Bureau of Reclamation
2800 Cottage Way, CGB-170
Sacramento, California 95825

Updated 2022 Restoration Allocation & Default Flow Schedule March 25, 2022

Overview

The following transmits the updated 2022 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 Runoff: the estimated flows that would occur absent regulation on the river. This value is also known as the "Natural River," "Unimpaired Runoff," "Unimpaired Inflow," or "Full Natural Flow," and is utilized to identify the water year type.
- Hydrograph Volumes: the annual allocation hydrograph based on water year unimpaired runoff, 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 Runoff 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 or otherwise identify Unreleased Restoration Flows and categorize recommended flows by account, 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.

Per the Guidelines, Reclamation will update the Restoration Allocation on a regular monthly schedule and may also update the allocation beyond that regular schedule when conditions warrant. **This update includes better data derived from Airborne Snow Observatory surveys and transmits channel limitations resulting from Exchange Contractor substitute supply which is planned to be delivered via the San Joaquin River. It is requested that the Restoration Administrator return a recommendation based on this allocation, not the previous allocation, on or before April 1, 2022.**

Forecasted Unimpaired Runoff

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 2022 (October 1, 2021 to September 30, 2022) observed accumulated and forecasted water year Unimpaired Runoff into 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") March 23, 2022 [1]	434.6				
Accumulated Unimpaired Runoff as percent of normal [2]	98%				
DWR, March 22, 2022 [3] (Published Value)	905	1,075[7]	1,245	1,427[7]	1,610
DWR, March 22, 2022 [4] (Runoff Adjusted)	950	1,112	1,274	1,449	1,626
NWS, March 24, 2022 [5] (Published Daily Value)	1,030	1,090	1,190	1,300	1,470
Smoothed NWS, March 24, 2022 [6] (7-day Smoothing)	1,039	1,113	1,235	1,350	1,531
Smoothed NWS, March 24, 2022 [4] (Runoff Adjusted)	1,034	1,107	1,227	1,345	1,528

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

2 Based on average accumulation of Unimpaired 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 Runoff 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 for March 1 (issued March 8) and updated March 22 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.

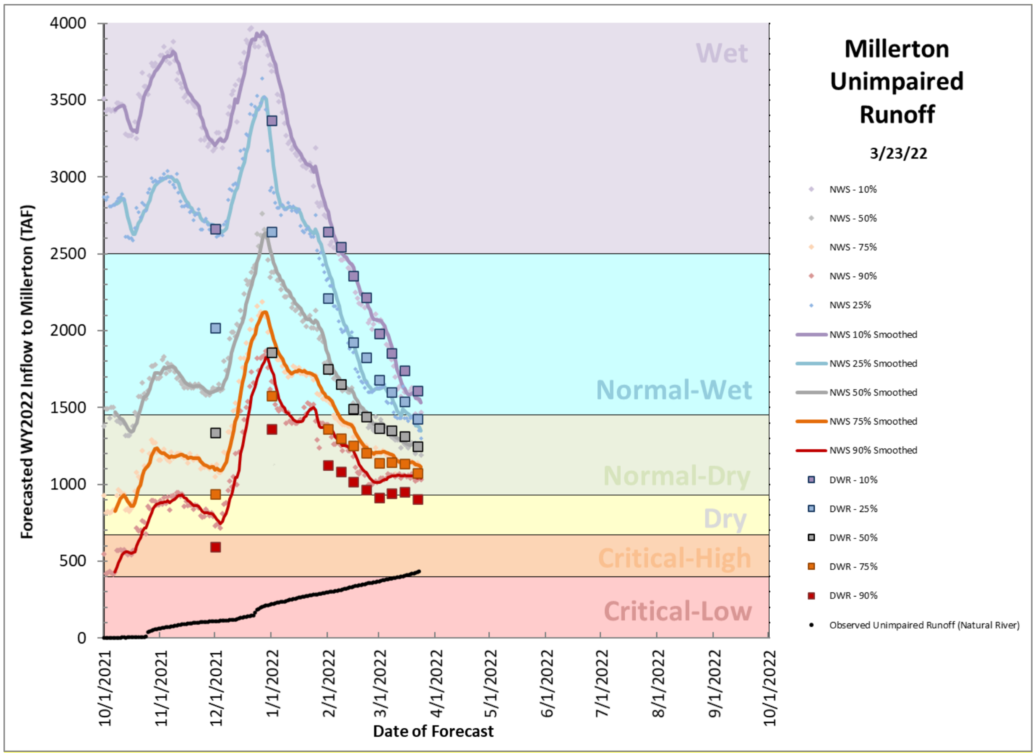

Figure 1a — Plot of 2022 Water Year forecasts. This includes both NWS Ensemble Streamflow Prediction Forecasts and DWR Forecasts

