

**From:** White, Kristin N <knwhite@usbr.gov>  
**Sent:** Thursday, July 28, 2022 6:22 PM  
**To:** Ekdahl, Erik@Waterboards  
**Cc:** Foresman, Erin@Waterboards; Riddle, Diane@Waterboards; Frazier, Scott@Waterboards; Hunt, Thaddeus@Waterboards; Holland, Matthew@Waterboards; Leahy, Tina@Waterboards; Heinrich, Dana@Waterboards; Aufdemberge, Amy L; Mooney, David M; Leahigh, John@DWR; Mizell, Tripp (James)@DWR; Fock, Anna@DWR; White, Molly@DWR; Nickels, Adam M  
**Subject:** Electronic Transmittal: Report on Hydrologic Forecasting Improvements and Operations Outlook for TUC Orders Conditions 3 & 5  
**Attachments:** TUCO\_Condition5\_Hydrology\_Compliance\_Sheet 7\_28\_2022.pdf; July Cond 3 letter\_7\_29\_22.docx.pdf  
**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

**EXTERNAL:**

Good afternoon—

Consistent with the February 15, 2022 and April 4, 2022 Temporary Urgent Change Orders (TUCOs) granted by the State Water Resources Control Board (SWRCB) to the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR), and in compliance with Condition 3 and Condition 5 of those Orders (respectively), DWR and Reclamation hereby submit this report and Operations Outlook.

This Operations Outlook will also be posted to DWR’s website under the Hydroclimate and Water Supply tab on DWR’s Drought Preparedness web page.

Kristin White  
Operations Manager  
Central Valley Operations Office  
Bureau of Reclamation  
Interior Region 10 · California-Great Basin  
916-979-2199  
knwhite@usbr.gov

2022 Operations Outlook (based on July projections)

**Accretions / Depletions (Condition 5b.)**

Values in TAF	April	May	June	July	August	September
Sacramento Valley	147	-67	-62	-60	-119	-48
Net Delta Consumptive Use	71	133	219	267	232	147

Note: May-Sep Sac Valley values are negative to represent Depletion

**Deliveries (Condition 5c.&5d.)**

Values in TAF	April	May	June	July	August	September	Basis of Water Right or Contractual Agreement
SWP - Feather River Service Area	32	120	113	129	73	29	A005630, A014443, Feather River Settlement Agreements
SWP - North of Delta Contract Deliveries	0	1	3	3	1	1	A016950, A016952, A017514A, A021443
SWP - South of Delta Contract Deliveries	42	38	38	57	51	29	A005630, A014443, A014445A, A017512, A025435, A025511, A025988, A026058
CVP - Settlement Contractors	187.5**	47.5	47.5	75.2	47.5	47.5	This is comprised of 75% of the Exhibit A quantities listed in the Settlement Contracts. It doesn't include the small Short Form Settlement Contracts. However, the Short Form Contracts only represent approximately 1.4% of the SRSC water quantities. (**This is the number scheduled, but prior to the April 14 notice, contract diversions would be limited to 18%. No contract diversions in April from storage releases. As of May 10, Reclamation will start counting against the contract.)
CVP- Sacramento River Agricultural Water Service Contractors	7	9	10	2	7	4	Water used by these contractors is part of the 75% allocated to the Settlement Contractors (allocation to NOD Water Service Ag Contractors is 0%.)
CVP- Sacramento River Municipal and Industrial Contractors	0.997	1.285	1.948	2.357	1.726	1.419	This includes the City of Redding's M&I Settlement Contract water and the McConnell Foundation and Centerville CSD's exchange water.
CVP- American River Municipal and Industrial Contractors	0.4	0.45	0.06	1.1	0.09	0.08	PHS for SMUD. Allocation to ARD CVP M&I Contractors is zero.
CVP - Contra Costa Water District	4.246	6.613	5.936	7.300	7.250	5.600	CVP M&I estimated scheduled diversions.
CVP - North of Delta Refuges	0.420	0.900	4.100	1.381	2.147	8.937	Includes Water to be Exchanged with DWR for Gray Lodge.
CVP - Exchange Contractors	44.7	79.8	104.5	119.5	96.7	49.8	Includes water being transferred to other districts, transfers are based on consumptive use reductions.
CVP - South of Delta Agricultural Water Service Contractors	0	0	0	0	0	0	Allocation to SOD Water Service Ag Contractors is 0%.
CVP - South of Delta Municipal and Industrial Service Contractors	1	2	2.622	13.676	14.127	13.676	Public Health and Safety Water only, consistent with M&I shortage policy
CVP - South of Delta Refuges	7.869	14.684	6.06	5.085	10.46	47.49	Refuge Water Supply Contract: 01WC201756, 01WC201758, 01WC201754
CVP - OID & SSJID (Stanislaus Basin) Water Right holders	49	69	80	75	63	47	1988 Operations Agreement
CVP - New Melones East Side Division Water Service Contractors (Stockton East, Central San Joaquin Water Conservation District)	0	0	0	0	0	0	Per Eastside Division Shortage Policy, Contractors' allocation is zero.
CVP Friant Unit Class I	12.329	25.549	27	28	33	18	Friant allocation went up in late July from 20% to 30%.

