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Updated 2018 Restoration Allocation & Default Flow Schedule

February 16, 2018

Introduction

The following transmits the updated 2018 Restoration Allocation and Default Flow Schedule to the Restoration Administrator for the San Joaquin River Restoration Program (SJRRP), consistent with the Restoration Flows Guidelines (version 2.0, February 2017). 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," and is utilized to identify the Water Year Type.
- Hydrograph Volumes: the annual allocation hydrograph based on water year unimpaired inflow, utilizing the Method 3.1 with the Gamma Pathway (RFG-Appendix C, Figure C-3) 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 Unimpaired Inflow forecast.
- Unreleased Restoration Flows: the amount of Restoration Flows not released due to channel capacity constraints and 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 Flexible Flow Volume: the volume of Restoration Flows released and the remaining volume available for flexible scheduling.
- 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 Restoration Flow Guidelines (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 recommend both an unconstrained and a capacity limited recommendation. If an unconstrained recommendation and a capacity limited recommendation are not provided by the Restoration Administrator, the Default Flow Schedule without constraints (Table 5a) and the Default Flow Schedule with constraints (Table 5b) will be used respectively.

Forecasted Unimpaired Inflow

Unimpaired Inflow 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. It is calculated for the period of a Water Year. The forecast of the Unimpaired Inflow determines the volume of Restoration Flows available for the Restoration Year (i.e. the Restoration Allocation). Information for forecasting the Unimpaired Inflow primarily includes:

- Reclamation estimate of Unimpaired Inflow (i.e. Natural River) 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].

Table 1 shows the water year 2018 (October 1, 2017 to September 30, 2018) observed accumulated and forecasted water year Unimpaired Inflows at Millerton Lake. This includes the published DWR forecast, the DWR forecast adjusted for expected runoff for the current month, and the NWS forecast with and without a 7-day smoothing function applied to remove the day-to-day variance, and finally the NWS forecast with 7-day smoothing and adjusted for expected runoff for the current month. 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

	Forecast Exceedance Percentile				
	90%	**75**%	**50**%	**25**%	**10**%
Accumulated "Full Natural" Unimpaired Inflow, February 14, 2018 [1]	148.4 TAF				
Accumulated Unimpaired Inflow as percent of normal	56%				
Total Unimpaired Inflow projected to end of water year [2]	N/A				
DWR, February 15, 2018 [3] (Published Value)	640 TAF	800 TAF [7]	985 TAF	1,030 TAF [7]	1,085 TAF
DWR, February 15, 2018 [4] (Runoff Adjusted)	644 TAF	799 TAF [7]	935 TAF	971 TAF [7]	1,020 TAF
NWS, February 15, 2018 (Published Daily Value [5])	489 TAF	578 TAF	718 TAF	1,100 TAF	1,560 TAF
Smoothed NWS, February 15, 2018 (7-day Smoothing [6])	473 TAF	555 TAF	697 TAF	1,074 TAF	1,557 TAF
Smoothed NWS, February 15, 2018 (Runoff Adjusted [4])	474 TAF	556 TAF	697 TAF	1,070 TAF	1,549 TAF

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

[2] Projected value only presented from May through September; based on USBR-SCCAO runoff regression method

[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.2017

[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] http://www.cnrfc.noaa.gov/water_resources_update.php?stn_id=FRAC1&stn_id2=FRAC1&product=WaterYear

[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 us 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] These are interpolated values as the complete DWR forecast was not available at the time of issuance.

