WATER RESOURCES AGENCY

M E M O R A N D U M

Monterey County

October 20, 2025

2025 Salinas River Discharge Measurement Series Results

Background

The Salinas River Discharge Measurement Series (River Series) is an annual streamflow measurement survey that provides information essential to understanding the hydrologic conditions under which reservoir releases and flows in the Salinas River are managed. The survey is typically conducted during the summer when precipitation is not a factor, natural flows have receded, and river flows are controlled by managed releases from Nacimiento and San Antonio reservoirs. During the River Series, reservoir releases are held constant, and discharge (streamflow) measurements are performed at multiple locations along the Salinas River within a discreet period of time. The discharge measurement values obtained are then analyzed to inform our understanding of the nature of the groundwater-surface water interaction along the channel.

2025 River Series Overview

The 2025 River Series event occurred on August 25 and 26, 2025. Ten river discharge measurements were performed by Monterey County Water Resources Agency (Agency) and U.S. Geological Survey (USGS) staff. Overall, the 2025 River Series documented an entirely losing stream system with a total of 606 cubic feet per second (cfs), or 1,201 acre-feet per day, leaving the surface water system across the ninety-one sampled river miles (Figures 1 and 2).

The 2025 River Series measurements recorded an overall reduction in discharge along the length of the channel compared with the 2024 River Series; this observation represents an increase in total discharge loss[1] for a second consecutive year since 2023 and an apparent reversal of the decreasing trend that was documented in the 2017-2023 period. This report provides for further analysis of the reach-to-reach discharge rate variations, comparison to historical River Series events, and discussion of factors that may have influenced the 2025 River Series results.

[1] Discharge "loss" refers to discharge (streamflow) rates that decrease with distance from the reservoirs, indicating that surface water is moving into the groundwater system and/or moving from the land surface to the atmosphere through evapotranspiration.

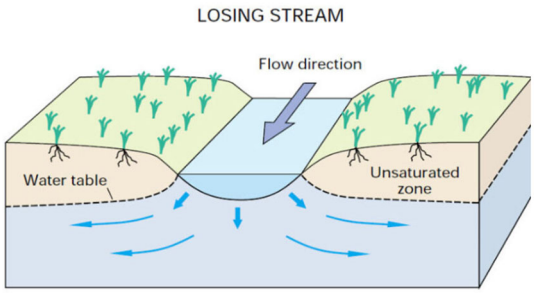

Figure 1. Conceptual illustration of a losing stream

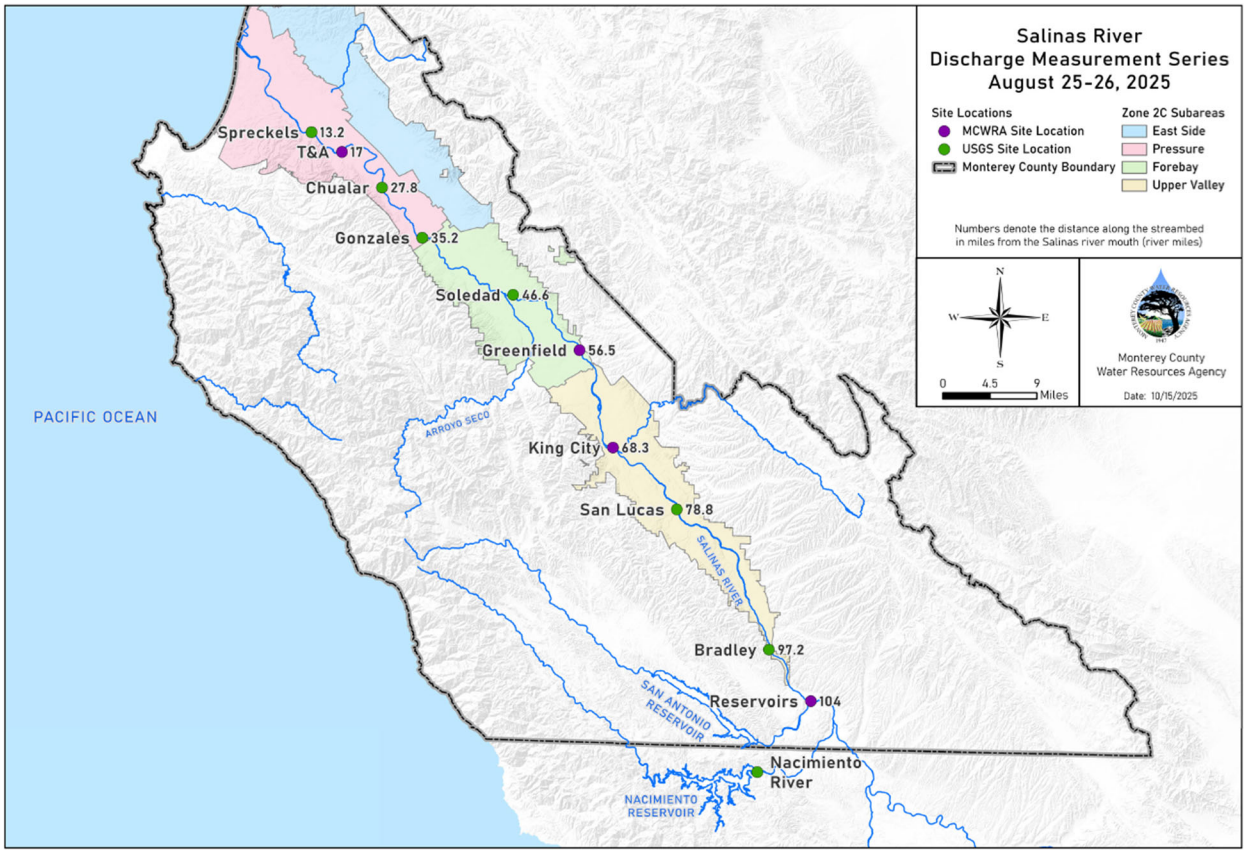

Figure 2. Salinas River Discharge Measurement Series Site Locations

Procedures and Methods

Measurements were collected from a total of 10 sample sites located downstream of Nacimiento and San Antonio Reservoirs, within the lower one hundred miles of the Salinas River watershed (Figure 2).