**Delta Flows (Condition 5b.)**

Values in cfs or TAF	April	May	June	July	August	September
Delta Inflow at Freeport (cfs)	8285	5933	9142	12328	9569	7392
Net Delta Outflow Index (cfs)	7434	3765	5482	5714	3011	3027
SJR at Vernalis Flow (cfs)	941	716	707	325	276	303
CVP Export (TAF)	54	56	54	163	166	119
SWP Export (TAF)	36	32	17	39	19	18

**Transfers (Condition 5e.)**

Values in TAF	April	May	June	July	August	September
NOD to SOD (estimated)	N/A	N/A	N/A	32	43	22

**Reservoir Inflow (Condition 5a.)**

Values in TAF	April	May	June	July	August	September
Trinity	62	23	32	9	3	3
Whiskeytown	58	8	6	2	1	1
Shasta	252	175	177	150	140	130
Folsom	256	79	111	80	75	67
New Melones	74	25	46	20	27	25
Oroville	341	233	153	117	123	115

**Reservoir Releases (Condition 5a.)**

Values in TAF	April	May	June	July	August	September
Trinity Release to Trinity River	79	67	28	28	53	52
Carr Tunnel diversion	25	16	24	33	31	30
Whiskeytown to Clear Creek	12	12	12	9	9	9
Spring Creek Tunnel diversion	8	10	18	20	20	40
Shasta Release to Sac River	194	277	242	277	277	238
Folsom Release to American River	69	64	152	281	252	102
New Melones to Stanislaus River	27	25	49	18	18	14
Oroville	78	119	202	252	163	128

**Reservoir End-of-Month Storage (Condition 5a.)**

Values in TAF	April	May	June	July	August	September
Trinity	766	693	716	660	577	495
Shasta	1808	1646	1777	1648	1521	1424
Folsom	769	669	807	577	386	337
New Melones	922	831	784	718	671	652
Oroville	1917	1909	1721	1450	1330	1283
San Luis Reservoir	950	918	791	664	617	580

**Monthly COA Balances (Condition 5f.)**

Values in TAF	April	May	June	July	August	September
Monthly Balance	216	160	95	0	0	0

Does not include adjustment for New Melones

**San Luis Reservoir**

Values in TAF	April	May	June	July	August	September
Total Pumping	48	6	0	0	0	0
Total Generation	4	26	117			



DEPARTMENT OF WATER RESOURCES  
Division of Operations and Maintenance  
3310 El Camino Avenue, Suite 300  
Sacramento, California 95821



— BUREAU OF —  
RECLAMATION

BUREAU OF RECLAMATION  
Central Valley Operations Office  
3310 El Camino Avenue, Suite 300  
Sacramento, California 95821

Erik Ekdahl  
State Water Resources Control Board  
1001 I Street  
Sacramento, California 95814

Re: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and  
Condition 5 of the April 4, 2022 Temporary Urgency Change Order

Dear Mr. Ekdahl:

Consistent with the February 15, 2022, Temporary Urgent Change Order (TUCO) by the State Water Resources Control Board (SWRCB) issued to the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR), and in compliance with Condition 3 of the TUCO, DWR and Reclamation hereby submit this report by the State Water Project (SWP) and the Central Valley Project (CVP), also collectively referred to as Projects.