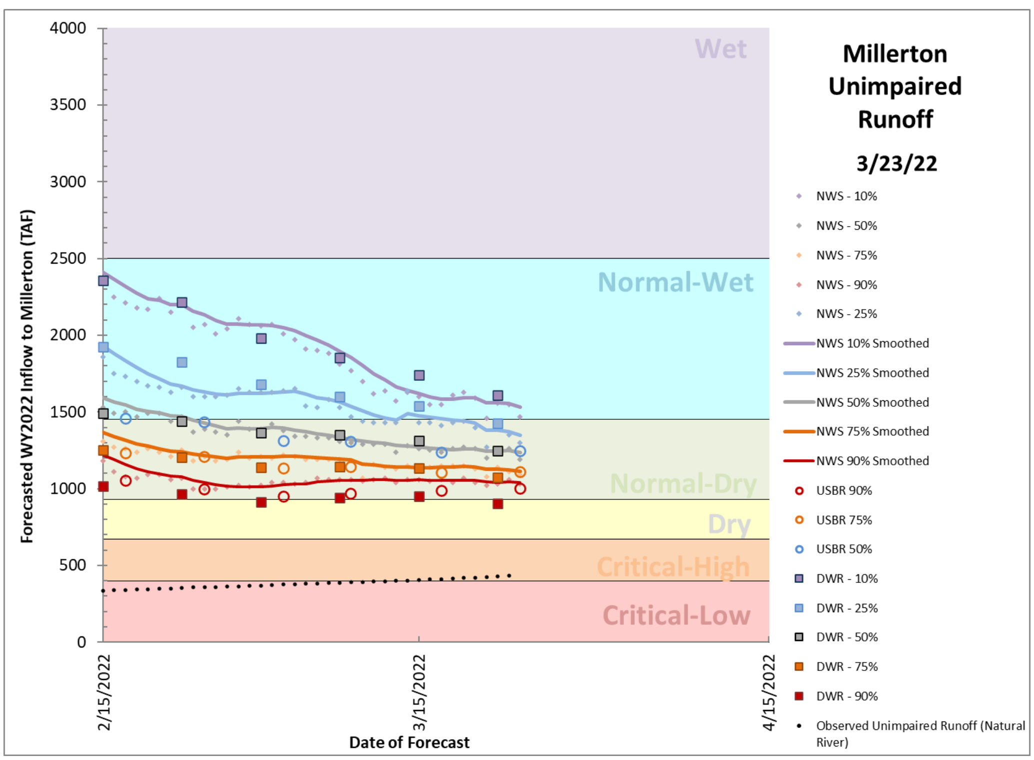

Figure 1b — Detail plot of most recent forecasts. Also shown are Reclamation's "hybrid" forecast with open circles.

After 75 days of nearly zero precipitation, some precipitation has fallen in late February and March. Rain and snowfall are tracking roughly along the 80-90% exceedance. Recent warming has started melting the snowpack in earnest, and the strong response of the natural river indicates that soil moisture is significantly better than 2021. Runoff efficiency since October 1 is estimated between 42% and 50%. The interval between the February 6 & 7 ASO survey and March 16 & 18 ASO survey included 111 TAF of snowmelt and 101 TAF of precipitation, for a total surface water input (SWI) of 212 TAF. During this time, the Natural River accumulated 104 TAF, but about 12 TAF of this total was from baseflow, so runoff derived from rain and snow is estimated at 92 TAF. This provides an estimate of current runoff efficiency of 43%. Soil moistures have likely dried somewhat since the December storm series, however soil moistures at high elevations are expected to improve as we approach peak snowmelt, with runoff efficiencies rising to 70% – 80%.

Snow monitoring has been strengthened this year with additional modeling efforts, a return to full sampling of snow courses, and four or five planned Airborne Snow Observatory (ASO) flights. There are five snow pillows that are not properly functioning in the watershed, increasing our reliance upon ASO surveys, models, and monthly snow course measurements. The February 6 & 7 ASO survey resulted in Reclamation revising its consensus on snowpack volume downward, effectively decreasing the anticipated runoff at all exceedances. The March 16 & 18 ASO survey indicated that there was slightly less snow than Reclamation's consensus estimate at the time, however, recent minor storms had markedly improved snowpack at the higher elevation. This higher elevation snowpack will result in greater runoff, despite the slightly lower volume, due to the thin and relatively wet soils at those elevations.

Table 2 depicts the aggregate snowpack volume from various models and Reclamation's consensus estimate, which leans heavily toward the ASO data and the revised distribution of SWE (Figure 2a). Model results from the iSnobal model are shown for March 18. The iSnobal model correction due to ASO data assimilation is shown in Figure 2b.

Table 2 — Total snowpack volume (TAF of Snow Water Equivalent) depicted by four models, an ASO measurement, and a consensus estimate for March 24, 2022.

	Snowpack Model Volumes					
	CNRFC	NOHRSC	CU Boulder	iSnobal (M3W)	Aerial Snow Survey (ASO)	Reclamation Consensus
March 17, 2022	741	613	801 [8]	541 [9]	555 [10]	**503**

[8] CU Boulder "Real-time SWE" model from March 15.

[9] The "iSnobal" model for the San Joaquin is produced by M3Works under a contract with ASO. The model was run on Mar 18 using ASO data for correction. The report predicts a total of 636 TAF.

[10] ASO survey flown on March 16 & 18 and reported on March 22.

