SAN JOAQUIN RIVER
RESTORATION PROGRAM

Bureau of Reclamation
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Final 2021 Restoration Allocation & Default Flow Schedule

June 25, 2021

Introduction

The following transmits the final 2021 Restoration Allocation and Default Flow Schedule to the Restoration Administrator for the San Joaquin River Restoration Program (SJRRP), consistent with the January 2020 (version 2.1) Draft Restoration Flow Guidelines (Guidelines). This Restoration Allocation and Default Flow Schedule provides the following:

- Forecasted water year Unimpaired Inflow: the estimated flows that would occur absent regulation on the river. This value is also known as the "Natural River" or "Unimpaired Runoff" or "Full Natural Flow," and is utilized to identify the water year type.
- Hydrograph Volumes: the annual allocation hydrograph based on water year unimpaired inflow, utilizing Method 3.1 with the Gamma Pathway (RFG-Appendix C, Figure C3) agreed to by the Parties in December 2008.
- Default Flow Schedule: the schedule of Restoration Flows in the absence of a recommendation from the Restoration Administrator.
- Additional Allocations: the hypothetical Restoration Allocations that would result from 10%, 50%, 75%, and 90% probability of exceedance of the Unimpaired Inflow forecast.
- Unreleased Restoration Flows: the amount of Restoration Flows not released due to channel capacity constraints, without delaying completion of Phase 1 improvements.
- Flow targets at Gravelly Ford: the flows at the head of Reach 2, and estimated scheduled releases from Friant Dam adjusted for the assumed Holding Contract demands and losses in Exhibit B.
- Restoration Budget: the volumes for the annual allocation, spring flexible flow, base flow, riparian recruitment, and fall flexible flow.
- Remaining Flow Volume: the volume of Restoration Flows released, the remaining volume available, and associated limitations and flexibility.
- Operational Constraints: the flow release limitations based on downstream channel capacity, regulatory, or legal constraints.

Consistent with Paragraph 18 of the Settlement, the Restoration Administrator shall make recommendations to the Secretary of the Interior concerning the manner in which the hydrographs shall be implemented. As described in the Guidelines, the Restoration Administrator is requested to recommend a flow schedule showing the use of the entire annual allocation during the upcoming Restoration Year, categorize all recommended flows by account, and Restoration Flow recommendation. If a recommendation is not provided by the Restoration Administrator, the Capacity Constrained Default Flow Schedule (Table 6b) or the most recently approved schedule will be implemented.

Reclamation released a previous Restoration Allocation and Default Flow Schedule on May 21. This final allocation does not change the volume of water available to the Restoration Administrator for scheduling. No further adjustments to the Restoration Allocation will be made this year. The Restoration Administrator may respond at their convenience with a full written recommendation if are any flow schedule changes are necessary.

Forecasted Unimpaired Inflow

Unimpaired Runoff represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds (a.k.a "Unimpaired Inflow" or "Natural River" or "Full Natural Flow"). It is calculated for the period of a water year. The forecast of the Unimpaired Runoff determines the volume of Restoration Flows available for the Restoration Year (i.e. the Restoration Allocation). Information for forecasting the Unimpaired Runoff includes:

- Observation of Unimpaired Runoff into Millerton Lake to support the water supply allocation[1];
- The California Department of Water Resources (DWR) Bulletin 120 latest update for San Joaquin River inflow to Millerton Lake Unimpaired Flow, and/or the most current DWR Bulletin Water Supply Index (WSI)[3];
- The National Weather Service (NWS) Ensemble Streamflow Prediction (ESP) Water Supply Forecast for the San Joaquin River at Millerton Lake[5;]
- Other forecast models, ground-based observations, remotely-sensed observations, hydrologic models, analysis of historic patterns, and short-term weather forecasts as appropriate.

Table 1 shows the water year 2021 (October 1, 2020 to September 30, 2021) observed accumulated and forecasted water year Unimpaired Inflows at Millerton Lake. This table also includes the published DWR forecast, the DWR forecast adjusted for an expected runoff for the current month, the NWS forecast with and without a 7-day smoothing function applied to remove the day-to-day variance, and the NWS forecast with 7-day smoothing and adjustment for the expected runoff for the current month (Reclamation adjusts the DWR and NWS values by replacing the forecasted runoff for the current month with Reclamation's own estimate of runoff for the current month, which increases accuracy and incorporates the latest data). Figure 1a plots DWR and NWS forecast values over the entire water year, while Figure 1b shows the most recent period in detail.

Table 1 — San Joaquin River Water Year Actuals and Forecasts at Millerton Lake, in Thousands of Acre-Feet (TAF)

	Forecast Exceedance Percentile				
	90%	**75%**	**50%**	**25%**	**10%**
Accumulated Unimpaired Runoff ("Natural River") June 23, 2021 [1]	484.8				
Accumulated Unimpaired Runoff as percent of normal [2]	33%				
DWR, June 2, 2021 [3] (Published Value)	505	523	540	563	585
DWR, June 24, 2021 [4] (Runoff Adjusted)	520	531	536	553	564
NWS, June 24, 2021 [5] (Published Daily Value)	517	517	518	520	529
Smoothed NWS, June 24, 2021 [6] (7-day Smoothing)	519	520	521	522	532
Smoothed NWS, June 24, 2021 [4] (Runoff Adjusted)	514	516	518	520	531

[1] http://www.usbr.gov/mp/cvo/vungvari/milfln.pdf

[2] Based on average accumulation of Unimparired Runoff

[3] B120: http://cdec.water.ca.gov/cgi-progs/iodir?s=b120, or B120 Update: http://cdec.water.ca.gov/cgi-progs/iodir_ss/b120up, or WSI: http://cdec.water.ca.gov/cgi-progs/iodir/WSI.2020 . April-July runoffs are converted to Water Year equivalents in this table.