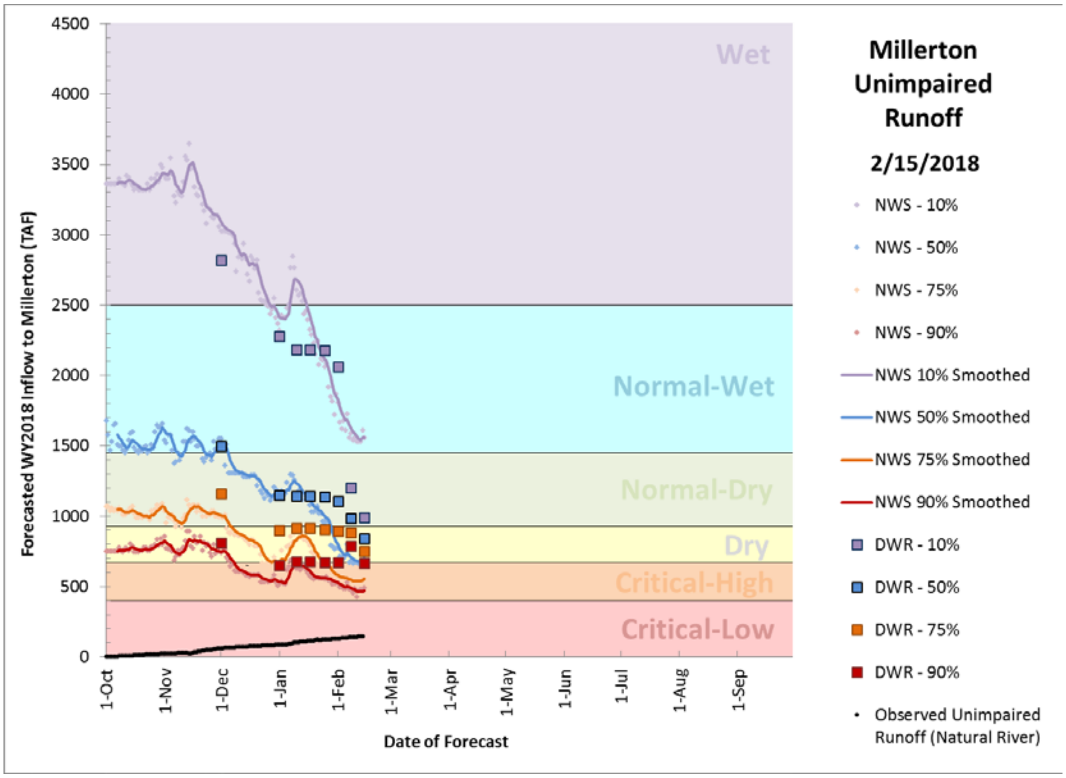

Figure 1a — Plot of 2018 Water Year forecasts, including both NWS Ensemble Streamflow Prediction Forecasts and DWR Forecasts