Combined reservoir releases were held near constant at approximately 646 cfs for five days prior to the River Series measurement event (Figure 3). This steady release is necessary to minimize the effect of fluctuating river flow, and it allows these variations to attenuate and move through the fluvial system prior to field personnel measuring the river discharge (River Series event). In this

way, the discharge measurements can more accurately be used to characterize the nature of the surface water-to-groundwater interaction along the Salinas River channel.

It should be noted that, during the month of August in 2025, there was no measurable precipitation recorded[2] that could have influenced the river discharge measurements; in addition, the USGS gauge located in Paso Robles, upstream from the reservoir releases, did not record any discharge during the entire month of August in 2025.

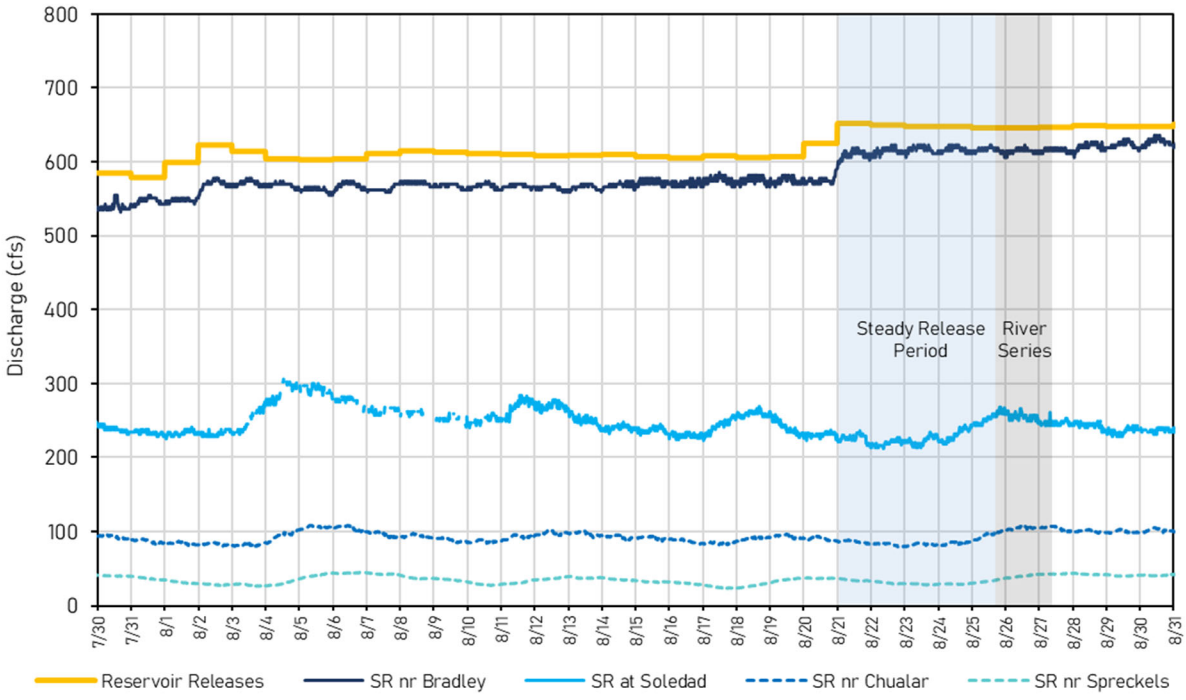

Figure 3. August 2025 Reservoir Releases and Salinas River Discharge at USGS Gages

Agency and USGS staff coordinated field efforts so that USGS routine monthly calibration discharge measurements coincided with Agency River Series measurements. USGS staff performed measurements at four established USGS automated gaging stations located near Bradley (river mile 97.2), Soledad (rm 46.6), Chualar (rm 27.8) and Speckles (rm 13.2). USGS staff also performed measurements at two other locations, San Lucas (rm 78.8) and Gonzales (rm 35.2). Agency staff performed measurements at the following sites: King City (rm 68.3), Greenfield (rm 56.5) and T&A, a site approximately two miles south of Spreckels (rm 17.0). Figure 2 displays the geographic distribution of each of these locations.

All Agency measurements were performed using an acoustic doppler velocimeter. USGS measurements were collected using either an acoustic doppler velocimeter or an acoustic doppler current profiler.

[2] King City Weather Station, as provided by the National Weather Service (NOAA; https://scacis.rcc-acis.org/)

Discharge Observations and Analysis

Discharge (Q) results for each site are summarized in Table 1 and graphed by river mile (RM) in Figure 4. The changes in discharge (ΔQ) between measurement sites, referred to as a 'river reach' and reach-to-reach loss rates (ΔQ/RM) are summarized in Table 2.

Table 1. Discharge Measurement Results for 2025 River Series

Measurement Site Name	River Mile (RM)	Measurement			Discharge Q (cfs)
		Date	Time	Source	
San Antonio Reservoir		8/25/2025	12:00	MCWRA	375 [a]
Nacimiento Reservoir		8/25/2025	16:21	USGS	271 [b]
Combined Reservoirs	104	8/25/2025	-	-	646 [c]
Bradley	97.5	8/26/2025	08:50	USGS	616
San Lucas	78.8	8/26/2025	10:35	USGS	543
King City	68.3	8/26/2025	10:23	MCWRA	465
Greenfield	56.5	8/26/2025	09:15	MCWRA	309
Soledad	46.7	8/26/2025	12:44	USGS	251
Gonzales	35.2	8/26/2025	14:28	USGS	160
Chualar	27.8	8/26/2025	10:28	USGS	109
T&A	17	8/26/2025	15:36	MCWRA	50
Spreckels	13	8/26/2025	13:17	USGS	40

[a] Reservoir releases as reported by the Agency
[b] Nacimiento USGS Gage Station
[c] Combined release from San Antonio releases and Nacimiento USGS Station