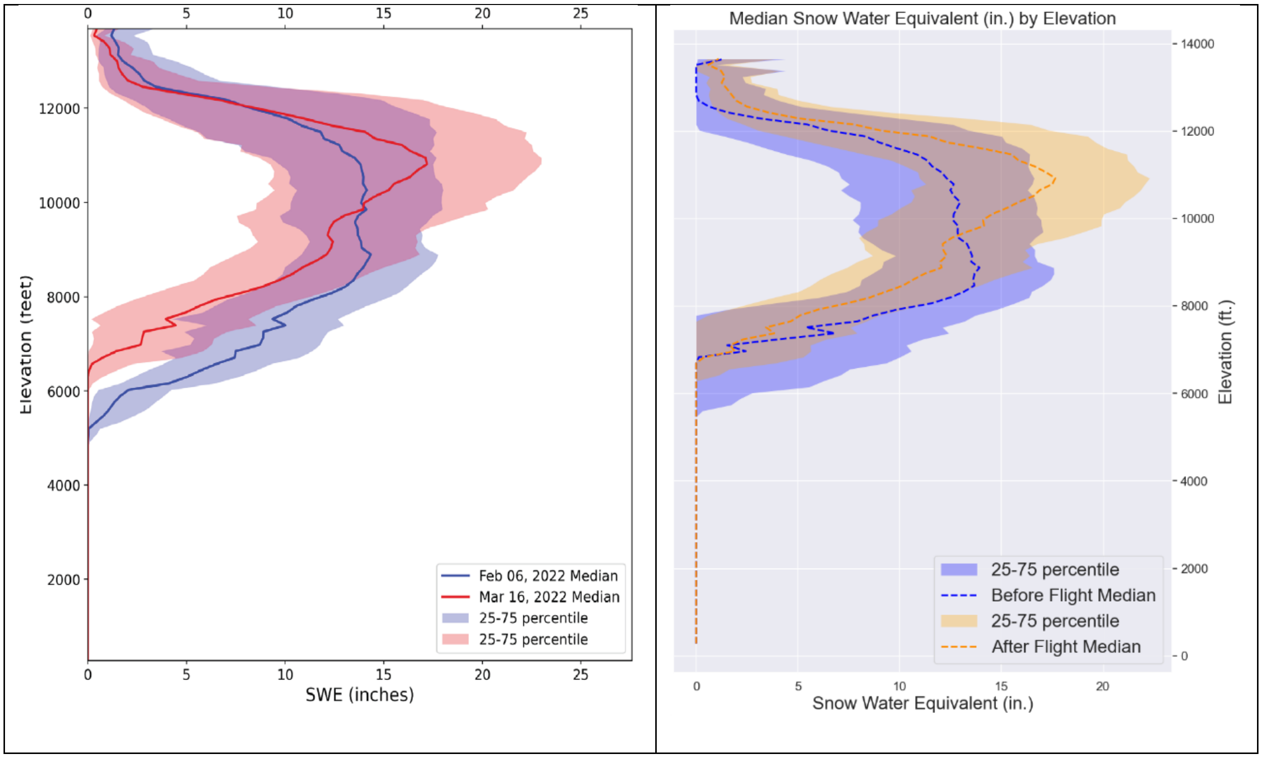

Figure 2a (left) — Measured elevation profiles of SWE depth in the San Joaquin from the first to the second ASO survey. The blue trace is from the February 6 & 7 survey. The yellow trace shows March 16 & 18 survey. The gains between 9,500' and 12,000' more than offset the losses at mid-elevations, are result in a higher runoff solution for the remainder of the water year.

Figure 2b (right) — Modeled elevation profiles of SWE depth in the San Joaquin from before and after ASO survey on March 16-18. The blue trace is from the iSnobal model prior to ASO data assimilation. The yellow trace shows the model state after correction using the ASO survey. iSnobal, like other models, had somewhat overestimated the snowpack at low elevation and underestimated the snowpack at high elevations.

A notable inconsistency arose this year as the snow courses and snow pillows at a given elevation were reporting more SWE depth than what is reported by ASO for the same elevation band. This inconsistency appears to be fully resolved with the latest ASO dataset. Snowmelt has been more rapid than expected on south-facing slopes, perhaps due to vegetation loss after the Creek Fire. This has stripped the sunnier slopes of snow, while leaving the flat, treed, and shaded slopes to retain more snow. Because most ground-based measurements are in these favored areas, there was little information on the SWE loss on these south slopes except for the ASO data (Figure 3).

