# SJRRP Flow Bench Evaluation

October 24, 2011

The Restoration Administrator's September 14, 2011 recommendation includes flows of 350 cfs release from Friant Dam starting October 21 – November 6, 2011. Reclamation took groundwater measurements on October 20 and Reclamation's calculations as shown herein indicate 50 cfs of flow from Sack Dam will not cause impacts. Flows will increase to 50 cfs past Sack Dam starting with a release from Mendota Dam on Thursday, October 27.

Absent other influencing factors, hydraulic modeling shows no adverse seepage impacts up to a 140 cfs release from Sack Dam. Some current groundwater wells show higher levels than expected due to other influencing factors, so increases will take place gradually in steps of approximately 0.5 foot of water surface elevation increase. This document evaluates the first increase to 50 cfs. Pending subsequent flow bench evaluations, flows past Sack Dam may increase to 80 cfs on November 2 depending on the amount of flow entering Mendota Pool. Subsequent increase to 140 cfs could occur in 6-7 days, but the RA recommends Interim Flows stopping at Friant Dam on November 6 for Mendota Pool maintenance.

As of October 21, 2011:

1. Flow rates from provisional real-time data are below known conveyance thresholds.

2. Daily operations coordination calls and the weekly planning call identified a potential concern regarding the Highway 165 project. Reclamation contacted CALTRANS and they did not have any concerns.

3. The seepage hotline received no calls to date in WY 2012.

4. Real-time groundwater monitoring did not identify groundwater levels above thresholds, Table 1. These wells do not restrict Friant Dam releases at this time.

5. Priority well weekly groundwater measurements, Table 2, identified groundwater tables above thresholds in one well. This well does not restrict releases at this time.

6. Stability in the lower reaches has been achieved.

7. Projected groundwater levels from the proposed increase in flow (Table 4) calculated based on groundwater levels measured the week of October 17, show projected groundwater levels below thresholds except for three wells.

    a. MW-10-90 – groundwater level predicted to rise 0.2 feet above threshold, assuming 50 cfs of flow in the Eastside Bypass and calculated from most current groundwater level. Observed sand excavation lowers water surface elevations from those predicted, and the local landowner expressed no concerns. This well does not restrict flows.

    b. MW-10-94 – groundwater level predicted to rise 1.1 feet above threshold, assuming 50 cfs of flow into the Eastside Bypass and calculated from the most current groundwater level. Observed sand excavation lowers water surface

elevations from those predicted. The local landowner has a working interceptor drain. This well does not restrict flows.

c. MW-10-95 - groundwater level predicted to rise 3.8 feet above threshold, assuming 50 cfs of flow into the Eastside Bypass and calculated from the most current groundwater level. Observed sand excavation lowers water surface elevations from those predicted. The local landowner has a working interceptor drain. High groundwater due to gravity irrigation has drained below the threshold in some of the field as measured by a hand-augur borehole. This well does not restrict flows.

8. The LSJLD has not identified any concerns.

9. The CCID has not identified any concerns.

10. The SLCC has not identified any concerns.

# Analysis

Priority well MW-10-95 (Reach 4B1 Eastside Bypass) measurements this week show depths to groundwater at 2.2 feet above the threshold. Reclamation conducted a site visit to MW-10-95 on Friday, October 7, 2011 and determined with the concurrence of the landowner that slow drainage nearby gravity irrigation is causing the shallow groundwater levels. The landowner did not identify concerns with 50 cfs of flow in the river channel, providing groundwater levels do not rise and trap his equipment in mud. Hand augur boreholes dug on October 20 found groundwater levels at the other edge of the field at 5.2 feet below ground surface, below the threshold. Measurements the previous week were 4.75 feet below ground surface. Figure 1 below shows the groundwater trends over time in this and other nearby wells. Extensive sand excavation not captured by the rating curves has occurred at this cross-section. Reclamation predicts a water surface elevation in the San Joaquin River with 50 cfs of 94.0 feet. This does not take into account sand excavation, uses the conservative cross-sections in the existing hydraulic model and therefore overestimates the stage increase. Reclamation measured the elevation of the groundwater level in MW-10-95 at 96.2 feet. Thus, predictions show the water surface elevation 2.2 feet below the groundwater level in the field, allowing drainage. The landowner has a working interceptor drain at this location and did not express concerns with up to 140 cfs of flow in the river. Reclamation will monitor groundwater levels at this location and shut off flows if necessary. This well does not restrict planned releases.

