLC2_CAMC2L_TotalLag",HandleMissingHow="SetMissi
ngIfOtherMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",Alias="CAMC2L_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScal
e=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
#################################################################################################
########################################### PALISADE ############################################
#
```

```
# Part VI: Compute new total adjusted flow at Palisade
# Total Adjusted Simulated flow Palisade = Palisade Local Adj Sim + Total Cameo Routed
# The Palisade Local time series from CBRFC includes diversions and return flows.
# We are including a net diversion change time series to simulate net changes of diversion/return flows.
# No explicit diversions are simulated. Only
# net diversion changes in the Caemo to Palisade reach are assumed.
# CGYC2 total ADJSIM = CGYC2 adjusted local flow (from Cody) + CAMC2 LAGK + NetDivChange
# Eventually, the plan is to simulate the diversions explicitly. Right now, the irrigators/farmers are not providing forecast diversion data
#
##########################################################################################################
#
Copy(TSID="CGYC2L_F..CGYC2L_F.Hour",NewTSID="CGYC2L_ADJ_TOTAL_NEW_Native...Hour",Alias="CGYC2L_ADJ_TOTAL_NEW_Native")
Copy(TSID="CGYC2L_F..CGYC2L_F.Hour",NewTSID="CGYC2L_ADJ_TOTAL_NEW...Hour",Alias="CGYC2L_ADJ_TOTAL_NEW")
#
# Route total native flow from Cameo to Palisade
#
VariableLagK(TSID="CAMC2L_ADJ_TOTAL_NEW_Native",FlowUnits="cfs",LagInterval="Hour",Lag="1500,5;2500,4;4000,3;8000,2",K="0,0;8000;0",NewTSI
D="CAMC2L_CGYC2L_NatLag...Hour",Alias="CAMC2L_CGYC2L_NatLag")
#
# Route total flow from Cameo to Palisade
#
VariableLagK(TSID="CAMC2L_ADJ_TOTAL_NEW",FlowUnits="cfs",LagInterval="Hour",Lag="1500,5;2500,4;4000,3;8000,2",K="0,0;8000;0",NewTSID="CA
MC2L_CGYC2L_TotalLag...Hour",Alias="CAMC2L_CGYC2L_TotalLag")
#
# New Native Total Adjusted at Palisade = Local Adjusted at Palisade (including div and return flow) + Total Native routed from Cameo to Palisade + net diversion
change
#
Add(TSID="CGYC2L_ADJ_TOTAL_NEW_Native",AddTSList=SpecifiedTSID,AddTSID="104988-
57008,CAMC2L_CGYC2L_NatLag",HandleMissingHow="SetMissingIfAnyMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native",Alias="CGYC2L_ADJ_TOTAL_NEW_Native_DAY",NewInterval=D
ay,OldTimeScale=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
#
# New Total Adjusted = Local Adjusted at Palisade (including div and return flow) + Total routed from Cameo to Palisade + net diversion change
#
Add(TSID="CGYC2L_ADJ_TOTAL_NEW",AddTSList=SpecifiedTSID,AddTSID="104988-
57010,CAMC2L_CGYC2L_TotalLag",HandleMissingHow="SetMissingIfOtherMissing")
ChangeInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",Alias="CGYC2L_ADJ_TOTAL_NEW_DAY",NewInterval=Day,OldTimeScal
e=MEAN,NewTimeScale=MEAN,NewUnits=cfs)
##########################################################################################################
########################################### OUTPUT TO HDB #############################################
#
```

```
# Part VII: Writing time series to HDB
#
###############################################################################################
# Writing hourly
#
# Save hourly time series but truncate POR by 7 hours at the end. See comment in Part II
#
ReadPropertiesFromExcel(InputFile="TimeSeriesProperties.xlsx",Worksheet="Properties",PropertyCellMap="OutputEnd:C7,OutputStart:C6",DateTimeProperties="OutputEnd,OutputStart")
#
# Kremling Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Dotsero Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Cameo Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Palisade Native
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
#
# Kremling Total 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Dotsero Total 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
```

```
# Cameo Total 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Palisade Total 2
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Williams Fork Release
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104923-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104923-57010",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104923-
57008",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104923-
57010",SiteDataTypeID=104923,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Wolford
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104924-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="104924-57010",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104924-
57008",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="104924-
57010",SiteDataTypeID=104924,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Granby
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100605-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100605-57010",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100605-
57008",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100605-
57010",SiteDataTypeID=100605,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
```

```
# Willow Creek
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100521-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100521-57010",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100521-
57008",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100521-
57010",SiteDataTypeID=100521,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Green Mountain
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100516-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="100516-57010",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100516-
57008",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="100516-
57010",SiteDataTypeID=100516,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Ruedi
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="101070-57008",ShiftData="-1,1")
ShiftTimeByInterval(TSList=AllMatchingTSID,TSID="101070-57010",ShiftData="-1,1")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="101070-
57008",SiteDataTypeID=101070,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case
Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="101070-
57010",SiteDataTypeID=101070,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total
2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
# Writing daily
#
# Use the following command for the call
#
ReadPropertiesFromExcel(InputFile="TimeSeriesProperties.xlsx",Worksheet="Properties",PropertyCellMap="OutputEnd:C5,OutputStart:C4",DateTimeProperties=
"OutputEnd,OutputStart")
#
# Kremling Native
WriteReclamationHDB(DataStore="ReclamationHDB-
ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HU
P_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
```

```
# Dotsero Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Cameo Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
# Palisade Native
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_Native_DAY",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Native",HydrologicIndicator="0",Agency="USBR",TimeZone="MST")
#
# Kremling Total 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="KRMC2_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100383,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Dotsero Total 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="EGLC2_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100350,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Cameo Total 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CAMC2L_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100379,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
# Palisade Total 2
WriteReclamationHDB(DataStore="ReclamationHDB-ECO",TSList=AllMatchingTSID,TSID="CGYC2L_ADJ_TOTAL_NEW_DAY",SiteDataTypeID=100384,ModelName="HUP_DSS",ModelRunName="HUP_DSS Case Total 2",HydrologicIndicator="2",Agency="USBR",TimeZone="MST")
#
```