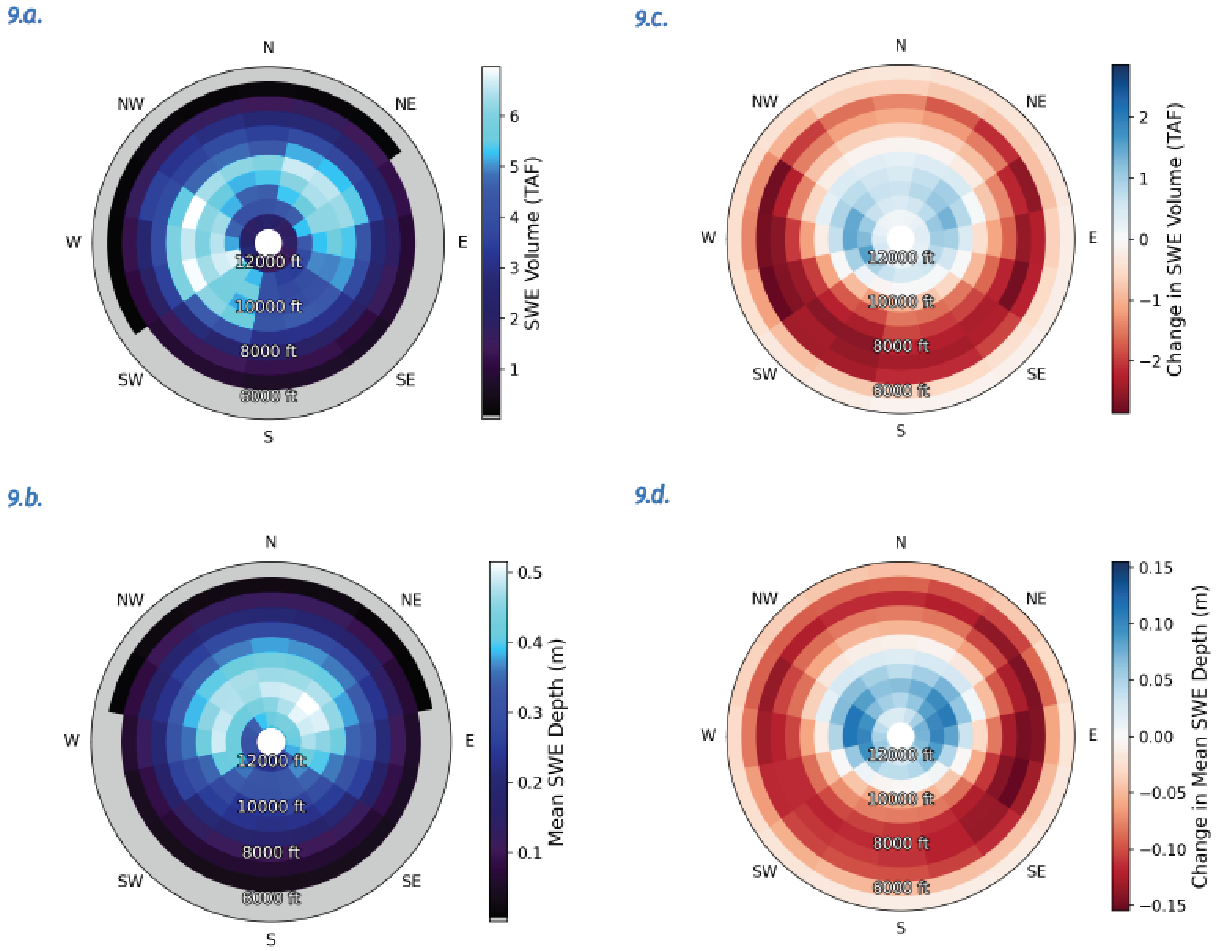

Figure 9. Aspect/elevation SWE and SWE difference plots. 9.a. & b. SWE volume (TAF) and depth (m) from March 16-18 survey; 9.c. & d. SWE volume (TAF) and depth (m) change from February 6-7 survey to March 16-18 survey.

Figure 3 a-d — These "cone plots" simplify the watershed into a single cone with the observer looking down on it. SWE volume is in the top two plots, with SWE depth on the bottom two plots. SWE change is on the righthand side.

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 Runoff, 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 40/60 blending respectively**. **No offset is applied to the blended forecast.** The selection of this blending ratio is strongly influenced by the accuracy of runoff predictions over the last 2 weeks among the two forecast models, and Reclamation's interpretation of the ASO data using an in-house water budget model.

At the 90% exceedance, we assume 3.5” of additional precipitation from March 24 to September 30. At the 50% we assume 7.2” of additional precipitation. To date, the watershed has received approximately 22.6” of basinwide precipitation.

Table 3 — Current Blending and Hybrid Unimpaired Runoff Forecasts (TAF)

	Forecast Probability of Exceedance using blending				
	90%	75%	50%	25%	10%
Blending Ratio (DWR/NWS)	40/60 with no offset				
Hybrid Unimpaired Runoff Forecast (TAF)	1,000	1,109	1,246	1,387	1,567

Restoration Allocation

As per the Guidelines, the **75% 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 exceedances 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 forecast blending and offsets determined by Reclamation and using the 75% exceedance forecast dictated by the Guidelines, Reclamation calculates an **Unimpaired Runoff hybrid forecast of 1,109 Thousand Acre-Feet (TAF) and a Normal-Dry Water Year Type. This provides a Restoration Allocation of 237.451 TAF as measured at Gravelly Ford (GRF).** Combined with Holding Contracts on the San Joaquin River, **this equates to a Friant Dam Release of approximately 354.396 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 2022 Restoration Year Shown with Other Hypothetical Values in Gray

	Forecast Probability of Exceedance using proposed blending				
	90%	**75%**	**50%**	**25%**	**10%**
Hybrid Unimpaired Runoff Forecast (TAF)	1,000	**1,109**	1,246	1,387	1,567
Water Year Type	Normal-Dry	**Normal-Dry**	Normal-Dry	Normal-Dry	Normal-Wet
Restoration Allocation at GRF (TAF)	222.778	**237.451**	255.893	274.874	299.746
Friant Dam Flow Releases (TAF)	339.723	**354.396**	372.838	391.819	416.691

Unreleased Restoration Flow Pricing

This allocation issuance sets the price for any 2022 Tier 2 Unreleased Restoration Flows (URFs) which may be made available to Friant Contractors. In accordance with the 2020-2024 URF agreement, the Tier 2 URF price is set at $188.87. Tier 1 URF pricing is independent of hydrology and fixed at $23.00 per acre-foot.