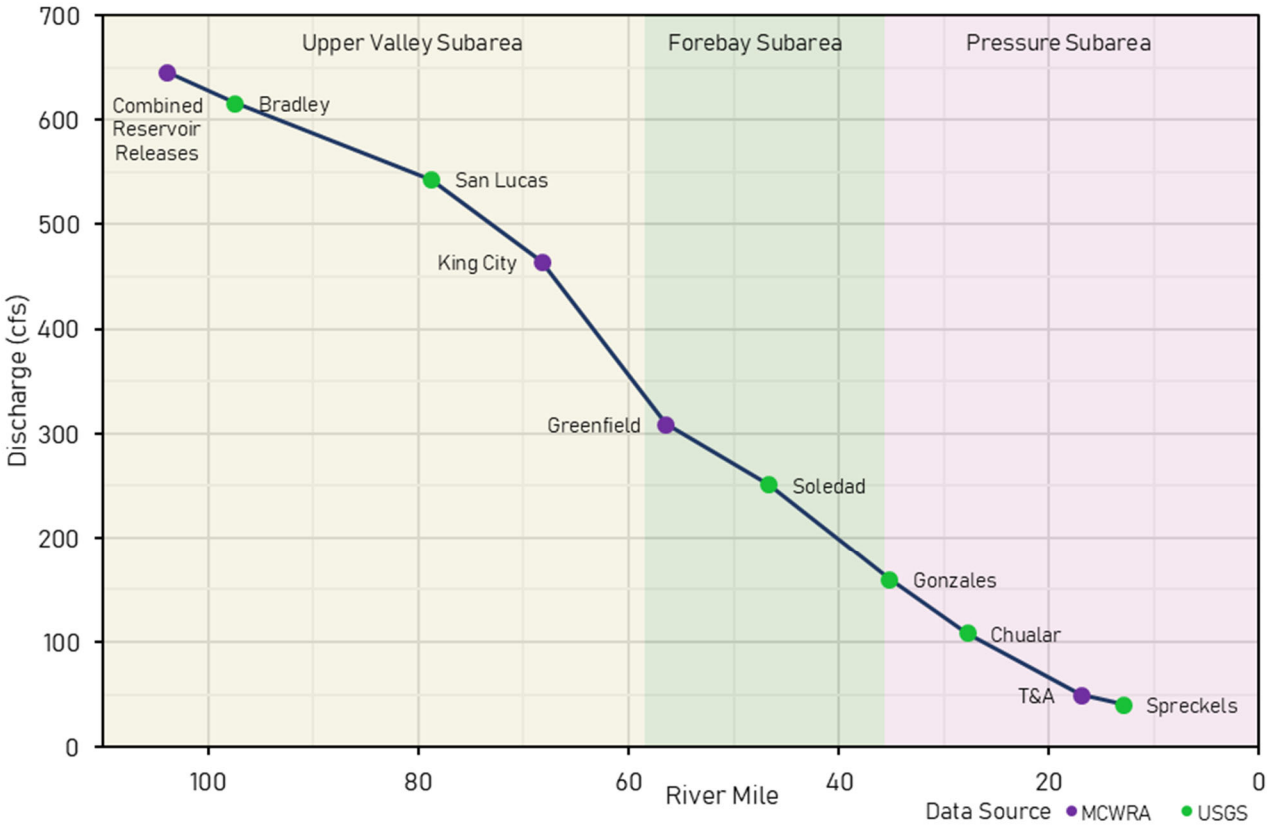

Figure 4. Discharge Measurement Series Results for the 2025 Salinas River Series

Table 2. 2025 Discharge Loss Rates by River Reach					
River Reach	**Upstream River Mile**	**Downstream River Mile**	**Reach Length (miles)**	**ΔQ (cfs)**	**ΔQ/RM (cfs/mile)**
Reservoirs - Bradley	104	97.5	6.5	30	4.6
Bradley - San Lucas	97.5	78.8	18.7	73	3.9
San Lucas - King City	78.8	68.3	10.5	78	7.5
King City - Greenfield	68.3	56.5	11.8	156	13.2
Greenfield - Soledad	56.5	46.7	9.8	58	5.9
Soledad - Gonzales	46.7	35.2	11.5	91	7.9
Gonzales - Chualar	35.2	27.8	7.4	52	7.0
Chualar - T&A	27.8	17	10.8	59	5.4
T&A - Spreckels	17	13	4	10	2.4
Chualar - Spreckels *	27.8	13	14.8	68	4.6

* Included for comparison of loss rates discussed in text

During the April through October conservation season, Salinas River flow is predominantly maintained by the modulated release of accumulated winter and spring inflow that is stored in Nacimiento and San Antonio Reservoirs. The Salinas River is predominantly a losing stream, meaning the amount of discharge decreases downstream as water from the river recharges the underlying aquifers, evaporates, is diverted from the river, or is taken up by riparian vegetation. By contrast, a gaining stream would show an increase in the amount of discharge downstream as groundwater was discharged into the surface water system. The data presented in Table 1 and Figure 4 show a uniform pattern of decreasing discharge from the reservoirs to Spreckels, indicating that the Salinas River is an entirely losing stream for the sampled portion of the river during the 2025 River Series.