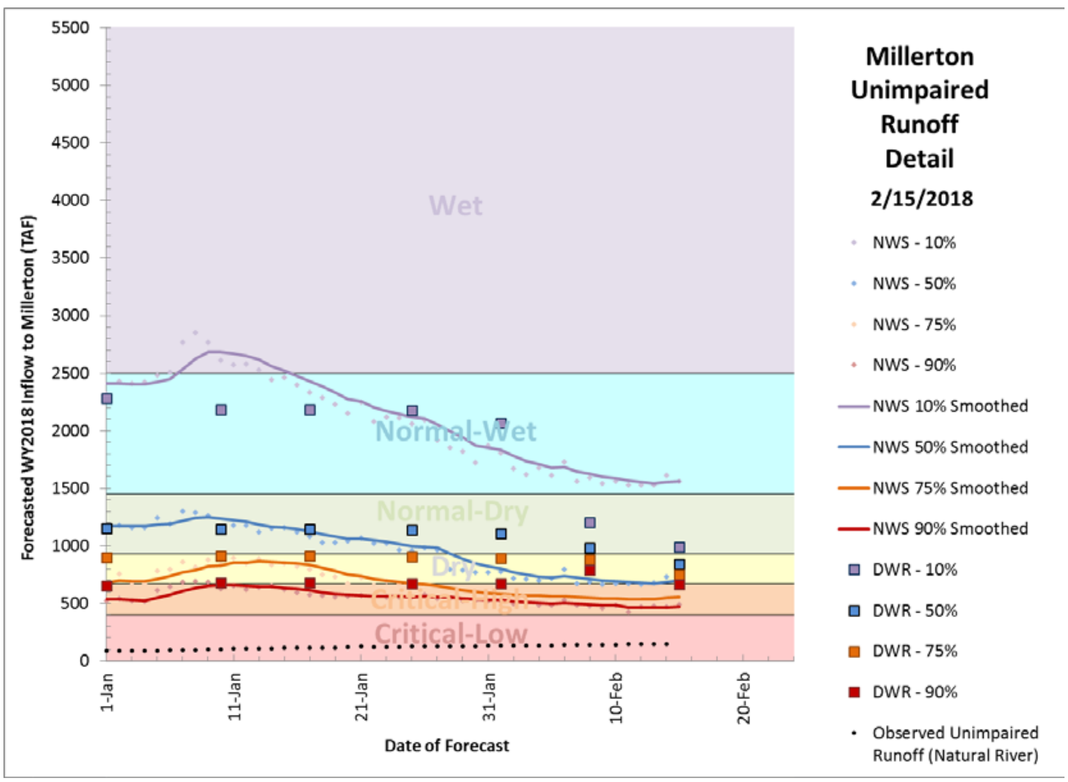

Figure 1b — Detail plot of most recent forecasts

Currently, there are substantial uncertainties in the volume of snowpack in the San Joaquin watershed and uncertainty regarding whether the remaining months of spring will return to a wetter weather pattern. Storms in late January did not deliver the precipitation to the San Joaquin Watershed that was forecasted, and so far February is markedly warmer and drier than normal. Freezing levels during precipitation events have been notably higher than average, resulting in much more rain than snow at mid-elevations. There is also substantial disagreement between the two primary runoff forecasts — The DWR B120 and the NWS ESP — that are used to set the Restoration Allocation. The spread between the two forecasts is higher than what is normally expected at this time of year. Uncharacteristically, the DWR forecast predicts a higher runoff than the NWS forecast. DWR is implementing a new technique in 2018 to set the 90% and 10% forecasts, which may explain why the February 1 DWR 90% is approximately 300 TAF above the NWS 90%. The February 15 update of the DWR brought these more in line with the NWS forecast, with a 150 TAF discrepancy. The discrepancy of the current 50% forecasts is still nearly 300 TAF, the root cause of which is unknown.

Combining Forecasts

Staff from the South-Central California Area Office of Reclamation and SJRRP jointly track and evaluate the accuracy of runoff forecasts. 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 professional judgment and the best available information. For the current allocation, the DWR "runoff adjusted" and NWS "smoothed runoff adjusted" forecasts are combined with a 30/70 blending respectively. This results in the Hybrid Unimpaired Inflow Forecasts shown in Table 2.

Table 2 — Current Blending and Hybrid Unimpaired Inflow Forecast

	Forecast Probability of Exceedance using blending				
	90%	**75**%	**50**%	**25**%	**10**%
Blending Ratio	30/70				
Hybrid Unimpaired Inflow Forecast (TAF)	525	629	768	1,041	1,391

This 30/70 blending is chosen based on the historic performance of the DWR and NWS forecasts at this time of the year, the accuracy of these forecasts in predicting monthly runoff over the recent months, the overall climate outlook for the remaining wet season, and other forecast performance factors. Snowpack modeling from USDA Agricultural Research Service using the ISNOBAL model was available and indicated an existing snowpack of 163 TAF of snow water equivalent, which would indicate that a high exceedance percentage is more likely than indicated by DWR and NWS. Similarly, a satellite-derived snowpack product from University of Colorado, Boulder, indicates a snow water equivalent volume of 191 TAF. Both of these models, which are experimental and unproven, indicate a 90% forecast of between 380 TAF and 550 TAF across a range of runoff ratio assumptions and 1-2”of precipitation across the remainder of the water year. The ARS model has not yet been adjusted to compensate for snow monitoring stations that are known to be underreporting snow or performing poorly, so the 163 TAF snowpack snow water equivalent is thought to be an underestimate.

A LIDAR survey of the watershed by the NASA Airborne Snow Observatory is planned for March 1, which should substantially improve our understanding of the snowpack volume and its distribution across different elevations. This valuable science is funded by Friant Water Authority and South Valley Water Association, in cooperation with Reclamation and DWR.

Snow course and snow pillow measurements indicate that there may be relatively more snow at the highest elevations, as shown in Figure 2 which compares 2018 with 2015. This snow course data in Figure 2 was collected between January 23 and February 1. The recent warm temperatures have likely melted much of the snow at lower elevations. There is very little snowpack, if any, remaining below 8,500’ elevation. However, the trend toward more snow at higher elevations may result in more snowpack than modeled by the NWS forecast. There are few continuous monitoring stations at high elevations so this snow may be undersampled by models. For this reason, staff at SCCAO and SJRRP believe that the 350 TAF – 500 TAF indicated by the ARS and Colorado models using conservative future precipitation assumptions, and the 473 TAF at the NWS 90% forecast are somewhat low.

We also have a lower confidence in the DWR forecast given its new technique for setting the 90% and 10% exceedances, and the performance of the DWR forecast over the last 45 days in predicting runoff, and the drier than normal conditions forecasted by the long-range weather models through the end of February. We suspect that the March 1 update of the DWR B120 will be reduced substantially.

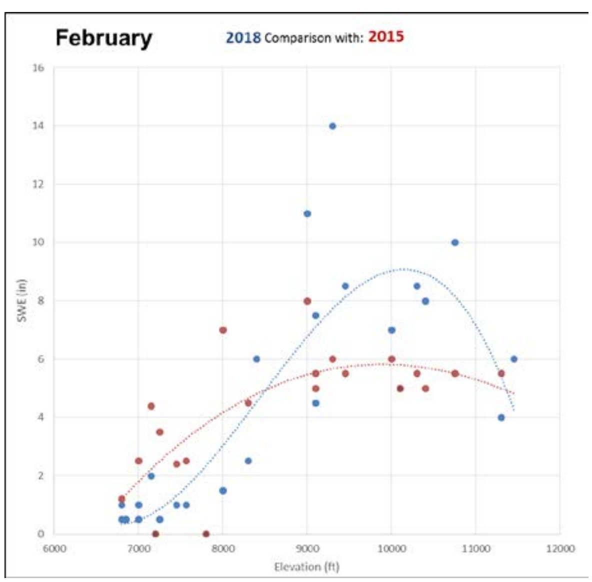

Figure 2 — Comparison of snow course measures in the San Joaquin Watershed plotting snow water equivalent against elevation (2018 in blue, 2015 in red)