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.

Hydrologic conditions in Northern California have turned extremely dry, with Lake Shasta inflow expected to be about 50% of normal and Folsom Lake inflow projected to be about 60% of normal for the water year (at the 75% exceedance). The 2022 forecast approaches last water year's historic low runoff into Lake Shasta; combined such back-to-back dry years are extraordinary. This extended dry hydrology has resulted in a predicted shortfall in meeting the San Joaquin River Exchange Contract at the 90%, 75%, and 50% exceedances. Substitute supply from the San Joaquin River is planned to be released from Millerton Lake. While the exact volume of substitute supply is not known at this time, the south of Delta shortfall is forecast to be significant. Releases of substitute water may start as early as April 1 using the San Joaquin River and are anticipated to continue through the summer months ending as late as mid-September. If Northern California hydrology and Delta pumping conditions improve markedly, these planned releases may be shortened by weeks or perhaps months. Reclamation will coordinate with the Restoration Administrator as information becomes available on the schedule of these releases. At this time, Reclamation does not forecast that subsequent Restoration Allocations will be reduced as a result of meeting this contractual requirement.

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 Runoff 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 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 54.1 TAF is generated that cannot be scheduled for release without shifting outside of the flexible flow periods (which would require 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	2135	150	1990	1985	*63.520*	*59.058*
Apr 16 – Apr 30	350	150	205	200	*10.413*	*5.950*
May 1 – May 28	350	190	165	160	*19.438*	*8.886*
May 29 – Jun 30	350	190	165	160	*22.909*	*10.473*
July 1 – July 29	350	230	125	120	*20.132*	*6.902*
Jul 30 – Aug 31	350	230	125	120	*22.909*	*7.855*
Sep 1 – Sep 30	350	210	145	140	*20.826*	*8.331*
Oct 1 – Oct 31	350	160	195	190	*21.521*	*11.683*
Nov 1 – Nov 6	700	130	575	570	*8.331*	*6.783*
Nov 7 – Nov 10	700	130	575	570	*5.554*	*4.522*
Nov 11 – Nov 30	350	120	235	230	*13.884*	*9.124*
Dec 1 – Dec 31	350	120	235	230	*21.521*	*14.142*
Jan 1 – Jan 31	350	100	255	250	*21.521*	*15.372*
Feb 1 – Feb 28	350	100	255	250	*19.438*	*13.884*
				Totals	***354.396***	***237.451***

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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*	*-1.511*
Mar 16 – Mar 31	551	130	426	421	*17.480*	*13.354*	*30.124*
Apr 1 – Apr 15	571	150	426	421	*16.982*	*12.519*	*46.538*
Apr 16 – Apr 30	571	150	426	421	*16.982*	*12.519*	*-6.569*
May 1 – May 28	611	190	426	421	*33.922*	*23.369*	*-14.484*
May 29 – Jun 30	350	190	165	160	*22.909*	*10.473*	*0.000*
July 1 – July 29	350	230	125	120	*20.132*	*6.902*	*0.000*
Jul 30 – Aug 31	350	230	125	120	*22.909*	*7.855*	*0.000*
Sep 1 – Sep 30	350	210	145	140	*20.826*	*8.331*	*0.000*
Oct 1 – Oct 31	350	160	195	190	*21.521*	*11.683*	*0.000*
Nov 1 – Nov 6	551	130	426	421	*6.555*	*5.008*	*1.776*
Nov 7 – Nov 10	551	130	426	421	*4.370*	*3.338*	*1.184*
Nov 11 – Nov 30	425	120	310	305	*16.844*	*12.084*	*-2.960*
Dec 1 – Dec 31	350	120	235	230	*21.521*	*14.142*	*0.000*
Jan 1 – Jan 31	350	100	255	250	*21.521*	*15.372*	*0.000*
Feb 1 – Feb 28	350	100	255	250	*19.438*	*13.884*	*0.000*
				Totals	***300.298***	***183.353***	***54.098***

[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 February 1, 2022, through February 28, 2023 (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 116.945 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 (TAF)</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">94.066</td><td>–</td><td>–</td></tr>
<tr><td>Mar 1 – Apr 30</td><td>16.919</td><td>25.428</td><td>–</td><td>–</td></tr>
<tr><td>May 1 – May 28</td><td>10.552</td><td>8.886</td><td rowspan="2">0</td><td>–</td></tr>
<tr><td>May 29 – Jul 29</td><td>25.666</td><td>17.375</td><td>–</td><td>–</td></tr>
<tr><td>Jul 30 – Aug 31</td><td>15.055</td><td>7.855</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Sep 1 – Sep 30</td><td>12.496</td><td>8.331</td><td>–</td><td>–</td><td rowspan="3">6.942</td></tr>
<tr><td>Oct 1 – Nov 30</td><td>17.177</td><td>25.175</td><td>–</td><td>–</td></tr>
<tr><td>Dec 1 – Dec 31</td><td>7.379</td><td>14.142</td><td>–</td><td>–</td></tr>
<tr><td>Jan 1 – Feb 28</td><td>11.702</td><td>29.256</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="3"></td><td rowspan="2">116.945 [13]</td><td>136.443</td><td>94.066</td><td>0</td><td>6.942</td></tr>
<tr><td colspan="4">237.451 (Base Flow Volume)</td></tr>
<tr><td colspan="5">354.396 (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 released 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 has the option on the return of URF exchanges in 2022 (Table 9).