River Discharge Loss Rate

Calculated as the difference between the combined reservoir releases and the discharge measured at the furthest downstream Spreckels site, the total discharge lost over the 91 miles of the River Series is:

$$646 \text{ cfs} - 40 \text{ cfs} = 606 \text{ cfs}$$

Assuming that reservoir releases remained constant over a twenty-four-hour period, this loss rate can be converted to a daily volume. Using a conversion factor of 1 cfs to 1.9835 acre-feet/day (afd), this loss rate would equate to 1,201.2 acre-feet per day between the two ends of the sampled portion of the Salinas River:

$$1281.3 \text{ afd} - 80.1 \text{ afd} = 1{,}201.2 \text{ afd}$$

A total discharge loss of 606 cfs suggests that, on average, 5.8 cfs are lost along every river mile. However, discharge does not decrease uniformly throughout the measured system. Variations in loss rates across the different reaches are evident in loss rate hydrographs (

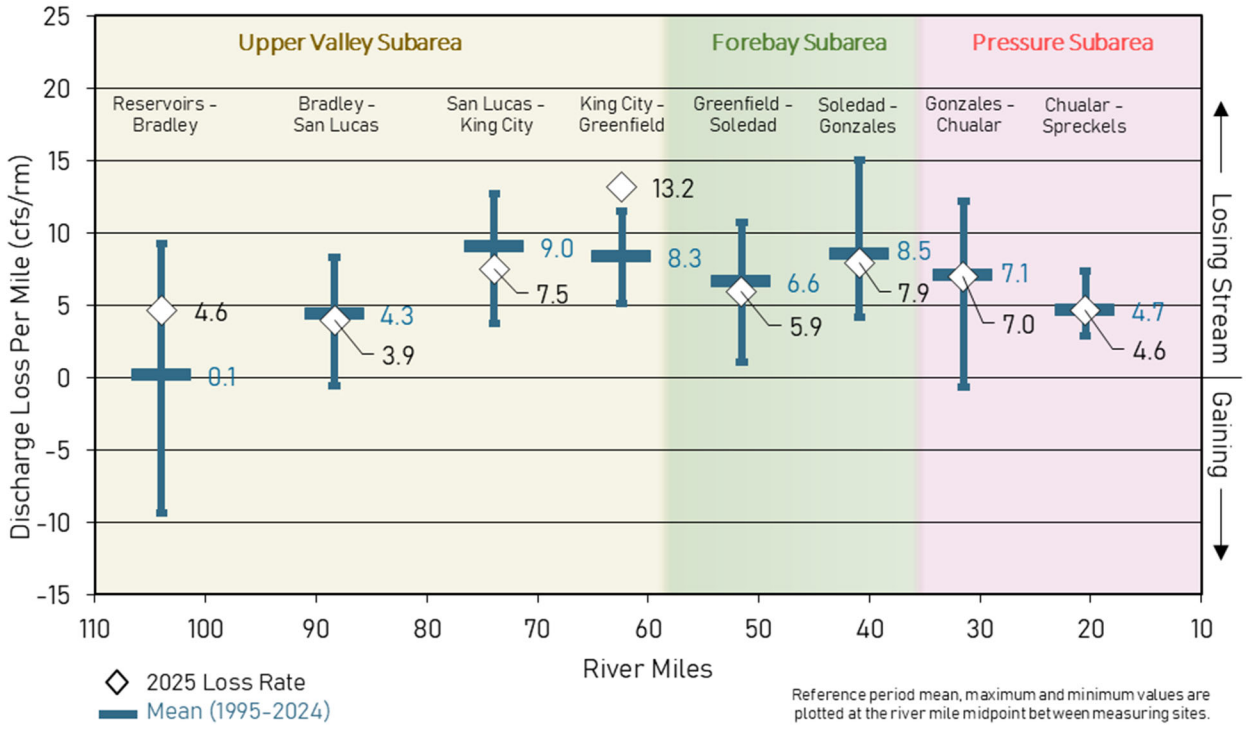

Figure 5). These hydrographs compare 2025 discharge loss rates per river mile (ΔQ/RM) to the mean loss rates for each reach. Mean loss rates are calculated using a reference period of 1995-2024, excluding years in which there was no River Series such as during the 2012-2016 drought period and 2022.

Reach-to-Reach Analysis

This section presents reach-by-reach discharge loss rates observed from the 2025 River measurement series, provided in Table 3 and plotted in Figure 5.

Table 3. 2025 Discharge Loss Rates compared to historical data, by River Reach

River Reach	2025	1995-2024[a]		
	Loss Rate (cfs/rm)	Average Loss Rate[a] (cfs/rm)	Minimum Loss Rate [Year] (cfs/rm)	Maximum Loss Rate [Year] (cfs/rm)
Reservoirs - Bradley	4.6	0.1	-9.4 [2002]	9.3 [2007]
Bradley - San Lucas	3.9	4.3	-0.6 [2007]	8.3 [2002]
San Lucas - King City	7.5	9.0	3.8 [1998]	12.7 [2019]
King City - Greenfield	13.2	8.3	5.1 [2008]	11.5 [2017]
Greenfield - Soledad	5.9	6.6	1.0 [2024]	10.7 [2007]
Soledad - Gonzales	7.9	8.5	4.1 [2005]	15.0 [1998]
Gonzales - Chualar	7.0	7.1	-0.7 [1998]	12.2 [2018]
Chualar - Spreckels	4.6	4.7	2.8 [1995]	7.3 [2019]

[a] Historical data includes measurements collected in years 1995, 1998-2000, 2002-2005, 2007-2009, 2011, 2012, 2017-2021 and 2023-2024.

- **Upper Valley subarea**

  - **Reservoirs-to-Bradley reach:** The reach between the confluence of the Reservoirs and Bradley in the Upper Valley is the only section of the Salinas River that has historically recorded significant gains in flow, indicated by negative loss rates observed in the past; this section of the river was considered to be a gaining reach before the 2012-2016 drought. River Series data show that this reach shifted to be a losing reach in 2017, a pattern that continues to present day including a loss rate of 4.6 cfs/rm recorded during the 2025 River Series.

  - **Bradley-to-San Lucas reach:** This reach had a loss rate of 3.9 cfs/rm, slightly below its historical period average of 4.3 cfs/rm. This reach had the smallest loss rate observed during the 2025 measurement event.

  - **San Lucas-to-King City reach:** This reach contains galleries of agricultural production wells in direct hydraulic communication with the Salinas River that can impact the overall discharge loss rate. During the 2025 River Series a discharge loss rate of 7.5 cfs/rm was measured, below its historical average (9.0 cfs/rm). Historically, this reach has the highest loss rates in the system, although during the 2025 measurement event, a higher loss rate was measured in the King City-to-Greenfield reach.