Condition 3 specifically requires DWR and Reclamation to identify and implement needed improvements to forecast methods to avoid significant over- or under- estimates of available water supplies and provide updates to the SWRCB on these efforts along with updates on current hydrologic and operational forecasts for the water year on a monthly basis starting in April of 2022 and continuing until the drought emergency is over.

Condition 3 also requires DWR and Reclamation to submit in writing monthly hydrologic and operational forecasts and include information on forecasted inflows; reservoir releases; water supply deliveries; reservoir storage levels; any Coordinated Operations Agreement debts; planned water transfers, forbearance agreement actions, exchanges, and other actions of this nature; and other relevant information that may be requested by the SWRCB's Executive Director to inform future drought-related decision making.

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order  
and Condition 5 of the April 4, 2022 Temporary Urgency Change Order

2

In this letter, the Projects provide updates on current hydrologic and operational forecasts for the water year, as well as information on planned water transfers, forbearance agreement actions, and exchanges. The attached table, prepared in response to Condition 5 of the latest TUCO, issued April 4, 2022, includes the information on forecasted inflows; reservoir releases; water supply deliveries; reservoir storage levels; and Coordinated Operations Agreement debts.

### Forecasting Improvements

#### *Bulletin 120 Improvements*

Last summer and fall, DWR staff focused their energy into making a lot of important improvements to forecast procedures, and these efforts have had a positive impact on forecasting accuracy and confidence. Meticulous work was put into updating averages and median increments to reflect a more recent period of record that is more indicative of California's changed climate. These seemingly small yet significant improvements show that the forecast equations are still able to produce reasonably accurate forecasts when combined with forecaster skill and insight. However, statistical equations and any hydrologic models continue to be challenged by limited data availability and by how well that data informs the models about changes to hydrology due to a more arid and varied climate.

Fortunately, DWR was able to utilize data from more sources this past year, leverage its partnerships, and maximize the benefits from its investments in Airborne Snow Observatory (ASO) flights, satellite data, and modeling techniques in producing the forecasts this year. DWR continues to work with partners to build physically based hydrologic runoff models that are better equipped to utilize a greater variety of data types and spatial coverage. While there remains a lot of work to fully implement these processes into the forecasting procedures, other efforts like ASO had immediate, positive impacts on forecast accuracy and forecaster confidence this past year.

The Snow Surveys and Water Supply Forecasting (SSWSF) team is focused this summer and fall on continuing to work on forecast improvement development projects. Some projects underway include: 1) developing an improved exceedance forecast method to improve late season Bulletin 120 forecasts; 2) developing irrigation and consumption constraints in the Sacramento Valley to compute more accurate full natural flow values which would better represent water supply availability; and 3) continuing to explore and develop machine learning processes and the viability of implementing them into the Bulletin 120 forecast procedures.

#### *Airborne Snow Observatory (ASO)*

As noted in a previous letter to the Board, the data from the ASO flights conducted in February and March revealed that there was significantly less snow than had been

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order  
and Condition 5 of the April 4, 2022 Temporary Urgency Change Order

3

previously estimated. Besides snow courses and snow pillows, DWR utilizes a suite of snowpack estimation models and tools such as a snowpack estimation product using satellite imagery from the University of Colorado – Boulder and the SNODAS modeling and data assimilation system developed by the National Operational Hydrologic Remote Sensing Center (NOHRSC). Both products utilize remote sensing data from satellites and correlate them to ground-based observations such as snow pillows to estimate snow water content. As is the case with traditional runoff forecast models, these products rely on historical distributions and statistics to create their products; as the historical correlations struggle to keep pace with the rapidly changing climate, these products become less reliable. In contrast, ASO data collected and iSnoBal model results produced throughout the winter and spring provided DWR forecasters with a greater confidence in knowing more accurately what the snowpack conditions were, especially given the atypical weather patterns experienced between December and May.

During the summer and fall of 2022, the Aerial Remote Sensing of Snow (ARSS) program is turning its focus toward planning for ASO flights in the upcoming water year, expanding the current database of snow-free baseline data necessary for successful winter ASO data collection, and collecting feedback from its partner agencies involved in the ARSS program to ensure that data collected--and the reports generated--through the ARSS program are meeting water management needs. DWR is continuing to work with its vendor to improve the data collection and dissemination process and continue efforts to develop and implement WRF-Hydro runoff models to improve forecasting procedures.