With approximately 1/3rd of the normal precipitation by volume remaining in the water year, it is unlikely that future precipitation will bring current conditions up to normal. Snowpack conditions appear slightly wetter than at the same time during 2015, which was a Critical-Low year type, however, soil moisture conditions in the San Joaquin watershed are clearly wetter than in 2015 which was after a period of extended drought. Seasonal climate models indicate March and April will have near-normal precipitation, so we are less likely to have near-zero precipitation in those months as was experienced in 2015. At present, we cannot rule out that 2018 will be a Critical-Low water year type, however the likelihood is very small (less than 2% chance based on available information).

The wet antecedent conditions and persistent base flow runoff is evident in Figure 3, which traces the observed runoff and compares it to the expected runoff at the 90% exceedance hybrid forecast. As one can see from the plot, observed runoff is tracking above the scaled forecast used to set the Restoration Allocation due to the antecedent moisture.

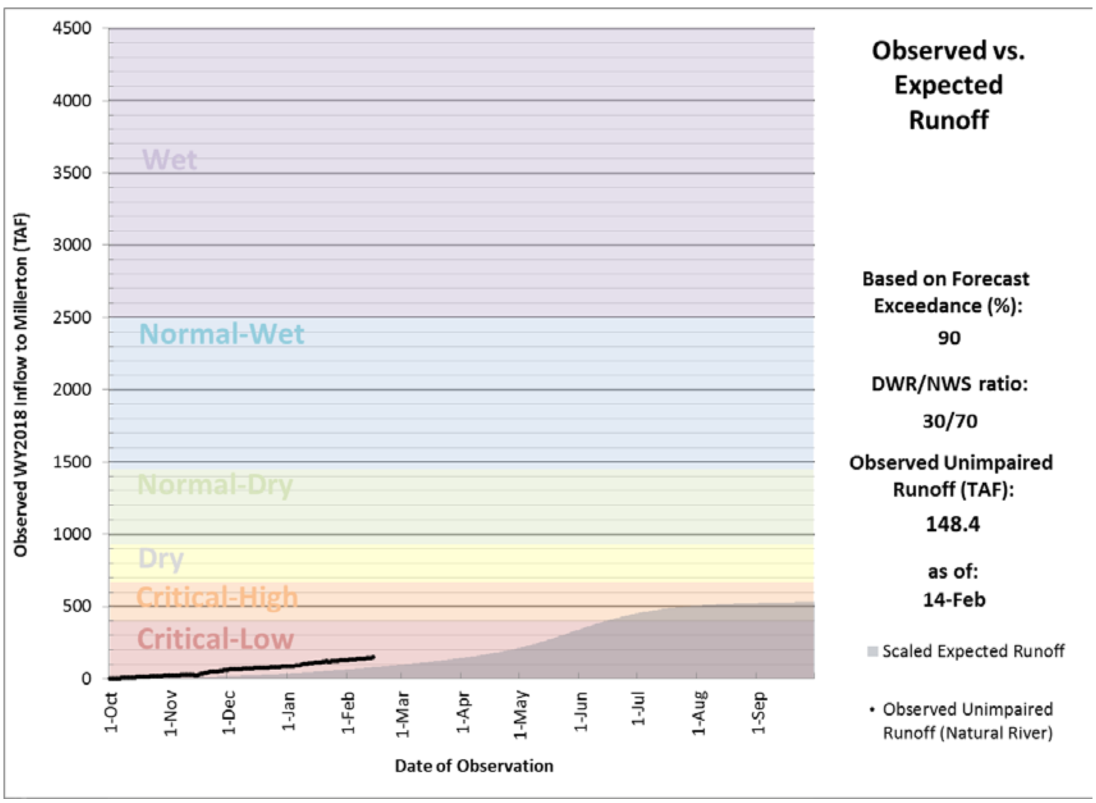

Figure 3 — Observed Unimpaired Inflow trace shown with 30-year average Unimpaired Inflow curve scaled to the current hybrid forecast value

Restoration Allocation

As per the current Guidelines, the 90% exceedance forecast is used for the allocation under current hydrologic conditions to set the Restoration Flow Allocation. Table 3 below, from the Guidelines version 2.0, depicts the progression of forecast exceedance used to set the Restoration Allocation.

