

# SJRRP Flow Bench Evaluation

April 23, 2018

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An updated Restoration Allocation was issued on March 29, 2018. In lieu of a full recommendation from the Restoration Administrator (RA), a provisional schedule was provided for the month of April. The RA has called for releases from Friant Dam to achieve a target at Gravelly Ford of 205 cfs, and maximum releases downstream of Sack Dam in consideration of seepage constraints and the Mendota Pool Inflow Credit. This Flow Bench Evaluation analyzes current seepage thresholds and constraints to indicate a potential flow target below Sack Dam; it is an update of the Flow Bench Evaluation published on April 18, 2018 based on more recent monitoring.

As of April 23, 2018:

1. Channel conveyance: Flow rates are below known conveyance thresholds.
2. Operations Conference Call: An operations call was held on April 18, 2018. The operational constraint of MW-14-208 was discussed on the call. Millerton also declared uncontrolled season on April 10, 2018 with flows being routed through canals to avoid spilling or river flood releases.
3. Seepage Hotline Calls: The seepage hotline has received no calls regarding Restoration Flows in Water Year 2018.
4. Real-time wells: All telemetered groundwater monitoring well levels are below Seepage Management Plan (SMP) thresholds.
5. Priority wells: Weekly groundwater measurements in priority wells – real-time and manually measured – indicate that all wells are below well thresholds with the exception of MW-14-208. The elevated water level in this well is attributed to recent gravity irrigation of the adjacent field.
6. Flow Stabilization: Flows in the system have been relatively stable; releases from Friant Dam have increased from 350 cfs to 380 cfs to maintain the Gravelly Ford target of 205 cfs. Flow changes are still subject to occur downstream due to operations at Mendota Pool and Sack Dam.
7. Projected Groundwater Level Changes: This analysis is based on the most recent field conditions at the constraining well, MW-14-208. To increase releases past Sack Dam, Restoration Flows from Mendota Pool will also increase. This will result in minor groundwater level increase in Reach 3. Below Sack Dam, the groundwater level is projected to increase within the current field clearance of 1.1 ft. All groundwater well levels are still projected to be below threshold by the Observed Groundwater Level Method or by the Drainage Method (Appendix J of the SMP). The Observed Groundwater Level Method conservatively applies the change in stage observed in the river to the groundwater elevation. The Drainage Method accounts for sufficient drainage from the well to the river channel.

8. Levees: LSJLD has not expressed concerns about this flow increase.
9. Water Districts: The SJRECWA has not identified any operational concerns.

## Data

Table 1 shows the groundwater depth in five real-time wells and eight manual measurements from field staff as reported in the weekly groundwater report with a publish date for the week ending April 14, 2018. Reclamation publishes the weekly groundwater report with manual measurements via electronic well sounder and recent flow data on the SJRRP website [HERE](#). To calculate field depths, Reclamation adds ground surface buffers and lateral gradient buffers to measured groundwater depths in the well (Figure 1, Equation 1).

$$Field\ Depth_{Current} = D_{Well} - GS_{Buffer} + LG_{Buffer} \quad (1)$$

Where:

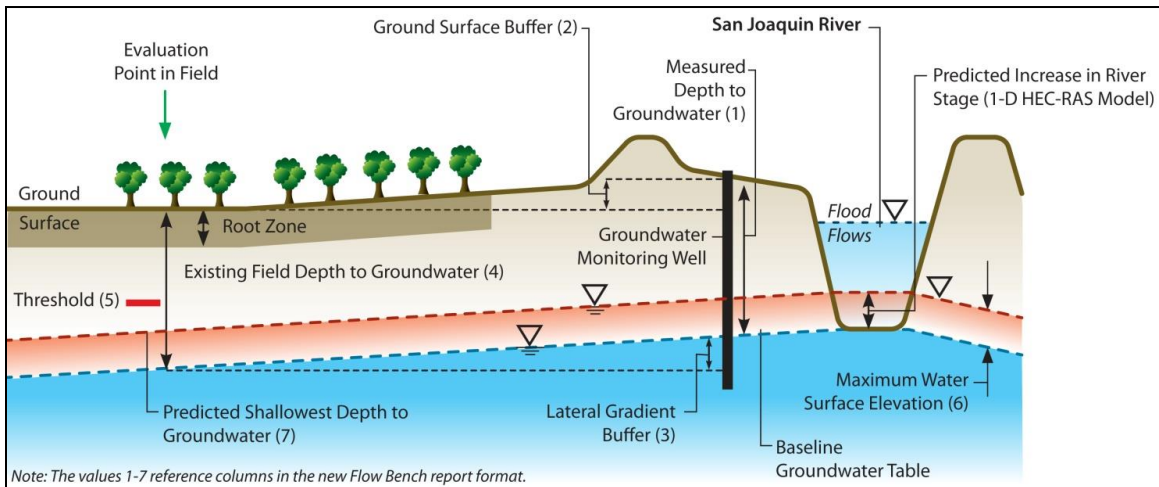
- Field Depth<sub>Current</sub>* Current groundwater level depth in the field
- D<sub>Well</sub>* Current groundwater level depth as measured in the monitoring well
- GS<sub>Buffer</sub>* Ground surface buffer, or the difference in elevation between the well and the field
- LG<sub>Buffer</sub>* Lateral gradient buffer, to account for losing reaches where the groundwater table slopes away from the river (if any)