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

<table>
<tr><th colspan="2">Flow Account</th><th>Yearly Allocation (TAF)</th><th>Released to Date [15] (TAF)</th><th>Remaining Flow Volume (TAF)</th></tr>
<tr><td rowspan="4">Base Flows</td><td>Continuity Flow Account (Mar 1 — Feb 28)</td><td>136.443</td><td>10.472</td><td>125.971</td></tr>
<tr><td>Spring Flexible Flows (Feb 1 – May 28)</td><td>94.066</td><td>14.174</td><td>79.892</td></tr>
<tr><td>Riparian Recruitment Flows (May 1 — Jul 29)</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Fall Flexible Flows (Sep 3 – Dec 28)</td><td>6.942</td><td>0</td><td>6.942</td></tr>
<tr><td colspan="2">Buffer Flows</td><td>—</td><td>0</td><td>—</td></tr>
<tr><td colspan="2">Unreleased Restoration Flows (Sales and Exchanges)</td><td>—</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">Unreleased Restoration Flows (Returned Exchanges)</td><td>—</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">Purchased Water</td><td>—</td><td>0</td><td>0</td></tr>
<tr><td colspan="3">**Totals:**</td><td>**24.646**</td><td>**212.805**</td></tr>
</table>

[15] As of 3/24/2022

Available URF Exchange Returns

Reclamation is in the process of extending and revising three existing Unreleased Restoration Flow exchanges. The available water for return to the Restoration Administrator, incorporating the expected agreement revisions, is shown in Table 9.

Table 9 — Volume available from URF Exchange Returns

Exchange Partner	Period of return [16]	Minimum Required Return (TAF)	Maximum Annual Return (TAF)	Notes
AEWSD	Mar-Sep	3.500	3.500 [16]	Expires in 2024, requiring the use of 3,500 AF for each of the remaining three years
FID	Flexible	0	2.000	Exchange expires in 2023
FID	Mar-Sep	0	3.600	Exchange is reduced by 10% per year
OCID	Mar-Sep	0	Up to 3.000	Return ratio depends upon Class 1 declaration

[16] unless otherwise by mutual agreement

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 10 summarizes known 2022 operational constraints.

Table 10 — Summary of Operational Constraints

Type of Constraint	Period	Flow Limitation
Levee Stability	Currently in effect	1,210 cfs in Reach 2B
	Currently in effect	2,600 cfs in Eastside Bypass
	Currently in effect	2,350 cfs in Reach 5
Channel Conveyance / Seepage Limitation	Currently in effect, see latest Flow Bench Evaluation for precise values	Reach 2A: Approx. 600 cfs @ GRF
		Reach 3: Approx. 850 cfs @ MEN
		Reach 4A: Approx. 300 cfs @ SDP
USFWS Biological Opinion	Until consultation for “Phase 2”	1,660 cfs of Restoration Flows through Eastside Bypass

The 2022 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 2022 Restoration Year Channel Capacity Report also identifies a maximum flow in the Middle Eastside Bypass of 2,600 cfs, which has increased from the 2021 Channel Capacity Report value of 1,070 cfs due to the completion of the Reach O levee improvements project and the removal of two weirs within the Eastside Bypass.

A flow bench evaluation conducted on March 25, 2022 focusing on the reaches above Mendota Pool identified a seepage limitation of approximately 600 cfs in Reach 2A. This is lower than the previous estimate of 800-820 cfs. Earlier flow bench evaluations were conducted on December 28, 2021 and again on January 7, 2022 focusing on Reach 4A. These two analyses indicated that flows of up to 300 cfs could be passed through Reach 4A without reaching seepage limitations. SJRRP Seepage Management Plan (SMP)[1] thresholds are not based on flow rates, they constrain the depth to groundwater in fields adjacent to the river, so actual flow limitations will vary and may be slightly higher or lower based on current groundwater conditions.

Releases from Friant Dam to meet the Exchange Contract are planned to be released from Friant Dam as early as April 1 and will reduce the available channel capacity for Restoration Flows in the reaches above Mendota Pool. During these Exchange Contractors releases, the SJRRP will operate such that the combined flow does not exceed SJRRP SMP thresholds while Restoration Flows are present in the channel. However, Exchange Contractor flows are not subject to the thresholds of the SJRRP SMP. When the combined release reaches a SMP threshold the SJRRP will follow the protocol defined in the SMP to evaluate response actions. SJRRP will work with the Restoration Administrator if a flow response is determined necessary to implement changes to the Restoration Flow schedule or otherwise reduce flows to comply with SMP thresholds. If Exchange Contractors flows exceed the SJRRP SMP thresholds, then Restoration Flows will cede the channel capacity and will not be released.