  - **King City-to-Greenfield reach:** The 2025 loss rate for this reach (13.2 cfs/rm) was the highest measured in the system, notably above the historical average (8.3 cfs), also setting a new record high in loss rate for this reach.

- **Forebay subarea**

  - **Greenfield-to-Soledad reach:** A loss rate of 5.9 cfs/rm was measured in 2025, slightly under the average recorded in this reach (6.6 cfs). The Greenfield-Soledad reach discharge loss values are commonly influenced by the Arroyo Seco River system contributing groundwater to the aquifer in this reach; the Arroyo Seco stream converges with the Salinas River just south of Soledad, saturating the soil where the Salinas Valley and the Arroyo Seco Cone meet. In 2025, a dry-normal water year, Arroyo Seco gauge recorded 14,457 acre-feet of surface water, spread in discontinuous streamflow events between the months of January and March (Figure 7).
  - **Soledad-to-Gonzales reach:** The loss rate recorded in the 2025 River Series (7.9 cfs/rm) was lower but comparable with the average for the reference period (8.5 cfs/rm).

- **Pressure subarea**

  - **Gonzales-to-Chualar reach:** The loss rate recorded in the 2025 River Series (7.0 cfs/rm) was about the same as the reference period average value (7.1 cfs/rm).

  - **Chualar-to-Spreckels reach:** This is the furthest downstream reach. It had a loss rate of 4.6 cfs/rm in 2025, practically matching its reference period average (4.7 cfs/rm). This reach is located over strata dominated by low permeability clay layers of the 180-

Foot and /400-Foot Aquifers.

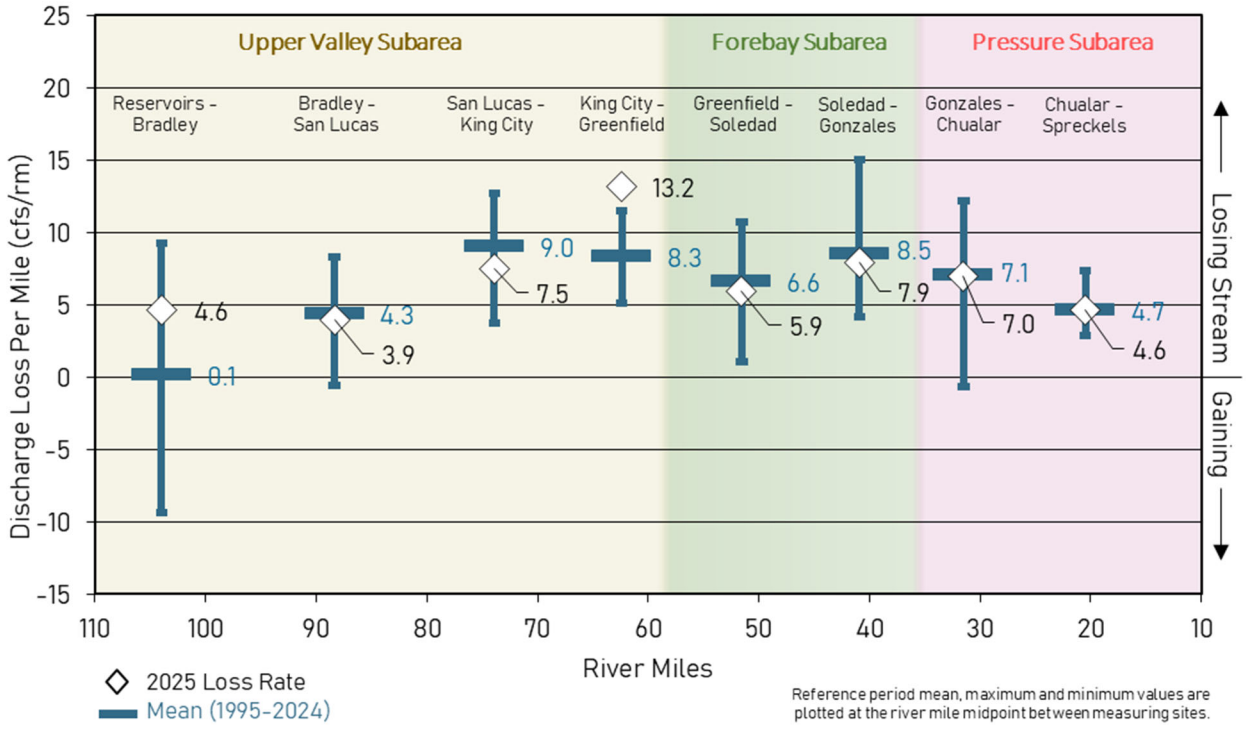

Figure 5. Comparison of 2025 Reach-to-Reach Discharge Loss Rates to 1995-2024 Loss Rate Ranges

Overall, most of the 2025 River Series reaches showed discharge loss rates that are comparable to their historical average rates. Specifically, 6 of 8 of the reaches in this report show loss rates that are slightly below their historical averages. The reaches standing out of this trend are Reservoir-Bradley and King City-Soledad, both showing discharge losses significantly greater than their historical averages.

Total System Discharge Losses

The overall discharge lost during the 2025 River Series can also be compared with other River Series measurement. For comparison purposes, Figure 6 shows the discharge measurements collected along the sampled river miles along with those same measurements from recent years in which low and high total discharge loss were observed (2024 and 2018, respectively). The River Series data have been collected while reservoir releases and Salinas River flows were managed to achieve similar discharge rates at Spreckels, as shown by discharge profiles converging into a narrow grouping of values at the end of the graph, in the Spreckels location (between a maximum of 65 cfs measured in 2023 to a minimum of 21 cfs measured in 2020).