Table 3 — Guidance on Percent Exceedance Forecast to Use for Allocation

		Date of Allocation Issuance					
	Value (TAF)	**January**	**February**	**March**	**April**	**May**	**June**
If the 50% forecast is:	Above 2200	50	50	50	50	50	50
	1100 to 2200	75	75	50	50	50	50
	900 to 1099	75	75	75	50	50	50
	700 to 899	90	90	75	50	50	50
	500 to 699	90	90	75	50	50	50
	Below 500	90	90	90	90	75	50

Applying the 30/70 forecast blending determined by Reclamation, and using the 90% exceedance forecast dictated by the Guidelines, Reclamation calculates an **Unimpaired Inflow hybrid forecast of 525 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**. Future updates to these forecasts and their blending will alter the Restoration Allocation multiple times before it is finalized at the end of June. Other hypothetical allocations are presented in Table 4 as grayed values, and indicate the range of probable forecasts and the resultant Restoration Allocation.

Table 4 — SJRRP Water Year Type and Allocation for 2018 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)	**525**	629	768	1,041	1,391
Water Year Type	**Critical-High**	Critical-High	Dry	Normal-Dry	Normal-Dry
Restoration Allocation at GRF (TAF)	**70.919**	70.919	177.204	228.297	275.413
Friant Dam Flow Releases (TAF)	**187.785**	187.785	294.149	345.242	392.358

Reclamation will issue updates to the Restoration Allocation based on changing hydrology as needed through the coming months and will finalize the allocation based on the hydrologic conditions present on June 30th. Thus the Restoration Allocation may increase or decrease, potentially substantially, over this period of time.

Default Flow Schedule

The Default Flow Schedule, known as 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 derived 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 Hydrograph

Table 5a shows the Exhibit B Method 3.1 default hydrograph flows and corresponding Restoration Allocation volumes for the entire year absent channel capacity constraints, including total releases from Friant Dam and Restoration Flows releases in excess of Holding Contracts.

Table 5b shows the Exhibit B Method 3.1 default hydrograph volumes with operational constraints, primarily controlled by a 1,210 cfs channel constraint in Reach 2B. This default hydrograph depicted in Table 5b will be implemented in the absence of a specific recommendation by the Restoration Administrator. Due to levee stability related channel capacity constraints in Reach 2B that constrain Friant Dam releases, a Restoration Flow volume of **0 TAF** is generated that is not scheduled in the constrained Default Flow Schedule and would become Unreleased Restoration Flows (URFs) under the default hydrograph. This is an estimated volume of water, actual URF volumes will depend on the Restoration Administrator Recommendation and real-time assessment of groundwater seepage channel constraints.

Table 5a — Default Hydrograph

Flow Period	Flow (cfs)				Volume (TAF)	
	Friant Dam Release	Holding Contracts[8]	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 – Jun 30 [9]	215	190	30	25	26.013	3.025
Jul 1 – Aug 31	255	230	30	25	31.359	3.074
Sep 1 – Sep 30	260	210	55	50	15.471	2.975
Oct 1 – Oct 31	160	160	5	0	9.838	0
Nov 1 – Nov 6	400	130	275	270	4.760	3.213
Nov 7 – Nov 10	120	120	5	0	0.952	0
Nov 11 – Dec 31	120	120	5	0	12.139	0
Jan 1 – Feb 28	110	100	15	10	12.873	1.170
				Totals	**187.785**	**70.919**

Table 5b — Default Hydrograph with Channel Constraints

Flow Period	Flow (cfs)				Volume (TAF)		
	Friant Dam Release	Holding Contracts [7]	Flow Target at GRF	Restoration Flow at GRF	Friant Dam Release	Restoration Flow at GRF	URF [8]
Mar 1 – Mar 15	500	130	375	370	14.876	11.008	0
Mar 16 – Mar 31	1500	130	1375	1370	47.603	43.478	0
Apr 1 – Apr 15	200	150	55	50	5.950	1.488	0
Apr 16 – Apr 30	200	150	55	50	5.950	1.488	0
May 1 – Jun 30 [9]	215	190	30	25	26.013	3.025	0
Jul 1 – Aug 31	255	230	30	25	31.359	3.074	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	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	0
Nov 11 – Dec 31	120	120	5	0	12.139	0	0
Jan 1 – Feb 28	110	100	15	10	12.873	1.170	0
				Totals	**187.785**	**70.919**	**0** [8]

[7] 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.

[8] This estimate of URF volume is based solely on Reach 2B channel capacity. Other flow and seepage constraints throughout the restoration area may result in higher actual URFs and is dependent on the Restoration Administrator's recommendation.