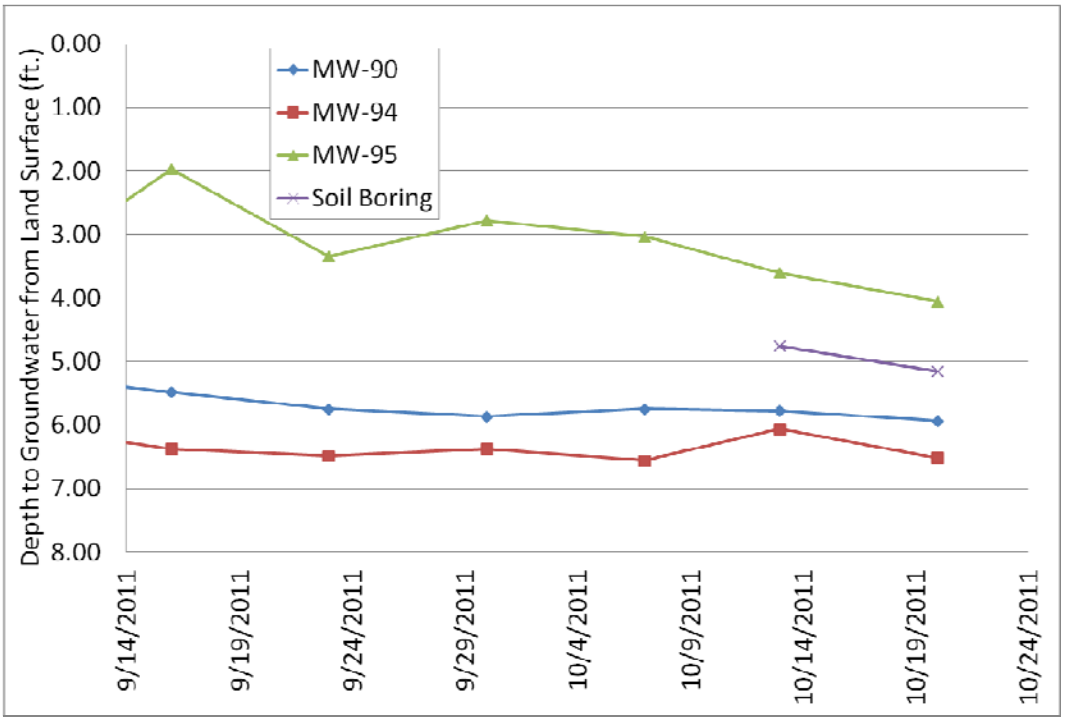



**Figure 1: Groundwater depths over time**

Predictions show MW-10-90 groundwater levels may rise to 0.2 feet above the threshold (Table 4). This does not take into account sand excavation which should lower the water surface elevation. Reclamation conducted a site visit with the landowner on Friday, October 7, 2011 and the landowner did not have concerns with the predicted increase or up to 140 cfs of flow in the river channel. This well does not restrict planned releases.

Adjacent to MW-10-94, Reclamation predicts a water surface elevation in the San Joaquin River with 50 cfs of 93.98 feet. This does not take into account sand excavation, uses the conservative cross-sections in the existing hydraulic model and therefore overestimates the stage increase. Reclamation measured the elevation of the groundwater level in MW-10-94 at 94.1 feet. Thus, predictions show the water surface elevation 0.12 feet below the groundwater level in the field, meaning based on elevations no water should seep into the field. The landowner has a working interceptor drain at this location to keep groundwater levels low and did not express concerns with up to 140 cfs of flow in the river. Reclamation will monitor groundwater levels at this location and shut off flows if necessary. This well does not restrict planned releases.

# Data

Table 1 shows the groundwater depth in 7 realtime wells as of October 21, 2011 at 11:00 am. The data shows no groundwater depths in the realtime groundwater wells above thresholds. The property underlying one of these realtime wells, MW-10-92, contains an existing tile drain.

**Table 1 – Realtime Well Data as of 10/21/2011**

| Well | Reach | Measured Groundwater Depth in Well (feet bgs) | Ground Surface Buffer (feet) | Lateral Gradient Buffer (feet) | Field Depth (feet bgs) | Field Threshold (feet bgs) | Comment |
|---|---|---|---|---|---|---|---|
| MW-09-54B | 2B | 13.2 | -7.9 | 5.5 | 10.7 | 10.0 | Acceptable |
| PZ-09-R3-7 | 3 | 8.5 | -0.7 | 0.0 | 7.7 | 3.5 | Acceptable |
| MW-10-75 | 3 | 8.5 | -0.5 | 0.2 | 8.2 | 6.3 | Acceptable |
| MW-11-130 | 4A | 7.5 | 0.0 | 0.0 | 7.5 | 5.0 | Acceptable |
| MW-10-89 | 4A | 11.4 | -3.4 | 0.0 | 8.0 | 7.6 | Acceptable |
| MW-10-92 | 4A | 9.1 | -2.6 | 0.0 | 6.5 | 5.0 | Acceptable |
| MW-11-142 | 4B1 | 5.8 | 0.0 | 0.0 | 5.8 | 4.0 | Acceptable |

bgs = below ground surface

Reclamation publishes the weekly groundwater report with manual measurements via electronic well sounder and recent flow data on the SJRRP website at: http://www.restoresjr.net/flows/Groundwater/Groundwater.html. Table 2 shows the manual measurements from field staff as reported in the weekly groundwater report. To calculate field depths, Reclamation adds ground surface buffers and lateral gradient buffers to measured groundwater depths in the well. A negative ground surface buffer indicates the well is above the field.

**Table 2 – Priority Well Weekly Groundwater Measurements**

| Well | Reach | Measured Groundwater Depth in Well (feet bgs) | Ground Surface Buffer (feet) | Lateral Gradient Buffer (feet) | Field Depth (feet bgs) | Field Threshold (feet bgs) | Comment |
|---|---|---|---|---|---|---|---|
| FA-9 | 2A | 7.5 | -3.7 | 2.5 | 6.3 | 5.0 | Acceptable |
| MW-09-47 | 2A | 7.5 | -3.5 | 3.3 | 7.3 | 7.0 | Acceptable |
| MA-4 | 2A | 9.4 | -6.1 | 4.6 | 7.9 | 7.0 | Acceptable |
| MW-09-49B | 2A | 4.9 | -1.7 | 2.4 | 5.7 | 4.5 | Acceptable |
| MW-09-55B | 2B | 8.3 | -3.7 | 3.0 | 7.7 | 7.0 | Acceptable |
| PZ-09-R2B-1 | 2B | - | -1.3 | 0.0 | - | 5.0 | Acceptable |
| PZ-09-R2B-2 | 2B | 10.3 | -3.9 | 0.0 | 6.5 | 4.5 | Acceptable |
| PZ-09-R3-5 | 3 | 10.9 | -1.2 | 0.0 | 9.8 | 5.0 | Acceptable |
| PZ-09-R3-6 | 3 | 9.8 | -1.5 | 0.0 | 8.3 | 4.0 | Acceptable |
| MW-09-87B | 4A | 10.9 | -1.9 | 1.0 | 10.0 | 4.2 | Acceptable |
| MW-10-90 | 4B1 | 5.9 | 0.8 | 0.0 | 6.7 | 6.0 | Acceptable |
| MW-10-94 | 4B1 | 6.5 | 0.0 | 1.0 | 7.5 | 7.0 | Acceptable |
| MW-10-95 | 4B1 | 4.1 | -2.2 | 1.0 | 2.8 | 5.0 | Above Threshold, gravity irrigation draining |