If Restoration Flows are combined with releases to meet the Exchange Contract, Restoration Flows will be accounted for using the schedule at Gravelly Ford. Restoration Flows will assume Exhibit B losses from Gravelly Ford to Mendota Pool; any remaining flow at Gravelly Ford or SJR Below Bifurcation gauges will be assumed to be Exchange Contractor Flows.

While this guidance is applicable to this water year, the SJRRP is investigating aspects of co-releasing Restoration Flows and other waters, and future guidance may supersede this current interpretation.

Reclamation will inform the Restoration Administrator of any changes to groundwater conditions that are likely to result in a reduction or increase in allowable 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. Reclamation will work with the Restoration Administrator to provide the best estimates of the Exchange Contractor releases to inform when available channel capacity changes.

[1] Seepage Projects – San Joaquin River Restoration Program (restoresjr.net)

2022 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 with the Guidelines. Table 11 summarizes the Allocation History for this Restoration Year.

Table 11 — Allocation History

Allocation Type	Issue Date	Forecast Blending Applied	Unimpaired Runoff Forecast (at forecast exceedance)	Year Type	Restoration Allocation at Gravelly Ford	Restoration Flows and URFs Released
Initial	January 13, 2022	30/70	1,678 TAF (@ 75%)	Normal-Wet	315.297 TAF	0 (thru 1/12/2022)
Update	February 18, 2022	40/60 w/ offsets	1,235 TAF (@ 75%)	Normal-Dry	254.413 TAF	0 (thru 2/17/2022)
Update	March 20, 2022	50/50 w/ offsets	1,105 TAF (@ 75%)	Normal-Dry	236.913 TAF	21.612 (thru 3/18/2022)
Update	March 25, 2022	40/60	1,109 TAF (@ 75%)	Normal-Dry	237.451 TAF	24.646 (thru 3/24/2022)

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
SMP	Seepage Management Plan
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 (2021) Flow Accounting

Table B — Restoration Flow Accounting and Unreleased Restoration Flows, and Holding Contracts, for the period February 2021 through February 2022. Flood management releases to San Joaquin River did not occur during this period. The final Restoration Allocation was 70.919 TAF. Additionally, Unreleased Restoration Flow exchange returns of 10.435 TAF were released, plus 0.902 TAF of Buffer Flows. The Restoration Allocation was expended with 0.000 TAF ending balance by transitioning from 2021 Allocation to 2022 Allocation midday on February 18, 2022.

<table>
<tr><th rowspan="2"></th><th rowspan="2"></th><th rowspan="2"></th><th colspan="7"></th></tr>
<tr><th></th><th></th><th></th><th></th><th></th><th></th><th></th></tr>
<tr><td>Feb 1 – Feb 28</td><td>–</td><td></td><td>–</td><td>0</td><td>–</td><td>–</td><td>–</td><td>–</td><td></td></tr>
<tr><td>Mar 1 – Mar 31</td><td>10.076</td><td></td><td>1.379</td><td>0</td><td>–</td><td>–</td><td>0</td><td>–</td><td>4.612</td></tr>
<tr><td>Apr 1 – Apr 30</td><td>12.922</td><td></td><td>0.986</td><td>0</td><td>–</td><td>–</td><td>0</td><td>–</td><td>5.813</td></tr>
<tr><td>May 1 – May 31</td><td>15.201</td><td></td><td>1.537</td><td>5.800[1]</td><td>–</td><td rowspan="4">0</td><td>0.783</td><td rowspan="5">0</td><td></td></tr>
<tr><td>Jun 1 – Jun 30</td><td>13.172</td><td></td><td>1.067</td><td>–</td><td>–</td><td>0.119</td><td></td></tr>
<tr><td>Jul 1 – Jul 31</td><td>16.322</td><td></td><td>0</td><td>–</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Aug 1 – Aug 31</td><td>16.701</td><td></td><td>0</td><td>–</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Sep 1 – Sep 30</td><td>14.957</td><td></td><td>0</td><td>–</td><td>0</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Oct 1 – Oct 31</td><td>13.743</td><td></td><td>0.724</td><td>–</td><td>0</td><td>–</td><td>0</td><td rowspan="3">0</td><td></td></tr>
<tr><td>Nov 1 – Nov 30</td><td>13.738</td><td></td><td>2.878</td><td>–</td><td>0</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Dec 1 – Dec 31</td><td>17.213</td><td></td><td>21.299</td><td>–</td><td>0.595</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Jan 1 – Jan 31</td><td>12.182</td><td></td><td>26.243</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td></td></tr>
<tr><td>Feb 1 – Feb 28</td><td>14.529</td><td></td><td>8.412</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td></td></tr>
<tr><td rowspan="5"></td><td rowspan="5">170.757</td><td rowspan="4">0</td><td>64.525</td><td>5.800</td><td>0.595</td><td>0</td><td>0.902</td><td>0</td><td rowspan="3">10.425</td></tr>
<tr><td colspan="4">70.919 (allocated Restoration Flows)</td><td colspan="2">0.902 (all Buffer Flows)</td></tr>
<tr><td colspan="6">71.822 (Restoration Flows affecting Friant water supply)</td></tr>
<tr><td colspan="7">82.247 (Restoration Flows released to river)</td></tr>
<tr><td colspan="5">70.919 (Restoration Allocation used)</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td></td><td colspan="7">253.004 (Friant Dam releases — excludes disposed URFs)</td></tr>
</table>