[4] The adjusted data has been updated with the actual unimpaired inflow through the current date and projected out for the remainder of the month.

[5] https://www.cnrfc.noaa.gov/ensembleProduct.php?id=FRAC1&prodID=9

[6] The NWS smoothed data uses a 7-day triangular weighted moving average, where the most recent day (n) is given greater weight than each previous forecast day (n-1, 2, 3, etc.); this reduces noise stemming from ESP model input. The following formula is used: $((Forecast_n * 1) + (Forecast_{n-1} * 0.857) + (Forecast_{n-2} * 0.714) + (Forecast_{n-3} * 0.571) + (Forecast_{n-4} * 0.429) + (Forecast_{n-5} * 0.286) + (Forecast_{n-6} * 0.143)) / 4$

[7] Values at the 75% exceedance and 25% exceedance are interpolated.

The DWR Bulletin 120 forecast from June 2 was adjusted by Reclamation to better align with observed runoff conditions to date and projections for the remainder of the month (becoming the "Runoff Adjusted DWR values"). The NWS forecast has been smoothed and a similar adjustment made for observed runoff conditions to date. These steps are shown in Table 1.

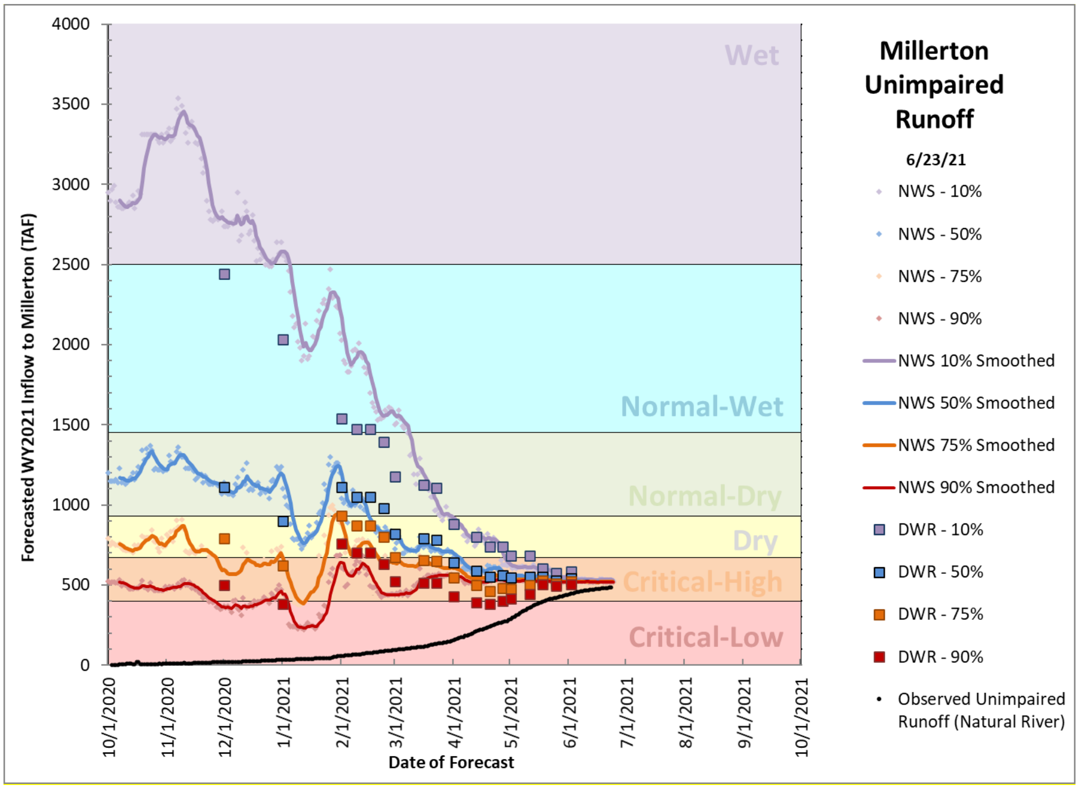

Figure 1a — Plot of 2021 Water Year forecasts, including both NWS Ensemble Streamflow Prediction Forecasts and DWR Forecasts