Note: bgs = below ground surface

Table 3 shows the anticipated flow rates used to evaluate future groundwater depths. Reclamation calculated losses from Friant Dam to the Mendota Pool based on the long-term pattern established by Exhibit B. Reach 3 includes an estimated 320 cfs delivery to Arroyo Canal in addition to the 50 cfs of Interim Flows.

**Table 3 Anticipated Change in Flows**

| | Recent Flows (cfs) | Exhibit B Losses from Friant Dam at 700 cfs release (cfs) | Sack Dam Flow (cfs) | Projected Flows (cfs) |
|---|---|---|---|---|
| Reach 1 | 350 | 0 | | 350 |
| Reach 2A | 210 | -155 | | 210 |
| Reach 2B | 120 | -255 | | 120 |
| Reach 3 | 320 | | 50 | 370 |
| Reach 4A | 0 | | 50 | 50 |
| Reach 4B1 | 0 | | 50 | 50 |

Table 4 shows the current and maximum rise in groundwater based on estimated changes in river stage and the conceptual model shown in Figure 2. Field depths are calculated by taking the most recent measurements from Table 2, adding the ground surface and the lateral gradient buffer, and subtracting the maximum predicted stage increase. Subsequent pages show the rating curves for each of the key wells from the Mussetter Engineering, Inc., 2008 San Joaquin HEC-RAS Model Documentation Technical Memorandum prepared for California Dept. of Water Resources, Fresno, California, June 2.

**Table 4 Predicted Maximum Change in Groundwater Levels for Key Wells**

| Well | Reach | Measured Groundwater Depth in Well (feet bgs) | Maximum Predicted Stage Increase (feet) | Ground Surface Buffer (feet) | Lateral Gradient Buffer (feet) | Field Depth (feet bgs) | Field Threshold (feet bgs) | Comment |
|---|---|---|---|---|---|---|---|---|
| FA-9 | 2A | 7.5 | 0.0 | -3.7 | 2.5 | 6.3 | 5.0 | Acceptable |
| MW-09-47 | 2A | 7.5 | 0.0 | -3.5 | 3.3 | 7.3 | 7.0 | Acceptable |
| MA-4 | 2A | 9.4 | 0.0 | -6.1 | 4.6 | 7.9 | 7.0 | Acceptable |
| MW-09-49B | 2A | 4.9 | 0.0 | -1.7 | 2.4 | 5.7 | 4.5 | Acceptable |
| MW-09-54B | 2B | 13.2 | 0.0 | -7.9 | 5.5 | 10.7 | 10.0 | Acceptable |
| MW-09-55B | 2B | 8.3 | 0.0 | -3.7 | 3.0 | 7.7 | 7.0 | Acceptable |
| PZ-09-R2B-1 | 2B | - | 0.0 | -1.3 | 0.0 | - | 5.0 | Acceptable |
| PZ-09-R2B-2 | 2B | 10.3 | 0.0 | -3.9 | 0.0 | 6.5 | 4.5 | Acceptable |
| PZ-09-R3-5 | 3 | 10.9 | 0.3 | -1.2 | 0.0 | 9.5 | 5.0 | Acceptable |
| PZ-09-R3-6 | 3 | 9.8 | 0.2 | -1.5 | 0.0 | 8.1 | 4.0 | Acceptable |
| PZ-09-R3-7 | 3 | 8.5 | 0.2 | -0.7 | 0.0 | 7.5 | 3.5 | Acceptable |
| MW-10-75 | 3 | 8.5 | 0.2 | -0.5 | 0.2 | 8.0 | 6.3 | Acceptable |
| MW-09-87B | 4A | 10.9 | 1.2 | -1.9 | 1.0 | 8.9 | 4.2 | Acceptable |

| Well | Reach | Measured Groundwater Depth in Well (feet bgs) | Maximum Predicted Stage Increase (feet) | Ground Surface Buffer (feet) | Lateral Gradient Buffer (feet) | Field Depth (feet bgs) | Field Threshold (feet bgs) | Comment |
|---|---|---|---|---|---|---|---|---|
| MW-10-89 | 4A | 11.4 | | -3.4 | 0.0 | 8.0 | 7.6 | Acceptable |
| MW-10-92 | 4A | 9.1 | 1.5 | -2.6 | 0.0 | 5.1 | 5.0 | Acceptable |
| MW-10-90 | 4B1 | 5.9 | 0.9 | 0.8 | 0.0 | 5.8 | 6.0 | Above Threshold |
| MW-10-94 | 4B1 | 6.5 | 1.6 | 0.0 | 1.0 | 5.9 | 7.0 | Above Threshold |
| MW-10-95 | 4B1 | 4.1 | 1.6 | -2.2 | 1.0 | 1.2 | 5.0 | Above Threshold |