[1] On May 28, 35.159 TAF of the Spring Flexible Flow account was transferred into the Continuity Flow Account, passing a Water Supply Test, and released in October through February

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]
1901	3,227.9	Wet
1902	1,704.0	Normal-Wet
1903	1,727.0	Normal-Wet
1904	2,062.0	Normal-Wet
1905	1,795.4	Normal-Wet
1906	4,367.8	Wet
1907	3,113.9	Wet
1908	1,163.4	Normal-Dry
1909	2,900.7	Wet
1910	2,041.5	Normal-Wet
1911	3,586.0	Wet
1912	1,043.9	Normal-Dry
1913	879.4	Dry
1914	2,883.4	Wet
1915	1,966.3	Normal-Wet
1916	2,760.5	Wet
1917	1,936.2	Normal-Wet
1918	1,466.8	Normal-Wet
1919	1,297.5	Normal-Dry
1920	1,322.5	Normal-Dry
1921	1,604.4	Normal-Wet
1922	2,355.1	Normal-Wet
1923	1,654.3	Normal-Wet
1924	444.1	Critical-High
1925	1,438.7	Normal-Dry
1926	1,161.4	Normal-Dry
1927	2,001.3	Normal-Wet
1928	1,153.7	Normal-Dry
1929	862.4	Dry
1930	859.1	Dry
1931	480.2	Critical-High
1932	2,047.4	Normal-Wet
1933	1,111.4	Normal-Dry
1934	691.5	Dry
1935	1,923.2	Normal-Wet
1936	1,853.3	Normal-Wet
1937	2,208.0	Normal-Wet
1938	3,688.4	Wet
1939	920.8	Dry
1940	1,880.6	Normal-Wet
1941	2,652.5	Wet
1942	2,254.0	Normal-Wet
1943	2,053.7	Normal-Wet
1944	1,265.4	Normal-Dry
1945	2,134.633	Normal-Wet
1946	1,727.115	Normal-Wet
1947	1,121.564	Normal-Dry
1948	1,201.390	Normal-Dry
1949	1,167.008	Normal-Dry
1950	1,317.457	Normal-Dry
1951	1,827.254	Normal-Wet
1952	2,840.854	Wet
1953	1,226.830	Normal-Dry
1954	1,313.993	Normal-Dry
1955	1,161.161	Normal-Dry
1956	2,959.812	Wet
1957	1,326.573	Normal-Dry
1958	2,631.392	Wet
1959	949.456	Normal-Dry
1960	826.021	Dry
1961	647.428	Critical-High
1962	1,924.066	Normal-Wet
1963	1,945.266	Normal-Wet
1964	922.351	Dry
1965	2,271.191	Normal-Wet
1966	1,298.792	Normal-Dry
1967	3,233.097	Wet
1968	861.894	Dry
1969	4,040.864	Wet
1970	1,445.837	Normal-Dry
1971	1,416.812	Normal-Dry
1972	1,039.249	Normal-Dry
1973	2,047.585	Normal-Wet
1974	2,190.308	Normal-Wet
1975	1,795.922	Normal-Wet
1976	629.234	Critical-High
1977	361.253	Critical-Low
1978	3,402.805	Wet
1979	1,829.988	Normal-Wet
1980	2,973.169	Wet
1981	1,067.757	Normal-Dry
1982	3,317.171	Wet
1983	4,643.090	Wet
1984	2,042.750	Normal-Wet
1985	1,135.975	Normal-Dry
1986	3,031.600	Wet
1987	756.853	Dry
1988	862.124	Dry
1989	939.168	Normal-Dry
1990	742.824	Dry
1991	1,027.209	Normal-Dry
1992	807.759	Dry
1993	2,672.322	Wet
1994	824.097	Dry
1995	3,876.370	Wet
1996	2,200.707	Normal-Wet
1997	2,817.670	Wet
1998	3,160.759	Wet
1999	1,527.040	Normal-Wet
2000	1,735.653	Normal-Wet
2001	1,065.318	Normal-Dry
2002	1,171.457	Normal-Dry
2003	1,449.954	Normal-Dry
2004	1,130.823	Normal-Dry
2005	2,826.872	Wet
2006	3,180.816	Wet
2007	684.333	Dry
2008	1,116.790	Normal-Dry
2009	1,455.379	Normal-Wet
2010	2,028.706	Normal-Wet
2011	3,304.824	Wet
2012	831.582	Dry
2013	856.626	Dry
2014	509.579	Critical-High
2015	327.410	Critical-Low
2016	1,300.986	Normal-Dry
2017	4,395.400	Wet
2018	1,348.979	Normal-Dry
2019	2,734.772	Wet
2020	886.025	Dry
2021	521.853	Critical-High

[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 Runoff 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 Runoff 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)	Unimpaired Runoff Forecast Error	Allocation Error
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	521.853	+7.147	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 May (or June under dry hydrologic conditions).