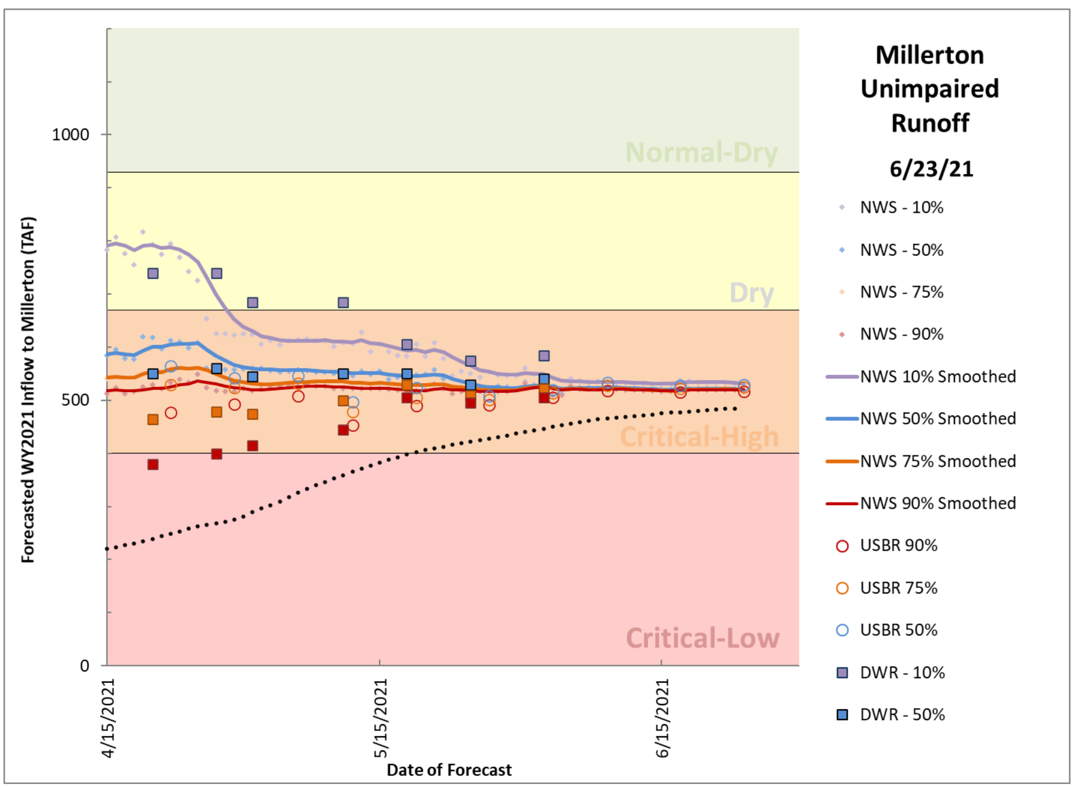

Figure 1b — Detail plot of most recent forecasts

Throughout the winter and spring of 2021, Reclamation relied upon multiple snowpack monitoring and modeling efforts. In addition to the long-established snow course and snow pillow networks, three Airborne Snow Observatory (ASO) datasets were captured in 2021, the third and final survey was conducted on May 3. This data is considered to be the most accurate measure of snowpack depth and volume. Other models consulted included the NOHRSC snow model, the CU Boulder "Real-time SWE" model, the iSnobal model produced by M3Works through ASO Inc., and the Snow-17 model maintained by CNRFC which is a component of their daily runoff forecasts. Current estimates of snowpack indicate only a few thousand acre-feet of snowpack, which has little influence upon the projected runoff going forward.

Table 2 — Total snowpack volume (TAF of Snow Water Equivalent) depicted by four models, ASO, and a consensus estimate for June 9, 2021.

Date	CNRFC	NOHRSC	CU Boulder	M3W iSnobal	Aerial Snow Survey (ASO)	Reclamation Consensus
Snow Water Equivalent Volume (TAF)	10	0	— [8]	12 [9]	— [10]	**4 to 12**

[8] CU Boulder "Real-time SWE" model was for May 11.
[9] Operation of the "iSnobal" model for the San Joaquin is switched from USDA-ARS to M3Works in April. Model data from June 2 and is synchronized with the ASO data.
[10] The third Aerial Snow Survey was conducted on May 3

Tracking of snowpack and comparison with unimpaired runoff indicated that runoff yields were extremely low prior to April 1. This is thought to be a combination of abnormally dry soil underneath the snowpack and sublimation of the snowpack after the major late-January storm. Runoff efficiencies climbed steadily once peak SWE was reached in late March, returning to values more in-line with previous Critical-High year types. The snowpack that melted during the period after April 1 produced the vast majority of the year's runoff. Despite this recovery, forecasts of monthly runoff for June, July, August, and September are some of the lowest on the 120-year historic record and may possibly break some records. Without substantial summer precipitation, the San Joaquin watershed will enter autumn with another significant soil moisture deficit.

Combining Forecasts

Staff from the South-Central California Area Office of Reclamation and SJRRP jointly track and evaluate the accuracy of runoff forecasts on a regular basis. Based on the age of these forecasts, the short-term and long-term weather forecasts, the climatological outlook, observed Unimpaired Inflow, and other available information, a hybrid forecast is generated. The weighting of the different components is regularly evaluated and selected using the best available information and professional judgment. **For the current allocation, the DWR "runoff adjusted" and NWS "smoothed runoff adjusted" forecasts are combined with a 60/40 blending respectively**. No additional offset is applied by Reclamation. This blending and offsetting results in the Hybrid Unimpaired Inflow Forecasts shown in Table 3.

Table 3 — Current Blending and Hybrid Unimpaired Inflow Forecast

	Forecast Probability of Exceedance using blending				
	90%	**75**%	**50**%	**25**%	**10**%
Blending Ratio (DWR/NWS)	60/40 with additional 0 TAF offset				
Hybrid Unimpaired Inflow Forecast (TAF)	517	525	529	540	550

Restoration Allocation

As per the Restoration Flow Guidelines, the **50% exceedance** forecast is used for the allocation under current hydrologic conditions to set the Restoration Flow Allocation. Table 4 below, from the Guidelines version 2.1, depicts the progression of forecast exceedance used to set the Restoration Allocation.