[9] Riparian Recruitment releases in Wet Water Year Types are included in the May 1 – June 30 flow period

Exhibit B Restoration Flow Budget

Table 6 shows the components of the restoration budget for March 1, 2018, through February 28, 2019 (i.e. the Restoration Year). The base flow allocation, spring flexible flow, fall flexible flow, and riparian recruitment flow reflect the Exhibit B hydrograph for the Restoration Allocation. The estimated total release at Friant Dam consists of 116,867 acre-feet release for Holding Contracts in addition to the Restoration Flows as measured at Gravelly Ford (GRF). The volume for Restoration Flows as well as various accounting flow components may change with any subsequent Restoration Allocation.

Table 6 — Restoration Budget with Flow Accounts

Flow Period	Holding Contract Demand [10] (TAF)	Restoration Flow Accounting Volumes (TAF)						
		Spring Flexible Flow	Summer Base Flow	Fall Flexible Flow	Winter Base Flow	Riparian Recruit-ment Flow	Buffer Flow	Flexible Buffer Flow
Mar 1 – Mar 15	3.868	11.008	–	–	–	-–	1.488	–
Mar 16 – Mar 31	4.126	43.478	–	–	–	–	4.760	–
Apr 1 – Apr 15	4.463	1.488	–	–	–	–	0.595	–
Apr 16 – Apr 30	4.463	1.488	–	–	–	–	0.595	–
May 1 – May 28	10.552	0	1.388	–	–	0 within 60-90 days of flushing flow	2.601	Of which 3.642 may be applied Mar 1–May 1, or Oct 1–Nov 30
May 29 – Jun 30	12.436	–	1.637	–	–			
Jul 1 – Aug 31	28.284	–	3.074	–	–		3.136	
Sep 1 – Sep 30	12.496	–	2.975	0	–	–	1.547	
Oct 1 – Oct 31	9.838	–	–	0	–	–	0.984	Of which 2.769 may be applied Sep 3–Dec 28
Nov 1 – Nov 6	1.547	–	–	3.213	–	–	0.476	
Nov 7 – Nov 10	0.952	–	–	0	–	–	0.095	
Nov 11 – Nov 30	4.760	–	–	0	–	–	0.476	
Dec 1 – Dec 31	7.379	–	–	0	0	–	0.738	
Jan 1 – Jan 31	6.149	–	–		0.615	–	0.676	–
Feb 1 – Feb 28	5.554	0	–	–	0.555	–	0.611	–
	116.867 [10]	**57.462**	**9.074**	**3.213**	**1.170**	**0**	**18.779**	
		70.919 (Restoration Flow Volume)						
	187.785 [10] (Friant Dam Release Volume)							

[10] In recent years, Holding Contract demands have been higher than assumed under Exhibit B of the Settlement, in which case, flows at Friant Dam are increased to achieve the Gravelly Ford Flow Target, and associated Friant Dam Release Volume is greater.

Remaining Flexible Flow Volume

The amount of water remaining for flexible flow scheduling is the volume of flexible flow water released from Friant Dam in excess of releases required to meet Holding Contract demands, less past releases. Table 7 tracks these balances. The released to date volumes are derived from QA/QC daily average data when available, and partly from provisional data posted to CDEC, and thus may have future adjustments. This may affect the remaining flow volume as well.

Table 7 — Estimated Flexible Flow Volume Remaining and Released to Date

Flow Account	Yearly Allocation [11] (TAF)	Released to Date [12] (TAF)	Remaining Flow Volume [12,13] (TAF)
Spring Period (Mar 1 – Apr 30)	57.462	0	57.462
Riparian Recruitment	0	0	0
Summer Base Flows (May 1 – Sep 30)	9.074	0	9.074
Fall Period (Oct 1 – Nov 30)	3.213	0	3.213
Winter Base Flows (Dec 1 – Feb 28)	1.170	0	1.170
Buffer Flows	18.779	0	18.779
Unreleased Restoration Flows	—	0	0
Purchased Water	—	0	0
	Total:	**0**	

[11] These Flow Volumes assume no channel constraints, as measured at Gravelly Ford

[12] As of 2/15/2018.

[13] Restoration Flow Guidelines limit the application of the calculated Remaining Flow Volume to certain times, and thus all of this volume may not be available for use.

[14] This volume of Restoration Flows was met by flood flows

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 8 summarizes known 2018 operational constraints.

Table 8 — Summary of Operational Constraints

Constraint	Period	Flow Limitation
Levee Stability	Currently in effect	1,210 cfs in Reach 2B
	Currently in effect	580 – 1,070 cfs in Eastside Bypass
Channel Conveyance / Seepage Limitation	Currently in effect	Approximately 300 cfs below Sack Dam / Reach 4A

The 2018 Restoration Year Channel Capacity Report identifies a maximum flow in Reach 2B of 1,210 cfs. This results in a maximum release from Friant Dam between 1,390 cfs and 1,550 cfs depending on the time of year. The 2018 Restoration Year Channel Capacity Report also identifies a maximum flow in the Middle Eastside Bypass of 580 to 1,070 cfs, depending on the configuration of the weirs at the Merced National Wildlife Refuge. Reclamation will coordinate with the Restoration Administrator through the biweekly Flow Scheduling conference calls and on an as-needed basis to update these constraints.