Note: bgs = below ground surface

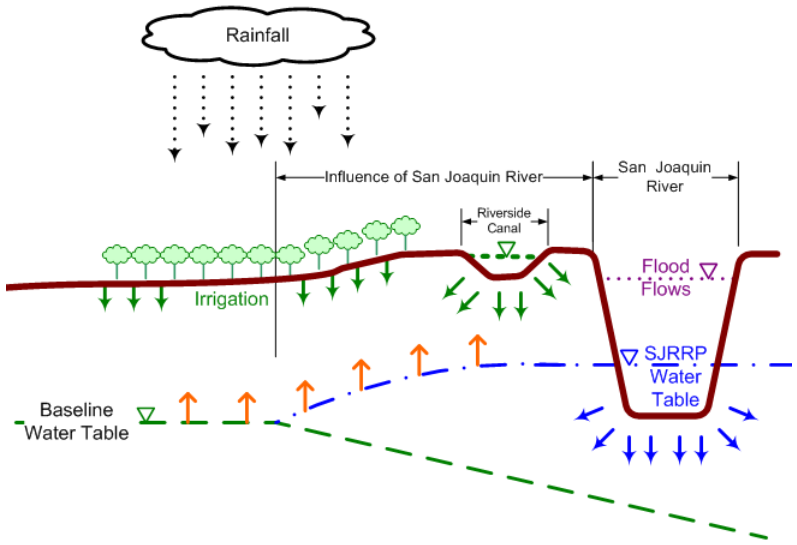