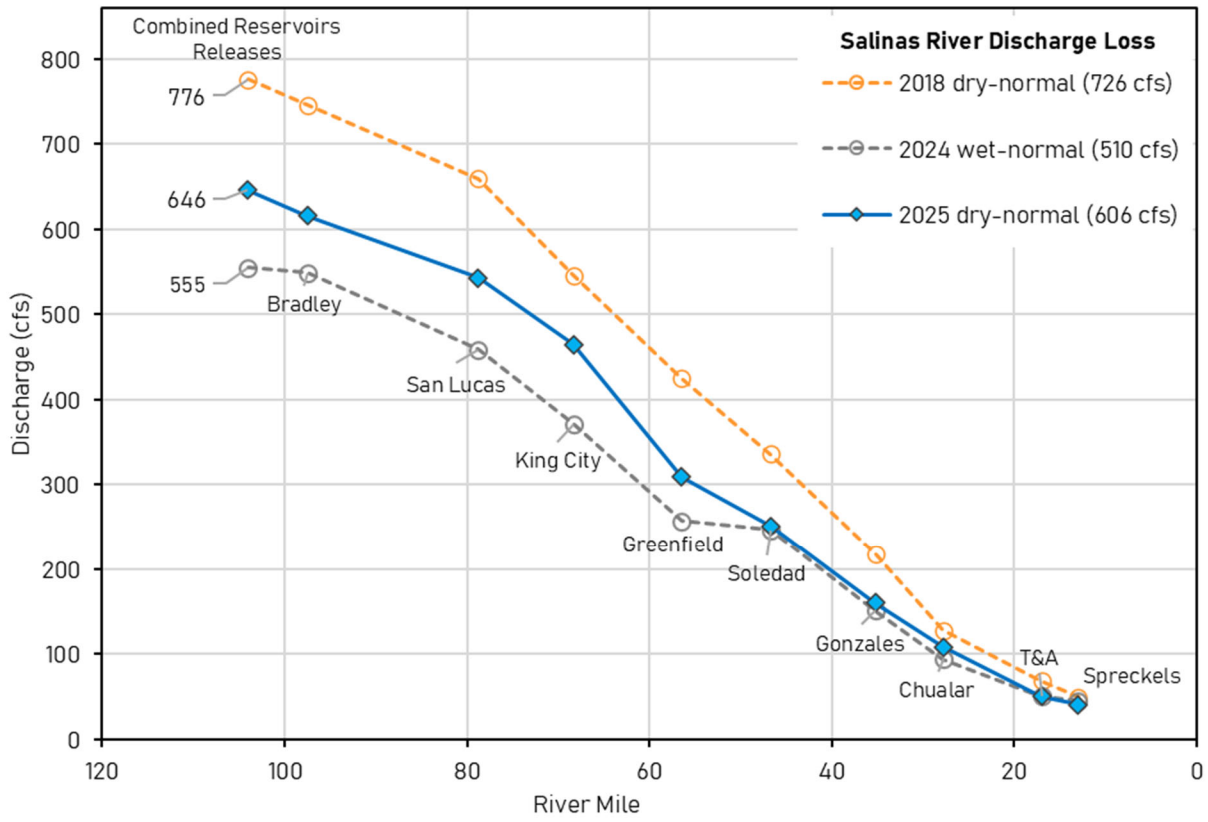

Figure 6. Discharge loss between Reservoirs and Spreckels (Total discharge loss value in parentheses).

Considering that the discharge rate of water released at the reservoirs is not constant every year, the estimated water loss in the fluvial system can also be compared in terms of discharge loss ratio between the initial discharge from the reservoirs and the rate measured at the end of the fluvial system in Spreckels (Table 4). Overall, 2025 was a dry-normal water year and combined reservoir releases during the River Series were 646 cfs, an increase compared to recent years, and an initial flow that is similar in magnitude to those releases in water years of the same water year type (dry, dry-normal years WY2020 and WY2021).

The resulting total discharge loss for the Salinas River in 2025 River Series is 606 cfs, a 93.8% loss ratio that represents an increase in total discharge loss for a second consecutive year since WY2023 (Figure 6-2).

Table 4. Discharge Loss between Reservoirs and Spreckels					
River Series Year	**Water Year Type**	**Combined Reservoirs Release Discharge (cfs)**	**Spreckels Discharge (cfs)**	**Total Discharge Loss (cfs)**	**Discharge Loss Ratio (%)**
2017	Wet	725	30	695	95.9%
2018	Dry-Normal	776	50	726	93.6%
2019	Wet	675	39	636	94.2%
2020	Dry-Normal	615	21	594	96.6%
2021	Dry	650	26	624	96%
2023	Wet	564	65	499	88.5%
2024	Wet-Normal	555	45	510	91.9%
2025	Dry	646	40.4	606	93.8%

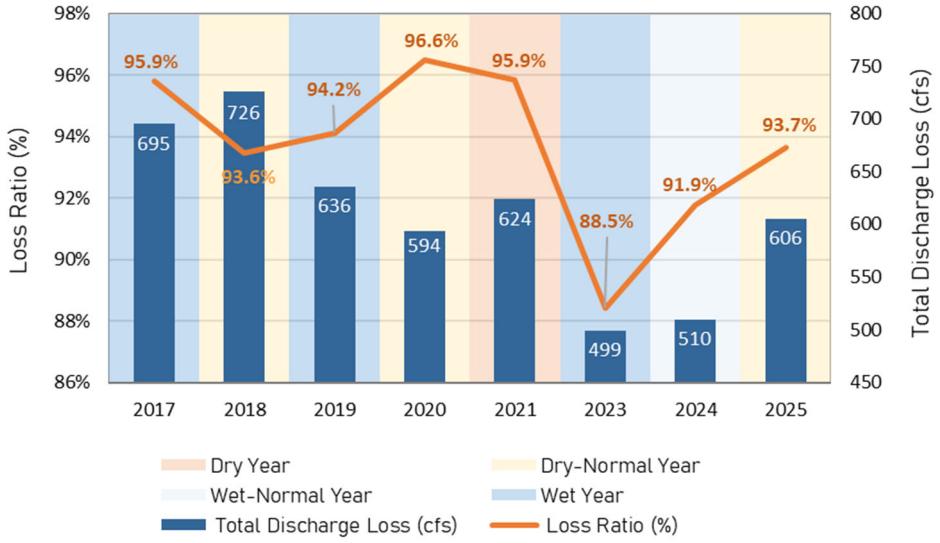

Figure 6-2. Historical Total Discharge losses & Loss Ratios

Several factors can impact flow and discharge loss in the Salinas River including weather, riparian vegetation, groundwater extractions, surface water diversions, the degree of aquifer depletion, expansion of irrigated farmland and antecedent moisture conditions which impact the degree of saturation in the subsurface. The overall 2025 discharge loss of 606 cfs is comparable to the losses measured in recent water years of the same type; it may be attributed predominately to a combination of the scarce rainfall recorded in WY 2025 (dry-normal water year) and the resulting increase in groundwater demand.