In addition, flows are limited to approximately 300 cfs below Sack Dam into Reach 4A due to groundwater seepage constraints as per the current Seepage Management Plan. The exact flow rate which can be accommodated through Reach 4A is dependent on groundwater levels and will be determined through Flow Bench Evaluations. Flows are expected to be constrained to approximately 300 cfs through the spring period below Sack Dam, with the possibility of approximately 500 cfs below Sack Dam in Spring 2018 if additional seepage easements are obtained. If flows must be reduced at Sack Dam as compared to upstream flow rates, Reclamation will make arrangements to capture excess Restoration Flows at approved points of rediversion such as Mendota Pool, upstream of Sack Dam.

Reclamation will complete a Flow Bench Evaluation prior to any scheduled flow increases at or below Gravelly Ford to verify the scheduled increase is not anticipated to cause groundwater levels to rise above thresholds. Should the requested flow increase trigger projected groundwater level rises above seepage thresholds, Reclamation will inform the Restoration Administrator of the current constraint, and adjust releases accordingly.

2018 Allocation History

The Restoration Allocation will be adjusted, often many times, between the date of the initial allocation and the final allocation, based on the hydrologic conditions. The Restoration Administrator is responsible for contingency planning and managing releases to stay within current and future allocations. As per the Restoration Flow Guidelines, shifts in flows from one period to another (e.g. Spring flows to summer flows) necessitated by changes in the Restoration Allocation are not subject to the Water Supply Test. Table 9 summarizes the Allocation History for this Restoration Year.

Table 9 — Allocation History

Allocation Type	Date	Unimpaired Inflow Forecast (at forecast exceedance)	Restoration Allocation at Gravelly Ford	Restoration Flows and URFs Released
Initial	January 23, 2018	741 TAF (@ 75%)	171.178 TAF	0 (as of 1/23/18)
Updated	February 16, 2018	525 TAF (@ 90%)	70.919 TAF	0 (as of 2/15/18)

The next updated Restoration Allocation is planned for mid-March.

Appendix A: Abbreviations, Acronyms, and Glossary

af	acre–feet
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 Flow Schedules
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
TAF	thousand acre–feet
URF	Unreleased Restoration Flows
WSI	DWR Water Supply Index
WY	water year, October 1 through September 30

Appendix B: History of Millerton Unimpaired Inflow

Table B — Water Year Totals in Thousand Acre-Feet

Water Year [1]	Unimpaired Inflow [2] (Natural River)	SJRRP Water Year Type [3]
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

Water Year [1]	Unimpaired Inflow [2] (Natural River)	SJRRP Water Year Type [3]
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

Water Year [1]	Unimpaired Inflow [2] (Natural River)	SJRRP Water Year Type [3]
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

[1] Water year is from Oct 1 through Sept 30, for example the 2010 water year began Oct 1, 2009.

[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.

[3] The six SJRRP Water Year Types are based on unimpaired inflow. 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 C: Previous Year (2016) Flow Accounting

Table C-1 — Restoration Flow Accounting and Unreleased Restoration Flows excluding Restoration Flows met by flood flows, Unreleased Restoration Flows lost to flood spill, and Holding Contracts during flood flows. For the period February, 2016 through February, 2017.