Table 4 — Guidance on Percent Exceedance Forecast to Use for Allocation

		Date of Forecast Used for the Allocation					
	Value (TAF)	**January**	**February**	**March**	**April**	**May**	**June**
If the 50% forecast is:	Above 2200	50	50	50	50	50	50
	1600 to 2200	75	75	50	50	50	50
	900 to 1599	75	75	75	50	50	50
	500 to 899	90	90	75	**50**	50	50
	Below 500	90	90	90	90	75	50

Applying the 60/40 forecast blending determined by Reclamation and using the 50% exceedance forecast dictated by the Guidelines, Reclamation calculates an **Unimpaired Inflow hybrid forecast of 529 TAF** and a **Critical-High Water Year Type**. This provides a **Restoration Allocation of 70.919 Thousand Acre-Feet (TAF)** as measured at Gravelly Ford (GRF). Combined with Holding Contracts on the San Joaquin River, this equates to a **Friant Dam Release of 187.785 TAF**. Other hypothetical allocations are presented in Table 5 as grayed values and indicate the range of probable forecasts and the resulting Restoration Allocations.

Table 5 — SJRRP Water Year Type and Allocation for 2021 Restoration Year Shown with Other Hypothetical Values in Gray

	Forecast Probability of Exceedance using proposed blending				
	90%	75%	**50%**	25%	10%
Hybrid Unimpaired Inflow Forecast (TAF)	517	525	**529**	540	550
Water Year Type	Critical-High	Critical-High	**Critical-High**	Critical-High	Critical-High
Restoration Allocation at GRF (TAF)	70.919	70.919	**70.919**	70.919	70.919
Friant Dam Flow Releases (TAF)	187.785	187.785	**187.785**	187.785	187.785

Contractual Obligation Considerations

Consistent with Section 10004(j) of the San Joaquin River Restoration Settlement Act, the Settlement and the Settlement Act do not modify the rights and obligations of the United States under the Purchase Contract between Miller and Lux and the United States (Purchase Contract) and the Second Amended Exchange Contact between the United States, Department of the Interior, Bureau of Reclamation and Central California Irrigation District, San Luis Canal Company, Firebaugh Canal Water District, and Columbia Canal Company (Exchange Contract). Reclamation's obligations in the Purchase Contract and Exchange Contract remain unchanged. This is consistent with Condition 17 of Reclamation's 2013 Water Rights order addressing Restoration Flows.

Conditions continue to be very dry across the CVP with limited Delta pumping, casting doubt on whether the Exchange Contract can be met by Delta pumping alone. Restoration staff will continue to coordinate with other units of the CVP and their potential to impact operations or allocations at Friant Dam.

Default Flow Schedule

The Default Flow Schedule, derived from Exhibit B in the Settlement, identifies how Reclamation will schedule the Restoration Allocation for the current Water Year Type and Unimpaired Inflow volume absent a recommendation from the Restoration Administrator. The Guidelines provide detail on how a Default Flow Schedule is parsed from the allocation volume. This approved method of distributing water throughout the year is referred to as "Method 3.1" with the "gamma pathway."

Exhibit B Method 3.1 Default Flow Schedules

Table 6a shows the Basic Default Flow Schedule flows and corresponding Restoration Allocation volumes for the entire year absent channel capacity and seepage constraints, including total releases from Friant Dam and Restoration Flows releases in excess of Holding Contracts. Volume is distributed as various flow rates across the year as per the methods explained in the Restoration Flow Guidelines.

Table 6b shows the Capacity Constrained Default Flow Schedule volumes with all expected operational constraints, primarily controlled by seepage limitations in Reach 4A. Any volume within the Spring Flexible Flow Account and Fall Flexible Flow Account that cannot be released on the default schedule is shifted to times with available capacity as per the Guidelines. This Capacity Constrained Default Flow Schedule depicted in Table 6b will be implemented in the absence of a specific recommendation by the Restoration Administrator. With these known constraints, a Restoration Flow volume of **0 TAF** is generated that cannot be scheduled for release without a Water Supply Test. This volume would become Unreleased Restoration Flows (URFs) under the Capacity Constrained Default Flow Schedule. This is an estimated volume of water, actual URF volumes will depend on several factors including the Restoration

Administrator Recommendation, flow schedule to-date, recapture of Restoration Flows at Mendota Pool, and real-time assessments of groundwater constraints.

Table 6a — Basic Default Flow Schedule

Flow Period	Flow (cfs)				Volume (TAF)	
	Friant Dam Release	Holding Contracts [11]	Flow Target at GRF	Restoration Flow at GRF	Friant Dam Release	Restoration Flow at GRF
Mar 1 – Mar 15	500	130	375	370	*14.876*	*11.008*
Mar 16 – Mar 31	1500	130	1375	1370	*47.603*	*43.478*
Apr 1 – Apr 15	200	150	55	50	*5.950*	*1.488*
Apr 16 – Apr 30	200	150	55	50	*5.950*	*1.488*
May 1 – May 28	215	190	30	25	*11.940*	*1.388*
May 29 – Jun 30	215	190	30	25	*14.073*	*1.636*
July 1 – July 29	255	230	30	25	*14.668*	*1.438*
Jul 30 – Aug 31	255	230	30	25	*16.691*	*1.636*
Sep 1 – Sep 30	260	210	55	50	*15.471*	*2.975*
Oct 1 – Oct 31	160	160	5	0	*9.838*	*0.000*
Nov 1 – Nov 6	400	130	275	270	*4.760*	*3.213*
Nov 7 – Nov 10	120	120	5	0	*0.952*	*0.000*
Nov 11 – Nov 30	120	120	5	0	*4.760*	*0.000*
Dec 1 – Dec 31	120	120	5	0	*7.379*	*0.000*
Jan 1 – Jan 31	110	100	15	10	*6.764*	*0.615*
Feb 1 – Feb 28	110	100	15	10	*6.109*	*0.555*
				Totals	***187.785***	***70.919***