Natural Discharge

One way to evaluate antecedent groundwater conditions is by looking at the water year type and timing of natural discharge in the system. While the River Series occurs in late summer, usually after several months of conservation releases, natural discharge can indicate the amount of groundwater recharge that occurred during the winter and spring recharge period. For example, frequent rainfall over an extended period of time allows for the subsurface to become saturated,

which promotes groundwater recharge, while times with episodic storms may only penetrate the top portion of the subsurface and potentially dry out before recharging the aquifers.

The frequency and intensity of natural discharge has been very different every year after the 2012-2016 drought, as illustrated by the mean daily discharge at the USGS Arroyo Seco near Reliz stream gage (Figure 7). In some years the Arroyo Seco had continuous discharge throughout the winter and spring seasons (WY 2017, 2023 and 2024) while other years only saw a few rain events that resulted in short periodic discharge (WY 2018, 2020, 2021 and 2022). In WY 2025 the Arroyo Seco near Reliz gage only recorded discontinuous discharge events between the end of January through March, accumulating the second smallest total annual discharge volume registered since the 2012-2016 drought (14,457 AF).

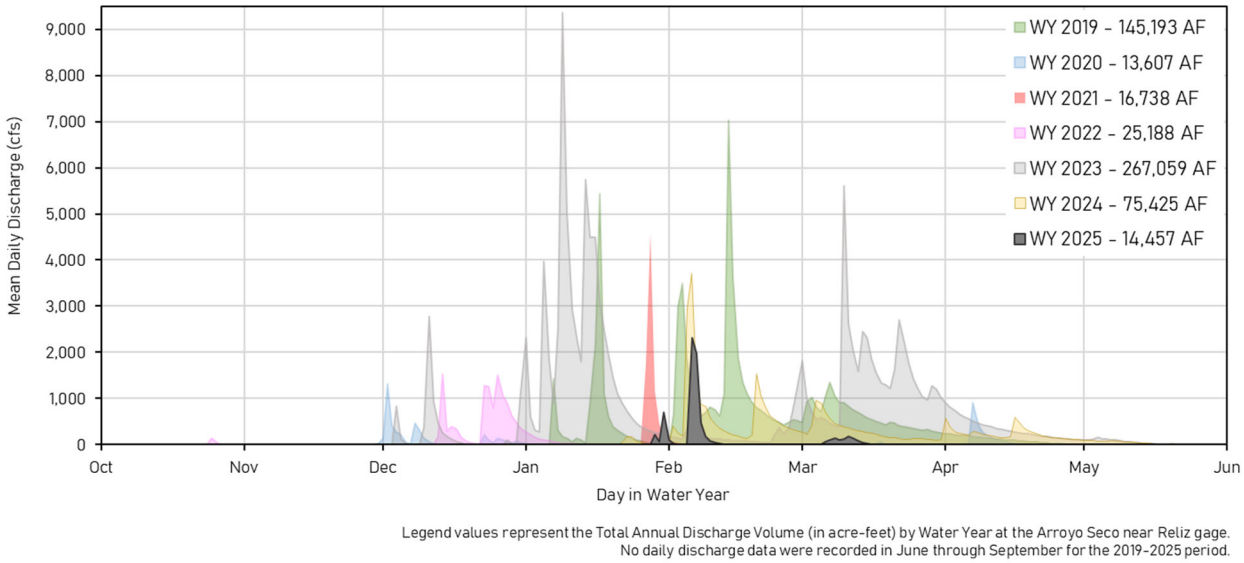

Figure 7. Mean Daily Discharge by Water Year at the USGS Arroyo Seco near Reliz Gage

Even though each of the 2017-2025 annual River Series events all documented an entirely losing stream system, the historical data show the frequency, duration, or magnitude of natural discharge does not directly correlate to the amount of discharge lost during the River Series, meaning that record-high volumes of natural discharge recorded during wet years did not change the overall surface water-to-groundwater interaction profile of the Salinas River. However, record-low volumes of natural discharge may locally impact the discharge loss measured in the River Series.

Groundwater Elevation Trends

Another factor that can influence river discharge losses is the degree of aquifer depletion, which can be thought of as the long-term decline in groundwater levels due to an imbalance between water demand and groundwater replenishment. When groundwater levels are lower than average, more aquifer storage is available to accept recharge from the river system, which is reflected in higher discharge losses. Conversely, above average groundwater levels can contribute to diminishing discharge loss.

Figure 8 shows average groundwater elevations in the Forebay and Upper Valley subareas during the 2012-2016 drought and beyond, through WY2025; the Salinas River flow can influence groundwater levels in these two subareas more directly than in the Pressure subarea, where the 180-Foot and 400-Foot Aquifers below the Salinas Valley Aquitard are less connected to the surface water.

The first year of the 2012-2016 drought had a modest impact on groundwater levels, but from 2013 to 2016 groundwater levels saw steep declines. These declines were especially pronounced from WY2014 to WY2016, coinciding with a three-year cessation in Conservation Releases due to a lack of available water in storage.

In WY2017, the first wet year following the 2012-2016 drought, groundwater levels showed a rapid recovery, followed by a slower but continual recovery through WY2019. By WY2020, groundwater levels started to stabilize or slow in their recovery compared to the pre-drought levels. The return of groundwater levels to pre-drought levels[3], indicated a lessening in the degree of aquifer depletion by WY2020. By WY2021, groundwater levels in the Forebay and Upper Valley Subareas started to decline again and by WY2022 the groundwater levels had decreased by over 10 feet in both subareas. This declining trend in groundwater levels shifted at the beginning of water year 2023 coinciding with the previously mentioned high precipitation events, which may explain the lower discharge loss is observed in the 2023 River Series compared to previous years.