<table>
<tr><th rowspan="2">Flow Period</th><th rowspan="2">Holding Contract Demand (TAF)</th><th colspan="7">Released Restoration Flow Volumes (TAF)</th><th rowspan="2">URFs (TAF)</th></tr>
<tr><th>Spring Flexible Flow</th><th>Summer Base Flow</th><th>Fall Flexible Flow</th><th>Winter Base Flow</th><th>Riparian Recruit-ment Flow</th><th>Buffer Flow</th><th>Flexible Buffer Flow</th></tr>
<tr><td>Feb 1 – Feb 15</td><td>–</td><td>0</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Feb16 – Feb 29</td><td>5.939</td><td>1.835</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Mar 1 – Mar 15</td><td>1.607</td><td>2.521</td><td>–</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td>Mar 16 – Mar 31</td><td>3.735</td><td>2.541</td><td>–</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td>Apr 1 – Apr 15</td><td>4.852</td><td>3.834</td><td>–</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td>Apr 16 – Apr 30</td><td>6.488</td><td>2.555</td><td>–</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td>May 1 – May 28</td><td>12.891</td><td>0</td><td>5.080</td><td>–</td><td>–</td><td rowspan="3">0</td><td rowspan="2">0</td><td rowspan="4">0</td><td>89.473</td></tr>
<tr><td>May 29 – Jun 30</td><td>15.087</td><td>–</td><td>5.413</td><td>–</td><td>–</td><td>4.696</td></tr>
<tr><td>Jul 1 – Aug 31</td><td>32.658</td><td>–</td><td>18.260</td><td>–</td><td>–</td><td>0</td><td>19.999</td></tr>
<tr><td>Sep 1 – Sep 30</td><td>13.140</td><td>–</td><td>11.925</td><td>0</td><td>–</td><td>–</td><td>0</td><td>24.421</td></tr>
<tr><td>Oct 1 – Oct 31</td><td>13.314</td><td>–</td><td>–</td><td>11.044</td><td>–</td><td>–</td><td>0</td><td rowspan="5">0</td><td>6.546</td></tr>
<tr><td>Nov 1 – Nov 6</td><td>2.017</td><td>–</td><td>–</td><td>3.037</td><td>–</td><td>–</td><td>0</td><td>–</td></tr>
<tr><td>Nov 7 – Nov 10</td><td>1.805</td><td>–</td><td>–</td><td>1.484</td><td>–</td><td>–</td><td>0</td><td>–</td></tr>
<tr><td>Nov 11 – Nov 30</td><td>5.988</td><td>–</td><td>–</td><td>5.915</td><td>–</td><td>–</td><td>0</td><td>–</td></tr>
<tr><td>Dec 1 – Dec 31</td><td>9.854</td><td>–</td><td>–</td><td>0</td><td>3.435</td><td>–</td><td>0</td><td>7.105</td></tr>
<tr><td>Jan 1 – Jan 31</td><td>1.922</td><td>–</td><td>–</td><td>–</td><td>0.438</td><td>–</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td>Feb 1 – Feb 28</td><td>0</td><td>0</td><td>–</td><td>–</td><td>0</td><td>–</td><td>0</td><td>–</td><td>–</td></tr>
<tr><td rowspan="5"></td><td rowspan="4">131.297</td><td>13.285</td><td>40.677</td><td>21.479</td><td>3.873</td><td>0</td><td rowspan="2">0.000</td><td rowspan="3"></td><td rowspan="3">152.240</td></tr>
<tr><td colspan="5">79.315</td></tr>
<tr><td colspan="6">79.315</td></tr>
<tr><td colspan="8">231.555</td></tr>
<tr><td colspan="9">362.852</td></tr>
</table>

Table C-2 — Restoration Flow Accounting and Unreleased Restoration Flows <u>including</u> Restoration Flows met by flood flows, Unreleased Restoration Flows lost to flood spill, and Holding Contracts during flood flows. For the period February, 2016 through February, 2017.

Flow Period	Holding Contract Demand (TAF)	Released Restoration Flow Volumes (TAF)							URFs (TAF)
		Spring Flexible Flow	Summer Base Flow	Fall Flexible Flow	Winter Base Flow	Riparian Recruit-ment Flow	Buffer Flow	Flexible Buffer Flow	
Feb 1 – Feb 15	–	0	–	–	–	–	–	–	–
Feb16 – Feb 29	5.939	1.835	–	–	–	–	–	–	–
Mar 1 – Mar 15	1.607	2.521	–	–	–	–	0	–	–
Mar 16 – Mar 31	3.735	2.541	–	–	–	–	0	–	–
Apr 1 – Apr 15	4.852	3.834	–	–	–	–	0	–	–
Apr 16 – Apr 30	6.488	2.555	–	–	–	–	0	–	–
May 1 – May 28	12.891	0	5.080	–	–	0	0	0	89.473
May 29 – Jun 30	15.087	–	5.413	–	–				4.696
Jul 1 – Aug 31	32.658	–	18.260	–	–		0		19.999
Sep 1 – Sep 30	13.140	–	11.925	0	–	–	0		24.421
Oct 1 – Oct 31	13.314	–	–	11.044	–	–	0	0	6.546
Nov 1 – Nov 6	2.017	–	–	3.037	–	–	0		–
Nov 7 – Nov 10	1.805	–	–	1.484	–	–	0		–
Nov 11 – Nov 30	5.988	–	–	5.915	–	–	0		–
Dec 1 – Dec 31	9.854	–	–	0	3.435	–	0		7.105
Jan 1 – Jan 31	24.466	–	–	–	9.866	–	0	–	–
Feb 1 – Feb 28	9.634	–	–	–	13.885	–	0	–	8.428
	162.475	**13.285**	**40.677**	**21.479**	**27.186**	**0**	**0.000**		**160.668**
		102.627							
		102.627							
		263.295							
	426.770								