**Table 1. Current Well Data**

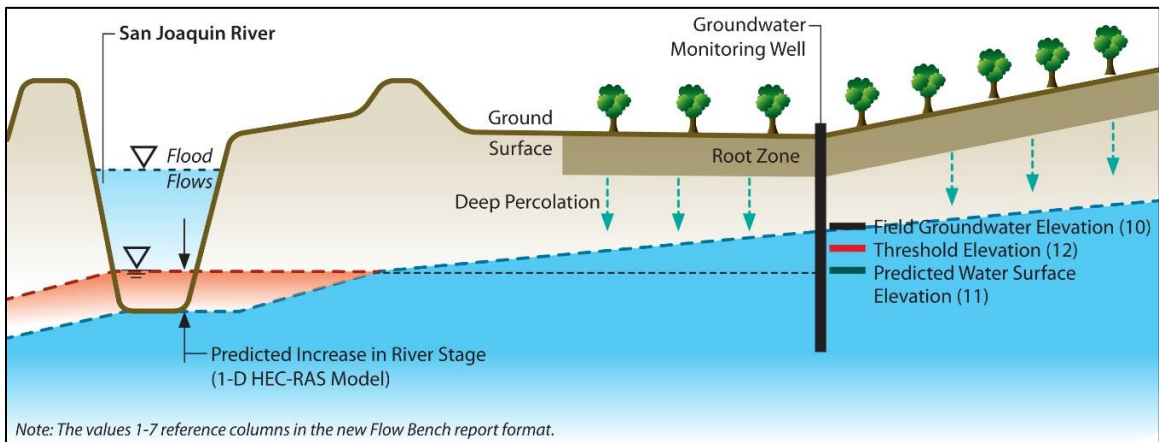
Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	2 - Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	5 - Field Threshold (feet bgs)	Comment
FA-9	2A	9.4	2.0	2.5	9.9	6.0	Acceptable
MW-09-47	2A	8.8	2.5	3.3	9.6	6.5	Acceptable
MA-4	2A	11.8	6.1	4.6	10.3	7.0	Acceptable
MW-09-49B	2A	6.1	1.7	2.4	6.8	5.5	Acceptable
MW-09-54B	2B	16.8	7.9	5.5	14.4	7.0	Acceptable
MW-09-55B	2B	9.5	3.7	3.0	8.9	5.5	Acceptable
PZ-09-R3-5	3	11.0	1.2	0.0	9.8	5.7	Acceptable
MW-12-191	3	12.4	1.0	0.0	11.4	6.5	Acceptable
PZ-09-R3-7	3	9.0	0.7	0.0	8.3	6.5	Acceptable
MW-10-75	3	16.9	0.5	0.2	16.6	8.0	Acceptable
MW-14-208	4A	5.6	1.0	0.0	4.6	5.5	Acceptable*
MW-10-89	4A	11.1	1.0	0.0	10.1	6.5	Acceptable
MW-10-92	4A	8.0	1.0	0.0	7.0	4.8	Acceptable

bgs = below ground surface; GW = groundwater

\*See Analysis for discussion of MW-14-208



**Figure 1. Conceptual Model for Observed Groundwater Level Method**



**Figure 2. Conceptual Model for Drainage Method**

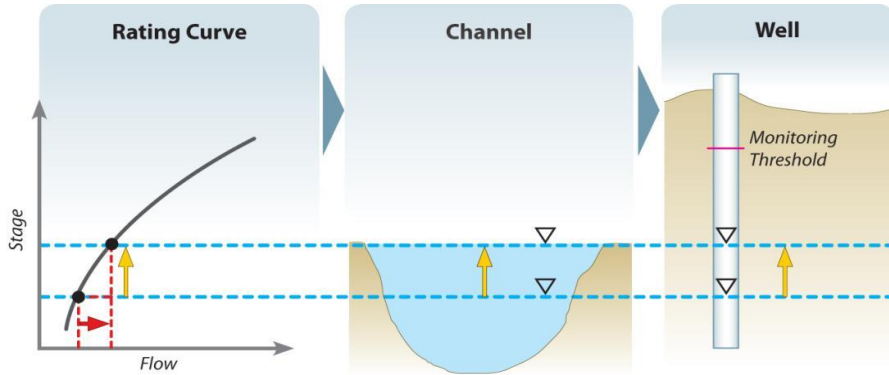
Table 2 shows the anticipated flow rates used to evaluate future groundwater depths. Reclamation calculated losses based on the values assumed in Exhibit B. San Luis Canal Company demands were also accounted for in Reach 3 using the most recent operations report sent April 20. Pre-condition flows are based on April 18 data to correspond with when measurements were recorded at MW-14-208. The comparison of pre-condition and projected flows informs the estimated result of increasing the Sack Dam target, and therefore informs the maximum allowable flow as projected by the analysis.