In WY2025, groundwater levels remained above the 30-year average as a continuation of the higher-than-average water levels registered in WY2023 and WY2024. However, groundwater elevations measured in WY2025 have declined in comparison to WY2024, and a trend towards average groundwater levels can be noted in the second half of WY2025.

[3] The Quarterly Conditions Report shows groundwater elevations for the major aquifers and subareas in the Salinas Valley and is updated every quarter of the water year. These reports can be accessed at: https://www.co.monterey.ca.us/government/government-links/water-resources-agency/documents/quarterly-salinas-valley-water-conditions

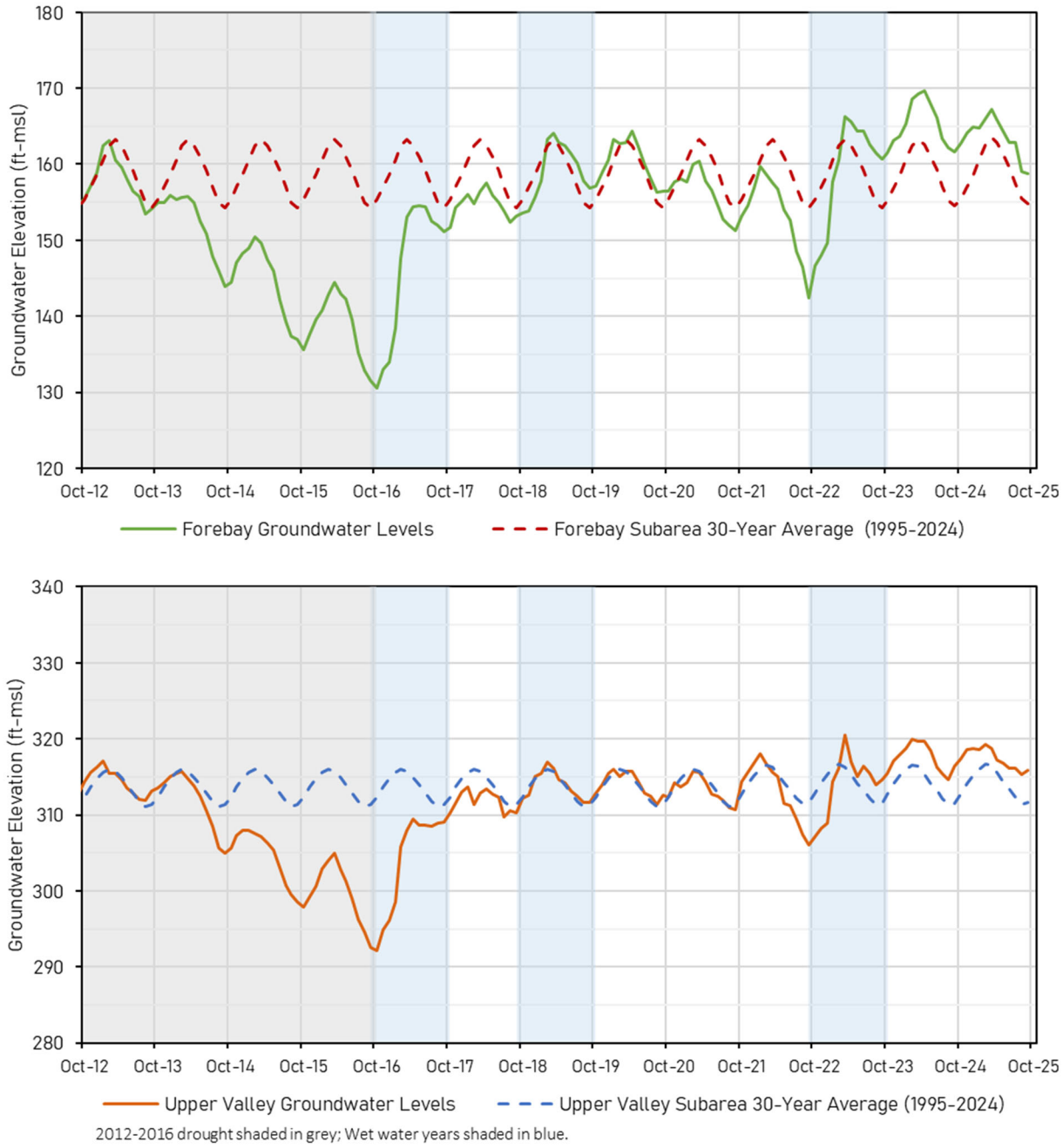

Figure 8. Groundwater Level Trends in the Forebay and Upper Valley Subareas

It should be noted that other variables besides natural discharge and the degree of aquifer depletion may need to be considered to better represent antecedent groundwater conditions and their impact on discharge in the Salinas River. The extent to which these variables may contribute to reach-to-reach loss rates in the Salinas River is beyond the scope of this memorandum but warrants further investigation. These variables may be better quantified in the future using modeling tools such as the Salinas Valley Integrated Hydrologic Model (SVIHM).

Summary

Overall, the 2025 River Series documented an entirely losing system, where 606 cfs (1,201.2 acre-feet per day, or 93.8% of the combined reservoirs release discharge) was lost across the ninety-one river miles sampled for this study. This represents an increase in total discharge loss for a second consecutive year since 2023.

Most of the sections of the river analyzed showed discharge loss rates closely below their respective historical average, except for Reservoir-Bradley and King City-Soledad; both of these reaches showed discharge loss rates significantly greater than their historical averages. For King City-Soledad reach in particular, an all-time high loss rate of 13.2 cfs per river mile was recorded.

Prepared by: Ricardo Carmona, Water Resources Hydrologist

Reviewed by: Amy Woodrow, Senior Water Resources Hydrologist