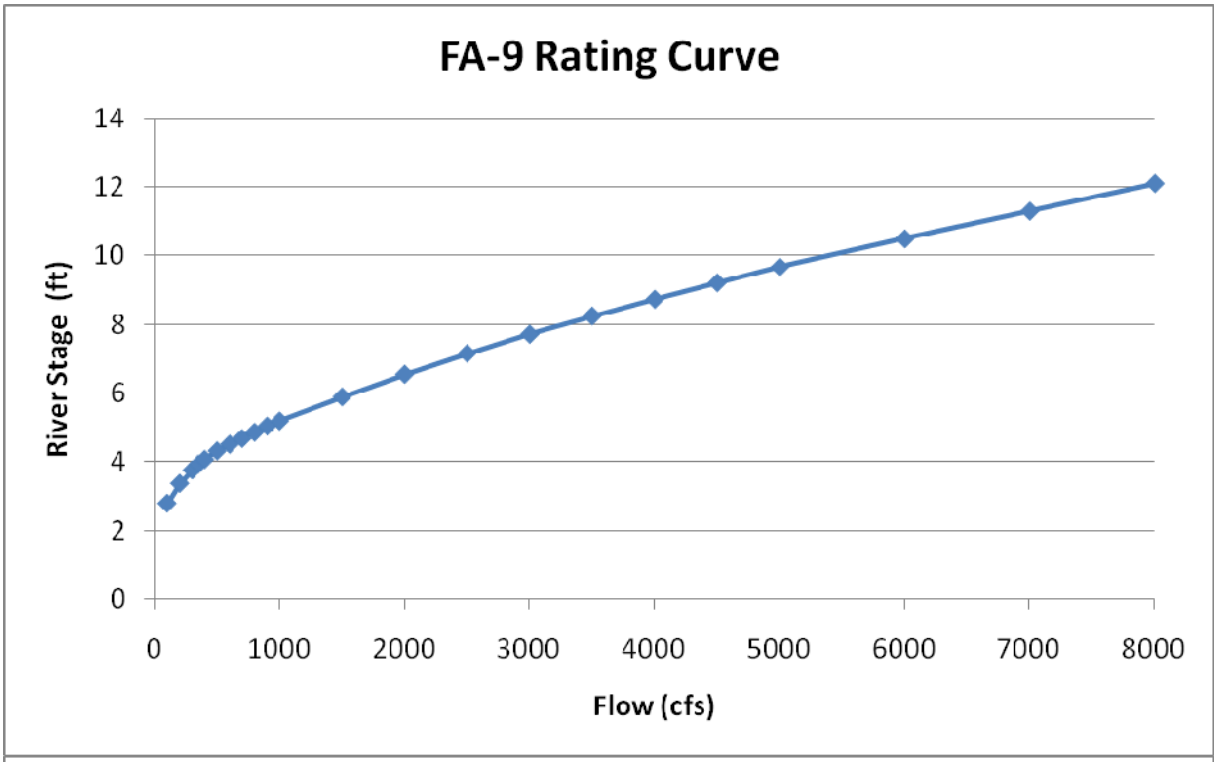
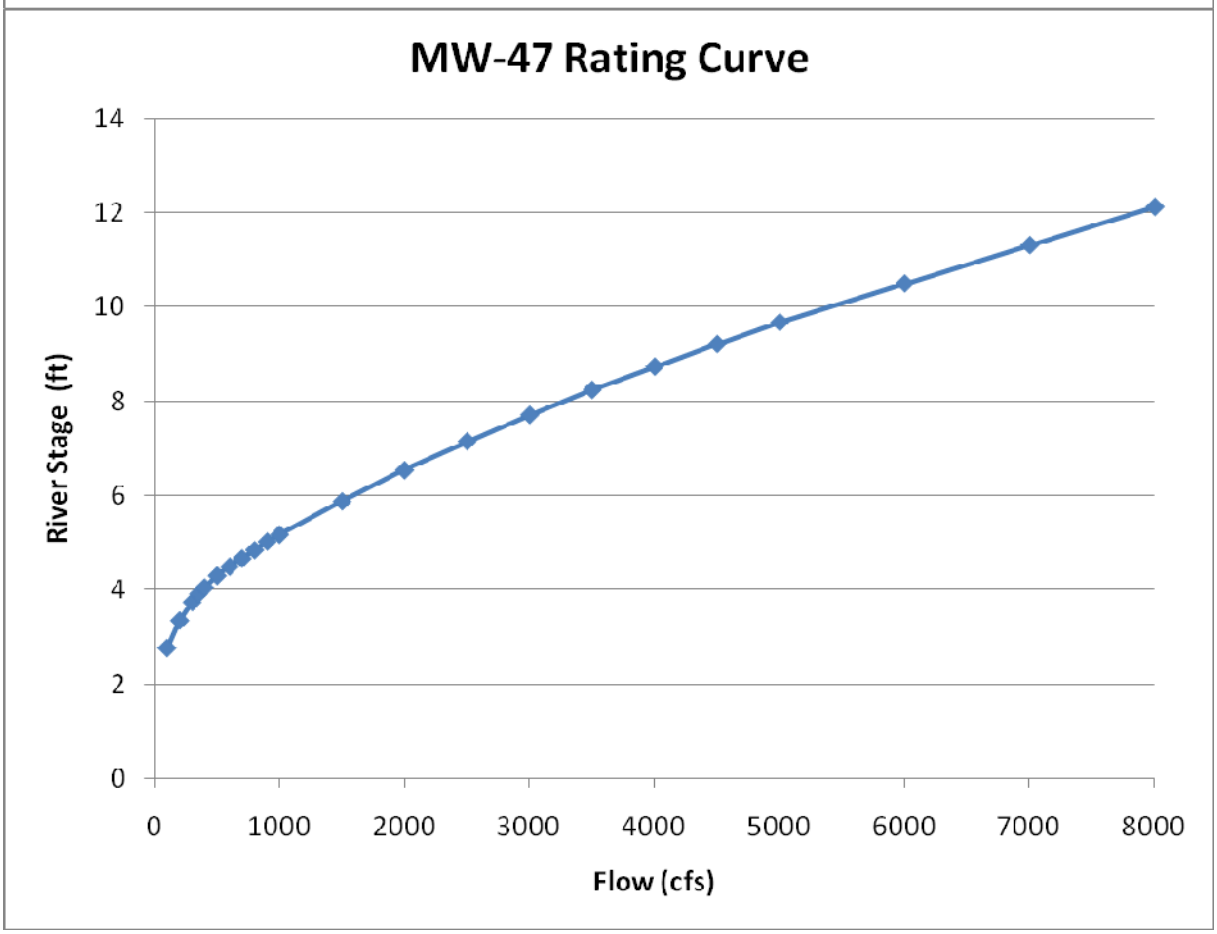