**Table 2. Anticipated Change in Flows.**

	Pre-condition Flows (cfs)	Projected Flows for Evaluation (cfs)
Reach 1	350	380
Reach 2A	205	205
Reach 2B	125	140
Reach 3	243	257
Reach 4A	123	157

Table 3 shows the rise in groundwater based on estimated changes in river stage and the conceptual models shown in Figures 1 – 3. Field depths are calculated by taking the most recent measurements from Table 1, adding the ground surface and the lateral gradient buffers, and subtracting the maximum predicted stage increase (Equation 2).

$$Field\ Depth_{Predicted} = Field\ Depth_{Current} - WSEL_{Max\ Increase} \quad (2)$$



**Figure 3. Conceptual Relationship between River Stage and Groundwater Levels**

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**Table 3. Predicted Groundwater Levels for Priority Wells**

Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	2 - Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	6 - Maximum Predicted WSEL Increase (feet)	7 - Predicted Shallowest GW Depth (feet bgs)	5 - Field Threshold (feet bgs)	Comment
FA-9	2A	9.4	2.0	2.5	9.9	0.0	9.9	6.0	Acceptable
MW-09-47	2A	8.8	2.5	3.3	9.6	0.0	9.6	6.5	Acceptable
MA-4	2A	11.8	6.1	4.6	10.3	0.0	10.3	7.0	Acceptable
MW-09-49B	2A	6.1	1.7	2.4	6.8	0.0	6.8	5.5	Acceptable
MW-09-54B	2B	16.8	7.9	5.5	14.4	0.1	14.3	7.0	Acceptable
MW-09-55B	2B	9.5	3.7	3.0	8.9	0.1	8.8	5.5	Acceptable
PZ-09-R3-5	3	11.0	1.2	0.0	9.8	0.1	9.7	5.7	Acceptable
MW-12-191	3	12.4	1.0	0.0	11.4	0.1	11.3	6.5	Acceptable
PZ-09-R3-7	3	9.0	0.7	0.0	8.3	0.1	8.1	6.5	Acceptable
MW-10-75	3	16.9	0.5	0.2	16.6	0.1	16.5	8.0	Acceptable
MW-14-208	4A	5.6	1.0	0.0	4.6	1.1	3.5	5.5	Acceptable*
MW-10-89	4A	11.1	1.0	0.0	10.1	1.1	9.0	6.5	Acceptable
MW-10-92	4A	8.0	1.0	0.0	7.0	0.7	6.4	4.8	Acceptable

bgs = below ground surface; GW = groundwater; WSEL = water surface elevation

\*See Analysis for discussion of MW-14-208

**Table 4. Summary of Groundwater Conditions Near MW-14-208**

Gage/Well	Water Surface ELEV (ft, NAVD88)	Depth to GW (ft bgs)	SMP Threshold Depth (ft)	Allows Groundwater Drainage?	Trend?
Menefee Staff Gage	98.60			YES	Falling
SWA Staff Gage	97.33			YES	Falling
MW-14-208	99.88	5.62	6.50	YES	Falling
Soil Boring 17-1		6.60	5.50	YES	Falling
Soil Boring 18-1		6.65	5.50	YES	Falling
MW-167	90.33	16.37		YES	Falling (GW Pumping)

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## Analysis

All thirteen priority groundwater monitoring wells are predicted to remain below seepage thresholds with a target of 205 cfs at Gravelly Ford and flows up to 157 cfs from Sack Dam, with the exception of MW-14-208 in Reach 4A.