Table 6b — Capacity Constrained Default Flow Schedule

Flow Period	Flow (cfs)				Volume (TAF)		
	Friant Dam Release	Holding Contracts [11]	Flow Target at GRF	Restoration Flow at GRF	Friant Dam Release	Restoration Flow at GRF	Unreleased Restoration Flow [12]
Mar 1 – Mar 15	551	130	426	421	*16.387*	*12.519*	*0*
Mar 16 – Mar 31	551	130	426	421	*17.480*	*13.354*	*0*
Apr 1 – Apr 15	571	150	426	421	*16.982*	*12.519*	*0*
Apr 16 – Apr 30	571	150	426	421	*16.982*	*12.519*	*0*
May 1 – May 28	333	190	148	143	*18.490*	*7.938*	*0*
May 29 – Jun 30	215	190	30	25	*14.073*	*1.636*	*0*
July 1 – July 29	255	230	30	25	*14.668*	*1.438*	*0*
Jul 30 – Aug 31	255	230	30	25	*16.691*	*1.636*	*0*
Sep 1 – Sep 30	260	210	55	50	*15.471*	*2.975*	*0*
Oct 1 – Oct 31	160	160	5	0	*9.838*	*0.000*	*0*
Nov 1 – Nov 6	400	130	275	270	*4.760*	*3.213*	*0*
Nov 7 – Nov 10	120	120	5	0	*0.952*	*0.000*	*0*
Nov 11 – Nov 30	120	120	5	0	*4.760*	*0.000*	*0*
Dec 1 – Dec 31	120	120	5	0	*7.379*	*0.000*	*0*
Jan 1 – Jan 31	110	100	15	10	*6.764*	*0.615*	*0*
Feb 1 – Feb 28	110	100	15	10	*6.109*	*0.555*	*0*
				Totals	***187.785***	***70.919***	***0***

[11] In recent years, Holding Contract demands have been higher than assumed under Exhibit B of the Settlement, in which case, flows at Friant are increased to achieve the Gravelly Ford Flow Target.

[12] This estimate of URF volume is based on the most constraining reach, with Spring Flexible Flows redistributed March 1 through May 28 as necessary and Fall Flexible Flows redistributed Sept 3 through December 28 as necessary up to channel capacity constraints. Actual URF volume will depend on the Restoration Administrator's recommendations.

Exhibit B Restoration Flow Budget

Table 7 shows the components of the annual water budget for March 1, 2021, through February 28, 2022 (i.e. the Restoration Year). The Continuity Flow Account, Spring Flexible Flow Account, Riparian Recruitment Flow Account, and Fall Flexible Flow Account reflect the Exhibit B hydrograph for the current Restoration Allocation. The expected 116.866 TAF for Holding Contracts is shown. The volume for each flow account may change with subsequent Restoration Allocations.

Table 7 — Restoration Budget with Flow Accounts

<table>
<tr><th rowspan="2">Period</th><th rowspan="2">Holding Contract Demand (TAF)</th><th colspan="4">Restoration Flow Accounts</th></tr>
<tr><th>Continuity Flow Account</th><th>Spring Flexible Flow Account</th><th>Riparian Recruitment Flow Account</th><th>Fall Flexible Flow Account</th></tr>
<tr><td>Feb 1 – Feb 28</td><td>–</td><td>0</td><td rowspan="3">40.959</td><td>–</td><td>–</td></tr>
<tr><td>Mar 1 – Apr 30</td><td>16.920</td><td>16.502</td><td>–</td><td>–</td></tr>
<tr><td>May 1 – May 28</td><td>10.552</td><td>1.388</td><td rowspan="2">0</td><td>–</td></tr>
<tr><td>May 29 – Jul 29</td><td>25.666</td><td>3.074</td><td>–</td><td>–</td></tr>
<tr><td>Jul 30 – Aug 31</td><td>15.055</td><td>1.636</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Sep 1 – Sep 30</td><td>12.496</td><td>2.975</td><td>–</td><td>–</td><td rowspan="3">0.595</td></tr>
<tr><td>Oct 1 – Nov 30</td><td>17.098</td><td>2.618</td><td>–</td><td>–</td></tr>
<tr><td>Dec 1 – Dec 31</td><td>7.378</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td>Jan 1 – Feb 28</td><td>11.702</td><td>1.170</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">116.866 [13]</td><td>29.365</td><td>40.959</td><td>0</td><td>0.595</td></tr>
<tr><td colspan="4">70.919 (Base Flow Volume)</td></tr>
<tr><td></td><td colspan="5">187.785 (Friant Release Volume)</td></tr>
</table>

[13] In recent years, Holding Contract demands have been higher than assumed under Exhibit B of the Settlement, in which case, flows at Friant are increased to achieve the Gravelly Ford Flow Target.

[14] Buffer Flow volumes are based on actual releases, and are not an allocated volume per se.

Remaining Flow Volumes

The amount of water remaining for scheduling is the volume of flows released from Friant Dam in excess of releases required to meet Holding Contract demands, less past releases. Table 8 tracks these balances among the four flow accounts. Tracking these four flow accounts is necessary for application of the Water Supply Test. The releases to date volumes are derived from quality-assurance/quality-control daily average data when available, and partly from provisional data posted to CDEC, and thus may have future adjustments. Such adjustments may also affect the remaining flow volume.

Note that the Restoration Administrator is exercising the return of URF exchanges in 2021, totaling 21.425 TAF.