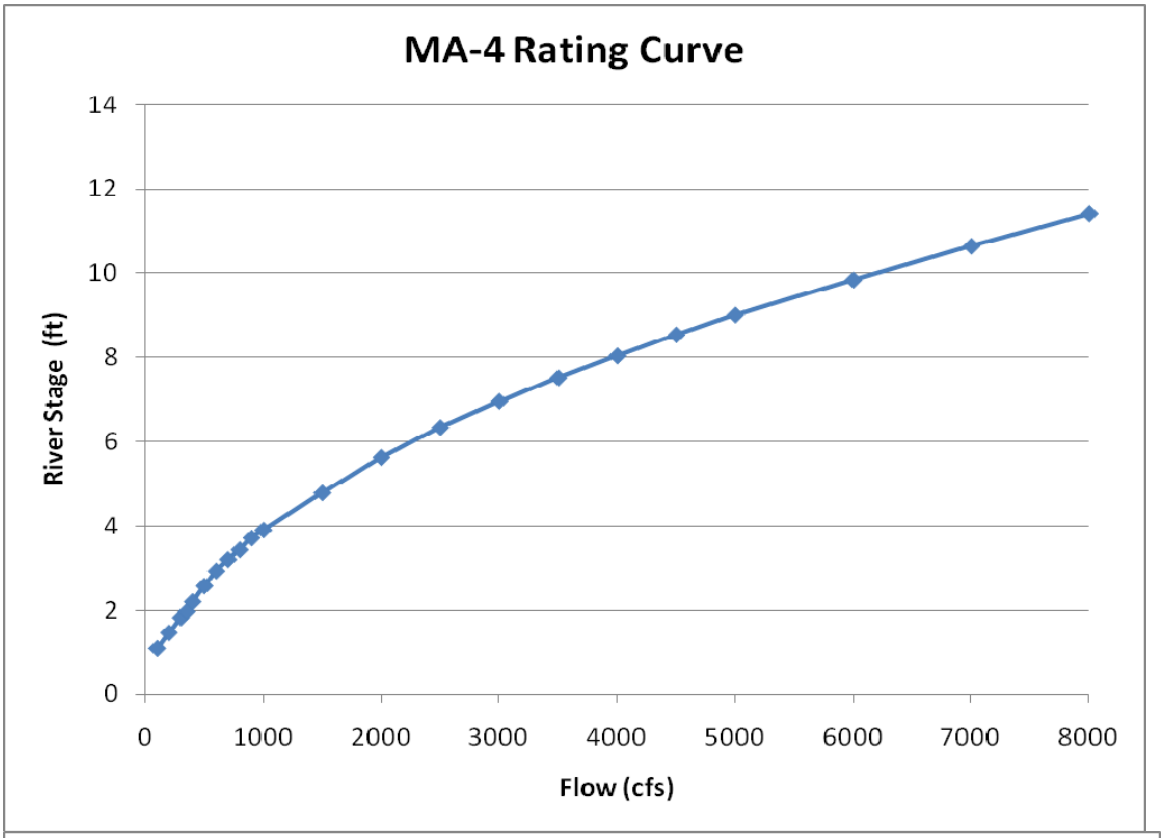
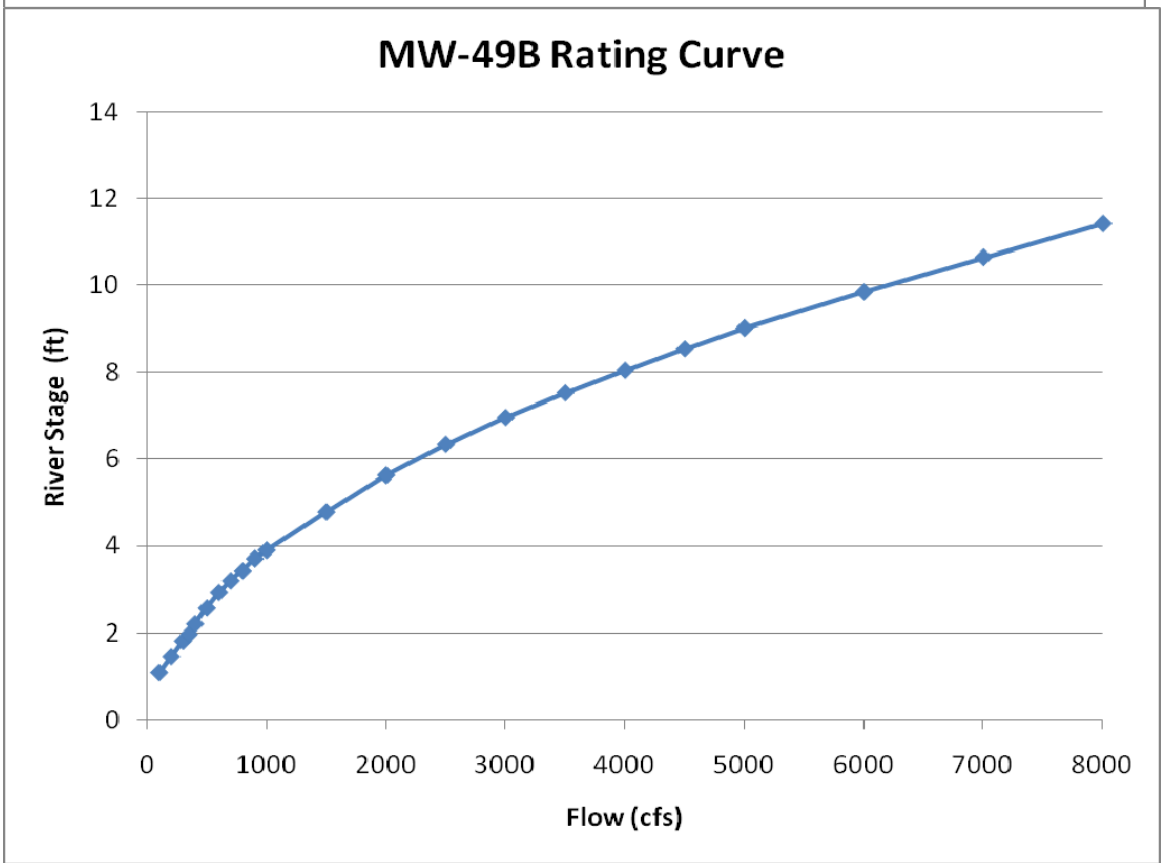