#### *WRF-Hydro Physically Based Model*

DWR continues to work collaboratively with the National Center for Atmospheric Research (NCAR) and other partner agencies to develop and improve upon the two pilot WRF-Hydro model projects underway. NCAR developed WRF-Hydro models in the Feather River and San Joaquin River watersheds and ran them in parallel to DWR forecasts during the winter and spring. NCAR is continuing to calibrate and improve these initial models, to evaluate the model results from this past season and to identify areas where DWR's expertise can help direct improvement efforts. DWR is also working with Airborne Snow Observatories, Inc. and NCAR to explore the use of the WRF-Hydro model in the Feather River and San Joaquin River watersheds to assess impacts on the hydrology from the large-scale fires that have occurred in both watersheds over the past two to three years.

#### Projected Hydrology and Runoff

The DWR's Hydrology and Flood Operations Branch within the Division of Flood Management produces estimates of water year runoff, or the water supply index (WSI), for the major watersheds of the Sacramento and San Joaquin River basins. The WSI forecast is a statistically based forecast of Water Year runoff for each major river basin

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order and Condition 5 of the April 4, 2022 Temporary Urgency Change Order 4

in the Sacramento and San Joaquin valleys (Sacramento, Feather, Yuba, American, Stanislaus, Tuolumne, Merced, and San Joaquin). The runoff forecasts are produced at the beginning of the month from December through May.

With the final weekly update of the Bulletin 120 on June 7, 2022, DWR's median forecast for the April through July runoff volume into Lake Oroville was 930 thousand acre-feet (TAF). As of the last week of July, the actual accumulated runoff to date into Lake Oroville since April 1, 2022, has been approximately 950 TAF. The final Water Supply Index (WSI) forecast was issued for conditions as of May 1, 2022.

For the Sacramento River Valley Type Index (SVI), the water year index (based on the 50% exceedance forecast) was 4.5, which places the SVI in the critical water year type. For the San Joaquin Valley Water Year Type Index (SJI), the water year index (based on the 75% exceedance forecast) was 1.5, which places the SJI in the critical water year type.

Although the final official Water Supply Index Bulletin 120 (B120) forecast was issued on May 1, 2022, the forecast provided in this submittal has been adjusted to account for observed conditions in June and July, and very dry conditions through September.

The Projects use the 90% exceedance forecast for the joint operations plan included in this report and the July Drought Plan addendum. The hydrologic forecast is unique to this water year and informed by precipitation, runoff, snowpack, and other antecedent hydrologic conditions, combined with the runoff associated with the antecedent conditions and the anticipated runoff resulting from precipitation forecasted to occur through September 30.

### SWP and CVP Operations Forecasts

The operations forecast uses the runoff forecast as model inputs to simulate Project operations under various regulatory requirements and produce forecasted reservoir storages, releases, and flows under the same hydrologic exceedances. This operations forecast gives general guidance for annual water delivery, storage management, and power planning purposes for this exceedance assumption. Actual hydrologic events unfold in time steps shorter than a month and are often unpredictable more than a few days to a week out. Day-to-day operations are driven by operating criteria such as those found in U.S. Army Corps of Engineers flood control manuals, SWRCB D-1641 Bay-Delta Standards, the NMFS and USFWS Biological Opinions, and the ITP for the SWP. Outputs from the forecast model, as provided in this Drought Plan, represent system responses to the overlay of specific expected monthly operating criteria on each of the discrete hydrologic scenarios provided in the May 1 water supply forecasts.

The forecast assumptions utilize existing storage conditions, actual runoff through June, forecasted runoff based on the May 1 B120 90% exceedance hydrology, projected water supply deliveries, and meeting existing flow and water quality standards, and fish

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order  
and Condition 5 of the April 4, 2022 Temporary Urgency Change Order

5

and wildlife protections. The forecast includes monthly storage levels, reservoir releases, Delta export rates, and Delta outflow through September 30, 2022. DWR and Reclamation will continue to update the operations forecasts each month, and expect that with each updated operations forecast, SWP and CVP operations may change.