Table 8 — Estimated Restoration Flow Volume Remaining and Released to Date

Flow Account		**Yearly Allocation** (TAF)	**Released to Date** [15] (TAF)	**Remaining Flow Volume** (TAF)
Base Flows	Continuity Flow Account (Mar 1 — Feb 28)	*29.365*	*10.963*	*18.402*
	Spring Flexible Flows (Mar 1 – Apr 30)	*40.959*	*0*	*40.959*
	Riparian Recruitment Flows (May 1 — Jul 29)	*0*	*0*	*0*
	Fall Flexible Flows (Oct 1 – Nov 30)	*0.595*	*0*	*0.595*
Buffer Flows		—	*0.902*	—
Unreleased Restoration Flows (Sales and Exchanges)		—	*0*	*0*
Unreleased Restoration Flows (Returned Exchanges)		—	*+10.425*	*+11.000*
Purchased Water		—	*0*	*0*
		Totals:	***22.290***	***70.956***

[15] As of 6/23/2021

Operational Constraints

Operating criteria, such as channel conveyance capacity, ramping rate constraints, scheduled maintenance, reservoir storage, contractual obligations, and downstream seepage concerns, may restrict the release of Restoration Flows. Table 9 summarizes known 2021 operational constraints.

Table 9 — Summary of Operational Constraints

Type of Constraint	Period	Flow Limitation
Levee Stability	Currently in effect	1,210 cfs in Reach 2B
	Currently in effect	1,070 cfs in Eastside Bypass
Channel Conveyance / Seepage Limitation	Currently in effect, see latest Flow Bench Evaluation for precise values	Reach 2A: 800 – 820 cfs @ GRF
		Reach 3: 850 cfs @ MEN
		Reach 4A: 260 – 300 cfs @ SDP
Merced NWR weir Removal	June 30 – September 24, 2021	0 cfs
USFWS Biological Opinion	Until consultation for "Phase 2"	1,660 cfs of Restoration Flows at Friant Dam (interpreted as 1,655 cfs at Gravelly Ford)

The 2021 Channel Capacity Report identifies a maximum flow in Reach 2B of 1,210 cfs due to levee stability constraints. This results in a maximum release from Friant Dam between 1,310 cfs and 1,540 cfs depending on the time of year. The 2021 Restoration Year Channel Capacity Report also identifies a maximum flow in the Middle Eastside Bypass of 1,070 cfs due to levee stability constraints. These values are unchanged from 2019. Reach O levee improvements were completed in 2020 and will allow an overall increase in then-existing capacity of the Middle Eastside Bypass to be documented in the 2022 Channel Capacity Report.

In 2020, multiple flow benches were conducted to verify expected seepage thresholds in Reach 2A and Reach 3. Analysis revealed a seepage limitation of 800 to 820 cfs in Reach 2A (measured at the GRF gauge) and 850 cfs in Reach 3 (measured at the MEN gauge). These seepage limitations fluctuate with prevailing groundwater conditions and may be slightly lower or higher at a given time. The limitation in Reach 3 must accommodate both Restoration Flows and diversion to Arroyo Canal, thus Reach 3 is currently the limiting reach in certain times of the year. SJRRP will coordinate with the Restoration Administrator on specific flow schedules that are close to these limits. Flow – groundwater relationships from October 2019 through January 2020 were examined to determine a new seepage limitation in Reach 4A. For the current Reach 4A seepage limitation, wells installed in 2017 and later were incorporated into the analysis. Inclusion of these additional data points revealed that the seepage limitation is a lower flow rate than previously expected. A flow bench evaluation has not been conducted recently and any flows approaching the expected seepage limitation would likely have to be proceeded by a flow bench to test our assumptions of groundwater conditions.

Reclamation will inform the Restoration Administrator of any changes to groundwater conditions that are likely to result in a reduction in scheduled Restoration Flows, will implement monitoring of groundwater conditions as necessary, and will adjust Friant Dam releases and/or Mendota Pool recapture (as preferred by the Restoration Administrator) to stay within seepage and channel capacity constraints.

Given the temporary halting of Restoration Flows in the currently approved schedule, removal of the Merced National Wildlife Refuge upper weir is likely moving forward. To speed that project completion, no Restoration Flows are permitted through September 24 (or sooner, depending on completion), taking advantage of the disconnected river pursuant to the currently approved Restoration Flow schedule.

2021 Allocation History

The Restoration Allocation are adjusted multiple times between the date of the initial allocation and the final allocation; issuances will generally take place on a monthly schedule but may also be issued based on rapidly changing hydrologic conditions. The Restoration Administrator is responsible for contingency planning and managing releases to stay within the current allocation to the extent possible, in accordance to the Guidelines. Table 10 summarizes the Allocation History for this Restoration Year.

Table 10 — Allocation History

Allocation Type	Issue Date	Forecast Blending Applied	Unimpaired Inflow Forecast (at forecast exceedance)	Year Type	Restoration Allocation at Gravelly Ford	Restoration Flows and URFs Released
Initial	January 21, 2021	30/70	296 TAF (@ 90%)	Critical-Low	0 TAF	0 (thru 1/20/2021)
Update	February 5, 2021	50/50	657 TAF (@ 75%)	Critical-High	70.919 TAF	0 (thru 2/4/2021)
Update	February 19, 2021	20/80	739 TAF (@ 75%)	Dry	170.732 TAF	0 (thru 2/4/2021)
Update	March 19, 2021	40/60	642 TAF (@ 75%)	Critical-High	70.919 TAF	3.390 (thru 3/18/2021)
Update	April 16, 2021	30/70 (-25 TAF Offset)	567 TAF (@ 50%)	Critical-High	70.919 TAF	9.503 (thru 4/15/2021)
Update	May 21, 2021	30/70 (-15 TAF Offset)	524 TAF (@ 50%)	Critical-High	70.919 TAF	17.774 (thru 5/19/2021)
Final	June 25, 2021	60/40	529 TAF (@ 50%)	Critical-High	70.919 TAF	22.290 (thru 6/23/2021)