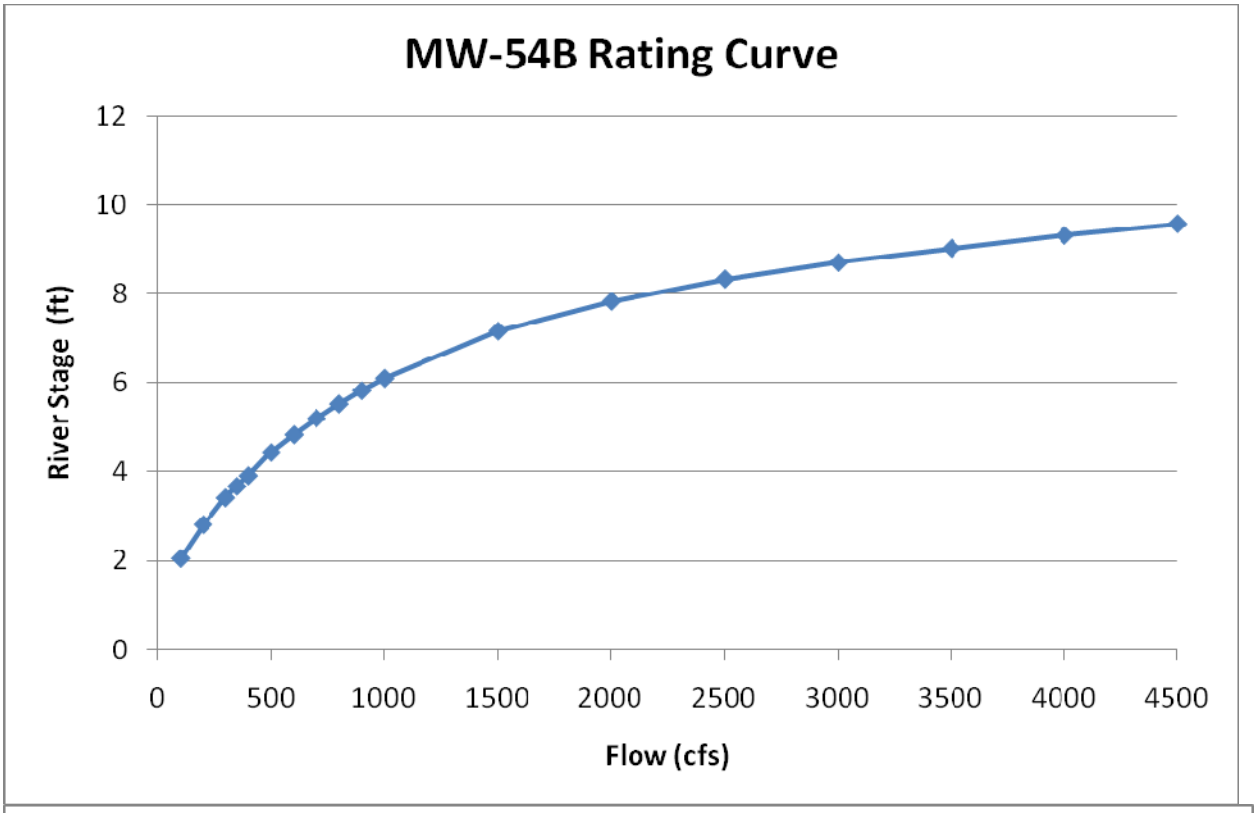

**Figure 2 Conceptual Model for Flow Bench Evaluations Estimated Groundwater Depths**

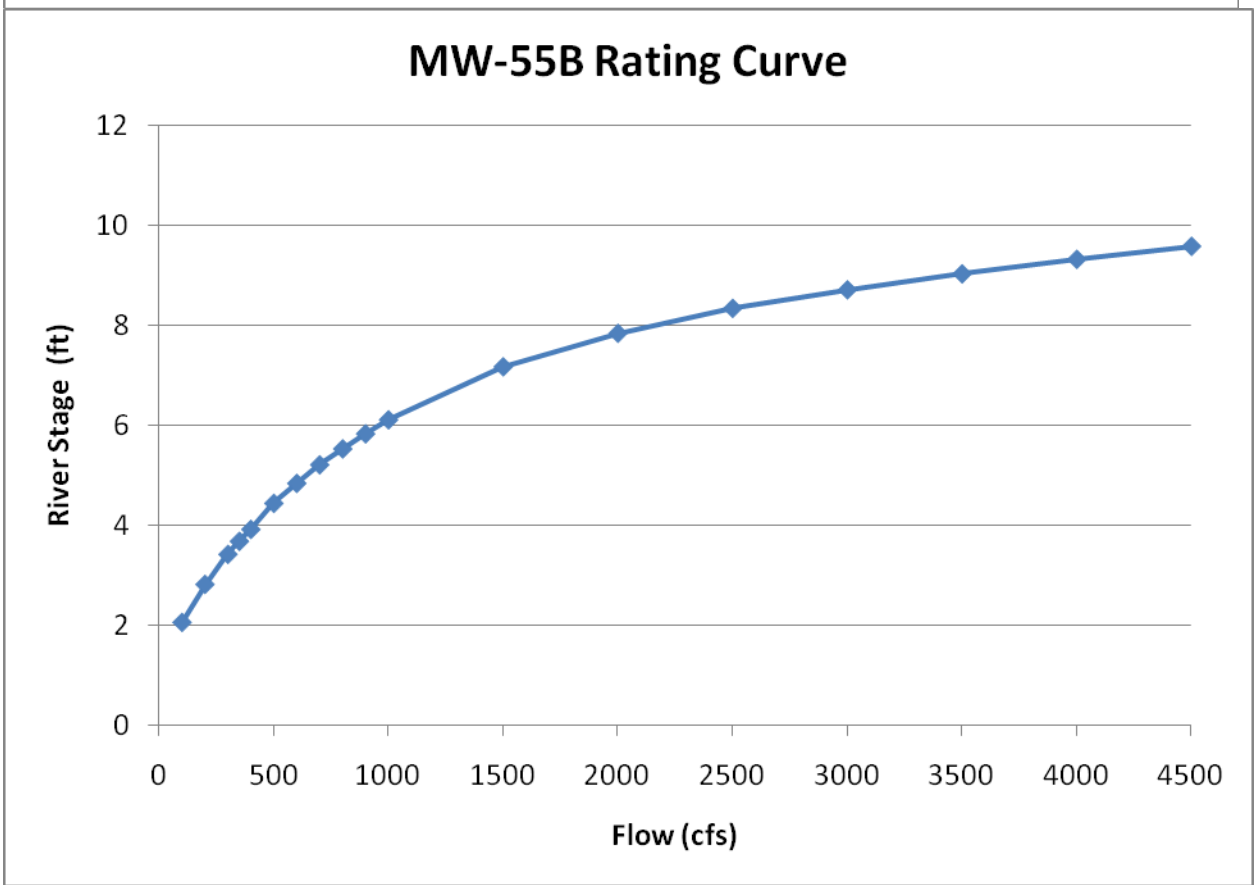

FA-9 Rating Curve
River Stage (ft)
0
2
4
6
8
10
12
14
0
1000
2000
3000
4000
5000
6000
7000
8000
Flow (cfs)