### Planned Transfers, Forbearance Agreement Actions, Exchanges

As of July 19, 2022, nine groundwater substitution transfer proposals (six from the Feather River watershed and three from American River watershed) have been submitted to DWR's online database system Water Transfers Information Management System. In addition, three reservoir release Intent to Transfer were submitted (one from Feather River and two from American River watersheds, respectively). Currently, there are no planned transfers and forbearance agreement actions from the Sacramento River Settlement Contractors to water users south of the Delta. Transfers may still occur between various contractors north of the Delta. Table 1 below shows the estimated maximum quantity of short-term transfers in various watersheds with the method to make water available to transfer.

Table 1: Estimated Maximum Quantity of Short-Term Transfers (acre-feet before any losses) as of July 19, 2022

Method to Make Water Available for Transfer	Feather River	American River	Total
Groundwater Substitution	19,819	14,698	34,517
Reservoir Release	10,000	22,000	32,000
<b>Total</b>	<b>29,819</b>	<b>36,698</b>	<b>66,517</b>

On July 19, 2022, the latest update from Yuba Water Agency provided the forecast for a total of 75,462 acre-feet of the Yuba Accord water transfer in 2022. Table 2 below shows the estimated Lower Yuba River Accord Component water quantity to DWR and Reclamation Participating Contractors. The total quantity will be updated periodically during the transfer year.

Table 2: Estimated Lower Yuba River Accord Component Water (acre-feet before any losses)

Estimated Lower Yuba River Accord Component Water Quantity (acre-feet before any losses)	
Component 1	13,062
Component 4	62,400
<b>Total</b>	<b>75,462</b>

Subject: Condition 3 of the February 15, 2022 Temporary Urgency Change Order  
and Condition 5 of the April 4, 2022 Temporary Urgency Change Order

6

Ongoing exchanges through the Consolidated Place of Use (CPOU) between the two Projects continue to be reported through the CPOU monthly reports. As authorized under the 2021-2022 CPOU order, the total quantity of transfers and exchanges will not exceed 431,780 acre-feet from July 16, 2021 through July 15, 2022.

On May 11, 2022, DWR and Reclamation submitted a Petition for Temporary Change to modify the State Water Project and Central Valley Project Authorized Place of Use through 2022-2023 CPOU request for a total amount of water to be exchanged not to exceed 393,385 acre-feet.

If you have any questions, please contact Molly White of DWR at (916) 574-2722 or Kristin White of Reclamation at (916) 979-2199.

Sincerely,

*Molly White*

---

Molly White, Manager  
Water Operations Office  
Division of Operations and Maintenance  
Department of Water Resources

*Kristin White*

---

Kristin White, Operations Manager  
Central Valley Operations Office  
Bureau of Reclamation

Attachment

cc: Diane Riddle ([Diane.Riddle@waterboards.ca.gov](mailto:Diane.Riddle@waterboards.ca.gov))  
Scott Frazier ([Scott.Frasier@waterboards.ca.gov](mailto:Scott.Frasier@waterboards.ca.gov))  
Erin Foresman ([Erin.Foresman@waterboards.ca.gov](mailto:Erin.Foresman@waterboards.ca.gov))  
Thaddeus Hunt ([Thaddeus.Hunt@waterboards.ca.gov](mailto:Thaddeus.Hunt@waterboards.ca.gov))  
Matthew Holland ([Matthew.Holland@waterboards.ca.gov](mailto:Matthew.Holland@waterboards.ca.gov))  
Tina Leahy ([Tina.Leahy@waterboards.ca.gov](mailto:Tina.Leahy@waterboards.ca.gov))  
Dana Heinrich ([Dana.Heinrich@waterboards.ca.gov](mailto:Dana.Heinrich@waterboards.ca.gov))  
  
Amy Aufdemberge ([Amy.Aufdemberge@sol.doi.gov](mailto:Amy.Aufdemberge@sol.doi.gov))  
David Mooney ([Dmmooney@usbr.gov](mailto:Dmmooney@usbr.gov))  
John Leahigh ([John.Leahigh@water.ca.gov](mailto:John.Leahigh@water.ca.gov))  
James Mizell ([James.Mizell@water.ca.gov](mailto:James.Mizell@water.ca.gov))