Pre-condition measurements at MW-14-208 indicate that the well is above its well threshold of 6.5 ft; however, pre-condition measurements in the field indicate groundwater levels are currently below threshold. Well measurements above the well threshold are attributed to recent gravity irrigation (Figure 4). Recent field monitoring has also indicated that water levels continue to fall at this site at a rate of approximately 0.1 ft per week after the most recent manual measurement on April 11 due to the end of pre-irrigation activities. Furthermore, monitoring indicates that current river stage and groundwater levels in the basin allow drainage in both directions (i.e. to the San Joaquin River and to the groundwater basin to the east). As described in the SMP, well thresholds are a proxy for field conditions. Field conditions are important to monitor since the field is where seepage impacts would be realized. Two borings were drilled in the field adjacent to MW-14-208 to determine the groundwater level in relation to the field threshold. Table 4 indicates a 1.1 ft clearance in the field before reaching the SMP field threshold of 5.5 ft. Therefore, this flow bench evaluation determined the maximum flow that would increase stage in the river within 1.1 ft.

Groundwater levels at MW-14-208 were analyzed, and found to remain below the thresholds identified in the Seepage Management Plan for flows up to 157 cfs, with potential seepage constraints occurring above that level. The flow bench evaluation assumes a 1:1 stage relationship as seen in Figure 3. Therefore, any predicted increase in stage in the river is applied to current monitoring levels of the groundwater table. Given that recent field measurements indicate 6.60 ft bgs at Soil Boring 17-1, there is 1.1 ft of clearance from the field threshold of 5.5 ft bgs. The predicted water surface elevation in the river from the 1-D HEC-RAS model (Tetra Tech 2009), indicates that from the current flow conditions, flows may increase up to 157 cfs before encroaching on the 1.1 ft of clearance.

The SJRRP will continue weekly monitoring of groundwater wells to track the influence of Restoration Flows, and will update this analysis if any changes to Restoration Flows are recommended. Follow-up monitoring is specifically scheduled at MW-14-208 to closely track the response of any proposed increases – not to exceed 157 cfs total flow – from Sack Dam.



Figure 4. Gravity Irrigation Observed near MW-14-208 on February 27, 2018

### Summary

This analysis in combination with recent field measurements, indicates acceptable conditions for up to 157 cfs past Sack Dam, with the condition that groundwater levels continue to be closely monitored at MW-14-208 so as not to surpass the field threshold. The maximum allowable flow below Sack Dam is currently limited by conditions at this well.

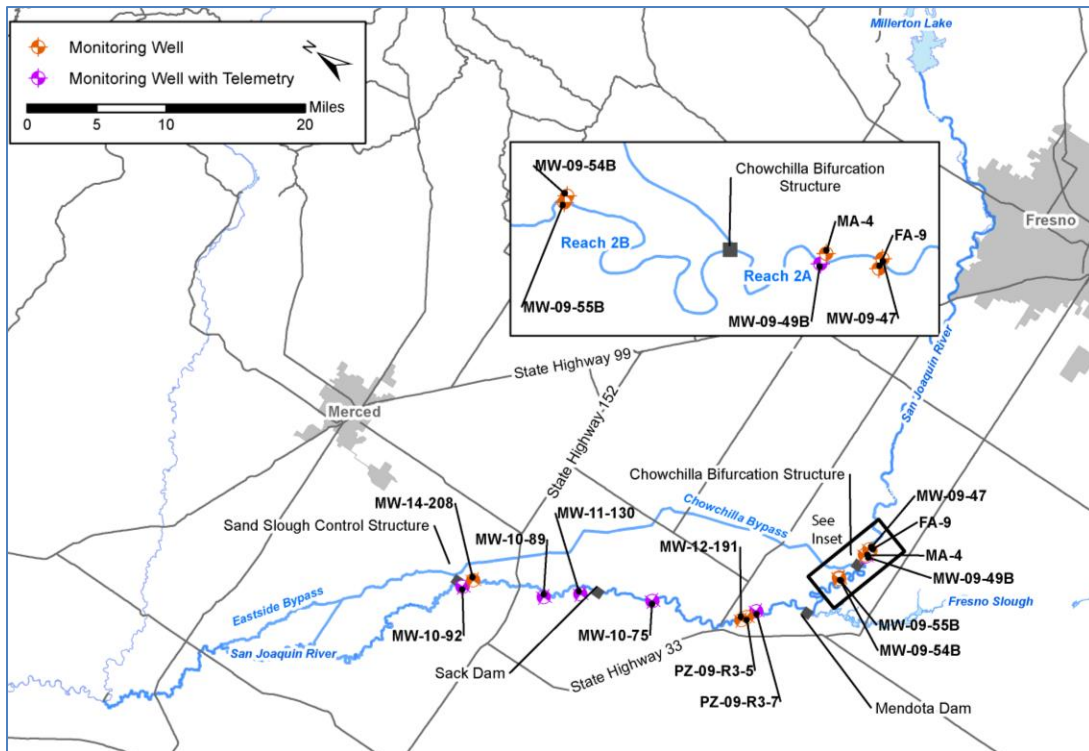


Figure 5. Priority Monitoring Well Location