Appendix A: Abbreviations, Acronyms, and Glossary

af	Acre-feet
ARS	USDA Agricultural Research Service
ASO	Airborne Snow Observatory
CALSIM	California Statewide Integrated Model
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
cfs	Cubic feet per second
CVP	Central Valley Project
Delta	Sacramento–San Joaquin Delta
DWR	California Department of Water Resources
ESP	Ensemble Streamflow Prediction
Exhibit B	Exhibit B of the Settlement depicting Default Hydrograph
GRF	Gravelly Ford Flow Gauge
Guidelines	Restoration Flow Guidelines
LSJLD	Lower San Joaquin Levee District
NWS	National Weather Service
QA/QC	Quality Assurance/Quality Control (i.e. finalized)
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Year	the cycle of Restoration Flows, March 1 through February 28/29
RWA	SJRRP Reclaimed Water Account
Secretary	U.S. Secretary of the Interior
Settlement	Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.*
SJREC	San Joaquin River Exchange Contractors
SJRRP	San Joaquin River Restoration Program
SLCC	San Luis Canal Company
SWE	Snow Water Equivalent
SWP	State Water Project
TAF	thousand acre–feet
URF	Unreleased Restoration Flows
WSI	DWR Water Supply Index
WY	Water year, October 1 through September 30

Appendix B: Previous Year (2020) Flow Accounting

Table B — Restoration Flow Accounting and Unreleased Restoration Flows, and Holding Contracts, for the period February 2020 through February 2021. Flood management releases to San Joaquin River did not occur during this period. This accounting includes a returned Unreleased Restoration Flow Exchange. The unused Restoration Allocation was 0.270 TAF.

Flow Period	Gravelly Ford 5 cfs requirement (TAF)	URF disposed	Released Restoration Flow Volumes (TAF)						
			Continuity Flow	**Spring Flexible Flow**	**Fall Flexible Flow**	**Riparian Recruitment Flow**	**Buffer Flow**	**Flexible Buffer Flow**	**URF returned**
Feb 1 – Feb 28	–		–	*0*	–	–	–	–	
Mar 1 – Mar 31	*8.015*		*6.676*	*0*	–	–	*0.605*	–	
Apr 1 – Apr 30	*11.268*	*40.131*	*9.572*	*0*	–	–	*0*	–	
May 1 – May 31	*13.478*		*15.867*	*1.982*	–		*0*		
Jun 1 – Jun 30	*12.845*	*5.277*	*9.572*	–	–	*0*			
Jul 1 – Jul 31	*15.269*		*10.554*	–	–		*0*	*0*	
Aug 1 – Aug 31	*15.231*	*4.195*	*11.189*	–	–		*0*		
Sep 1 – Sep 30	*13.789*		*11.125*	–	*0*	–	*0*		*0.487*
Oct 1 – Oct 31	*13.704*		*12.184*	–	*0*	–	*0*		
Nov 1 – Nov 30	*11.627*		*13.894*	–	*0*	–	*0*	*0*	
Dec 1 – Dec 31	*11.183*		*14.231*	–	*0*	–	*0*		
Jan 1 – Jan 31	*9.989*		*13.464*	–	–	–	*0*	–	
Feb 1 – Feb 28	*8.554*	*13.900*	*8.600*	–	–	–	*0*	–	
	144.958	***63.502***	***136.443***	***1.982***	***0***	***0***	***0.605***	***0***	***0.487***
			138.425 (Allocated Restoration Flows)				***0.605 (all Buffer Flows)***		
			139.030 (Restoration Flows Affecting Friant water supply)						
			139.517 (Restoration Flows released to river)						
		201.927 (Restoration Allocation Used)							
			284.475 (Friant Dam Releases — excludes disposed URFs)						

Appendix C: History of Millerton Unimpaired Runoff

Table C — Water Year Totals in Thousand Acre-Feet

Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]	Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]	Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]	Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]
1901	3,227.9	Wet	1933	1,111.4	Normal-Dry	1965	2,271.191	Normal-Wet	1997	2,817.670	Wet
1902	1,704.0	Normal-Wet	1934	691.5	Dry	1966	1,298.792	Normal-Dry	1998	3,160.759	Wet
1903	1,727.0	Normal-Wet	1935	1,923.2	Normal-Wet	1967	3,233.097	Wet	1999	1,527.040	Normal-Wet
1904	2,062.0	Normal-Wet	1936	1,853.3	Normal-Wet	1968	861.894	Dry	2000	1,735.653	Normal-Wet
1905	1,795.4	Normal-Wet	1937	2,208.0	Normal-Wet	1969	4,040.864	Wet	2001	1,065.318	Normal-Dry
1906	4,367.8	Wet	1938	3,688.4	Wet	1970	1,445.837	Normal-Dry	2002	1,171.457	Normal-Dry
1907	3,113.9	Wet	1939	920.8	Dry	1971	1,416.812	Normal-Dry	2003	1,449.954	Normal-Dry
1908	1,163.4	Normal-Dry	1940	1,880.6	Normal-Wet	1972	1,039.249	Normal-Dry	2004	1,130.823	Normal-Dry
1909	2,900.7	Wet	1941	2,652.5	Wet	1973	2,047.585	Normal-Wet	2005	2,826.872	Wet
1910	2,041.5	Normal-Wet	1942	2,254.0	Normal-Wet	1974	2,190.308	Normal-Wet	2006	3,180.816	Wet
1911	3,586.0	Wet	1943	2,053.7	Normal-Wet	1975	1,795.922	Normal-Wet	2007	684.333	Dry
1912	1,043.9	Normal-Dry	1944	1,265.4	Normal-Dry	1976	629.234	Critical-High	2008	1,116.790	Normal-Dry
1913	879.4	Dry	1945	2,134.633	Normal-Wet	1977	361.253	Critical-Low	2009	1,455.379	Normal-Wet
1914	2,883.4	Wet	1946	1,727.115	Normal-Wet	1978	3,402.805	Wet	2010	2,028.706	Normal-Wet
1915	1,966.3	Normal-Wet	1947	1,121.564	Normal-Dry	1979	1,829.988	Normal-Wet	2011	3,304.824	Wet
1916	2,760.5	Wet	1948	1,201.390	Normal-Dry	1980	2,973.169	Wet	2012	831.582	Dry
1917	1,936.2	Normal-Wet	1949	1,167.008	Normal-Dry	1981	1,067.757	Normal-Dry	2013	856.626	Dry
1918	1,466.8	Normal-Wet	1950	1,317.457	Normal-Dry	1982	3,317.171	Wet	2014	509.579	Critical-High
1919	1,297.5	Normal-Dry	1951	1,827.254	Normal-Wet	1983	4,643.090	Wet	2015	327.410	Critical-Low
1920	1,322.5	Normal-Dry	1952	2,840.854	Wet	1984	2,042.750	Normal-Wet	2016	1,300.986	Normal-Dry
1921	1,604.4	Normal-Wet	1953	1,226.830	Normal-Dry	1985	1,135.975	Normal-Dry	2017	4,395.400	Wet
1922	2,355.1	Normal-Wet	1954	1,313.993	Normal-Dry	1986	3,031.600	Wet	2018	1,348.979	Normal-Dry
1923	1,654.3	Normal-Wet	1955	1,161.161	Normal-Dry	1987	756.853	Dry	2019	2,734.772	Wet
1924	444.1	Critical-High	1956	2,959.812	Wet	1988	862.124	Dry	2020	886.025	Dry
1925	1,438.7	Normal-Dry	1957	1,326.573	Normal-Dry	1989	939.168	Normal-Dry	2021		Critical-High
1926	1,161.4	Normal-Dry	1958	2,631.392	Wet	1990	742.824	Dry			
1927	2,001.3	Normal-Wet	1959	949.456	Normal-Dry	1991	1,027.209	Normal-Dry			
1928	1,153.7	Normal-Dry	1960	826.021	Dry	1992	807.759	Dry			
1929	862.4	Dry	1961	647.428	Critical-High	1993	2,672.322	Wet			
1930	859.1	Dry	1962	1,924.066	Normal-Wet	1994	824.097	Dry			
1931	480.2	Critical-High	1963	1,945.266	Normal-Wet	1995	3,876.370	Wet			
1932	2,047.4	Normal-Wet	1964	922.351	Dry	1996	2,200.707	Normal-Wet			

[1] Water year is from Oct 1 through Sept 30, for example the 2010 water year began Oct 1, 2009. Unimpaired Runoff is based on Reclamation calculations, and hypothetical water year types are shown here; actual Restoration water year types are based on the final allocation, which may sometimes differ slightly from the calculated water year total.

[2] Also known as “Natural River” or “Unimpaired Inflow into Millerton” – This is the total runoff that would flow into Millerton Lake if there were no dams or diversions upstream. There was a lower level of precision prior to 1945. Friant Dam uses 1.9835 conversion from cfs to AF.

[3] The six SJRRP Water Year Types are based on unimpaired inflow and are not updated as climatology changes as per the Settlement. Critical-Low= <400 TAF, Critical-High=400-669.999 TAF, Dry= 670-929.999 TAF, Normal-Dry 930-1449.999, Normal-Wet 1450-2500, Wet>2500

Appendix D: Final Restoration Allocations and Error

Table D — History of Restoration Allocations

Year	Type	Date of Final Allocation Issuance[2]	Unimpaired Runoff Forecast in Final Allocation (TAF)	Restoration Allocation in Final Issuance (TAF)	Observed Unimpaired Runoff on Sep. 30 (TAF)	Error (Unimpaired Runoff / Allocation)
2009	Interim Flows			261.5	1,455.379	—
2010	Interim Flows			98.2	2,028.706	—
2011	Interim Flows			152.4	3,304.824	—
2012	Interim Flows			183	831.582	—
2013	Interim Flows			65.5	856.626	—
2014	Restoration Flows	Mar 3	518	0 [1]	509.579	+8.421 / 0 [1]
2015	Restoration Flows	Sep 28	327	0	327.410	-0.410 / 0
2016	Restoration Flows	Sep 30	1300.986	263.295	1,300.986	0 / 0
2017	Restoration Flows	Jul 10	4,444	556.542	4,395.400	+48.600 / 0
2018	Restoration Flows	May 22	1,427	280.258	1,348.979	+78.021 / +10.503
2019	Restoration Flows	May 20	2,690	556.542	2,734.772	-44.772 / 0
2020	Restoration Flows	June 19	880	202.197	886.025	-6.025 / -1.345
2021	Restoration Flows	June 25	529	70.919	—	— / 0

[1] No water was provided under this Critical-High designation due to necessity for Friant Dam to release flows for the Exchange Contract.

[2] In 2018 with the completion of Version 2.0 of the Restoration Flows Guidelines, the date of final Restoration Allocation issuance was advanced from September 30 to either May or June.