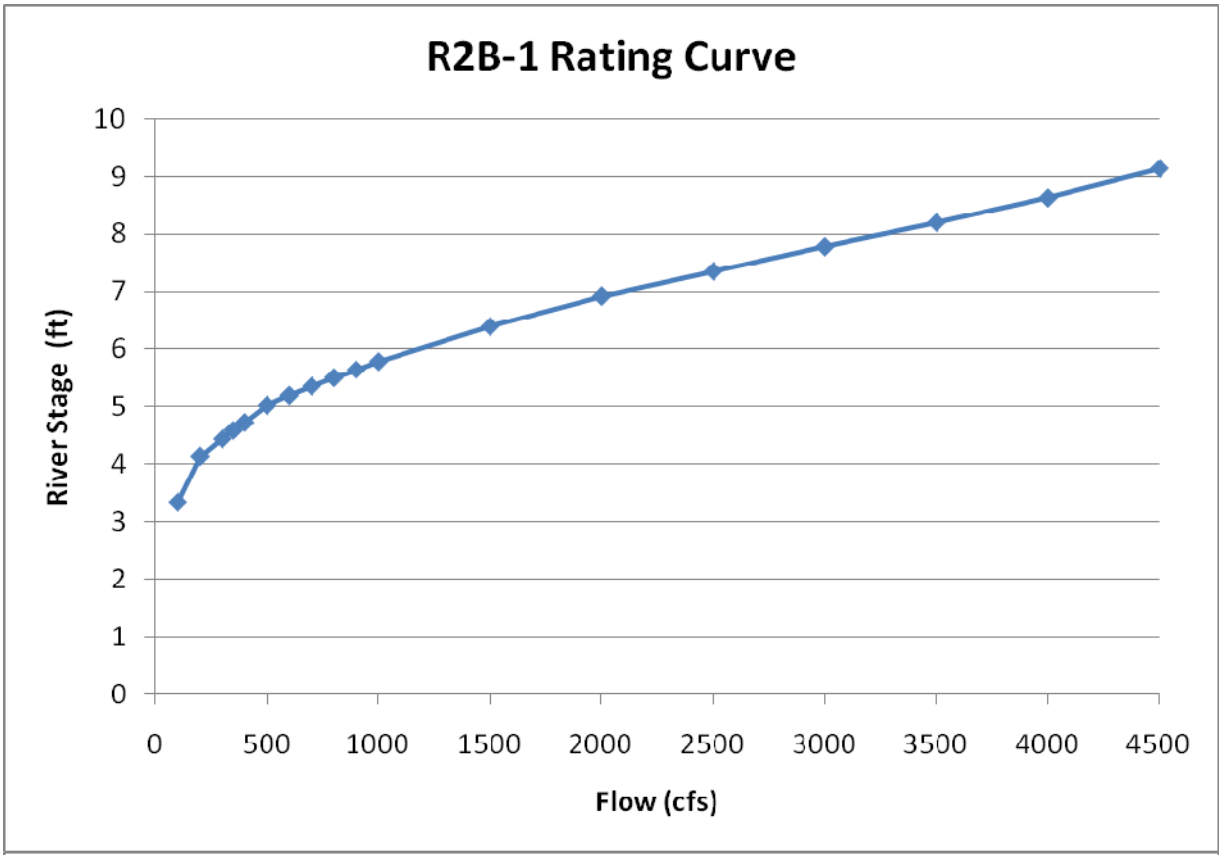

MW-47 Rating Curve
River Stage (ft)
0
2
4
6
8
10
12
14
0
1000
2000
3000
4000
5000
6000
7000
8000
Flow (cfs)

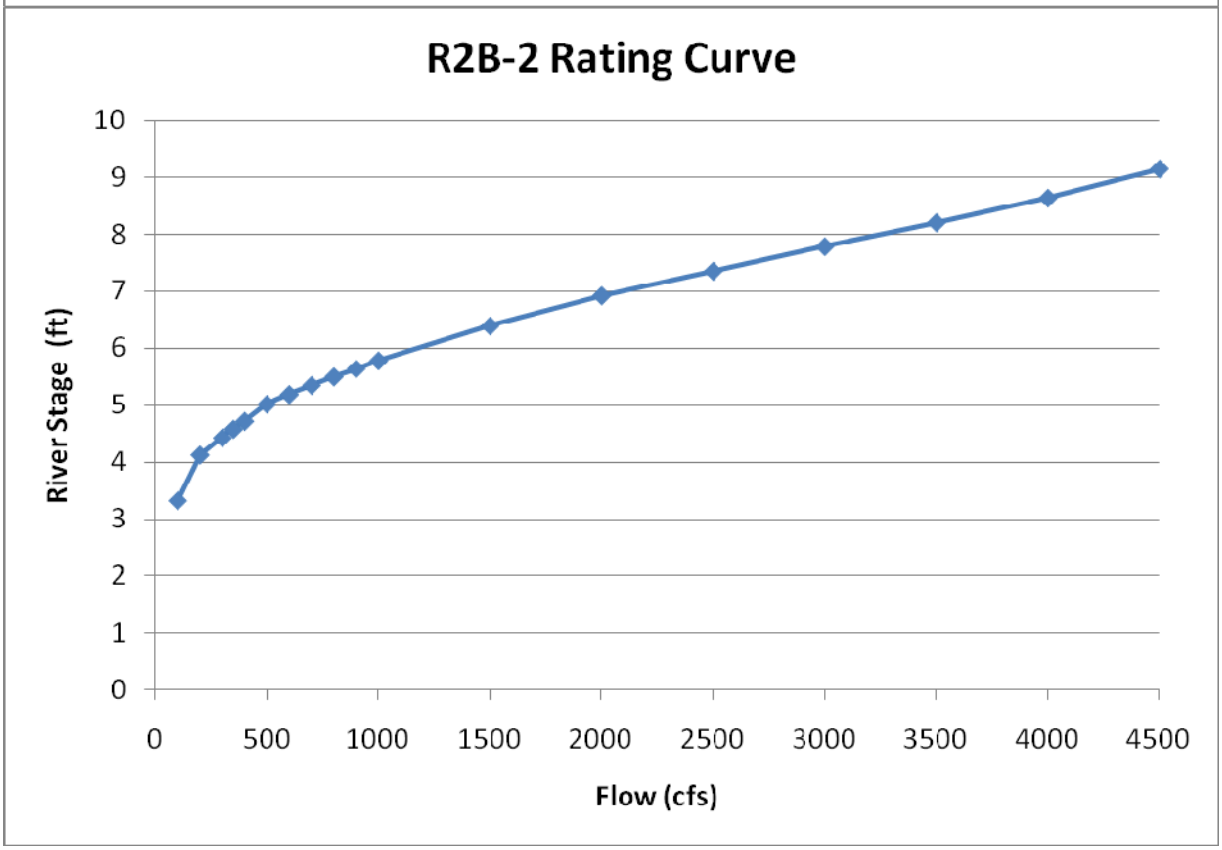

MA-4 Rating Curve
River Stage (ft)
Flow (cfs)
0
2
4
6
8
10
12
14
0
1000
2000
3000
4000
5000
6000
7000
8000

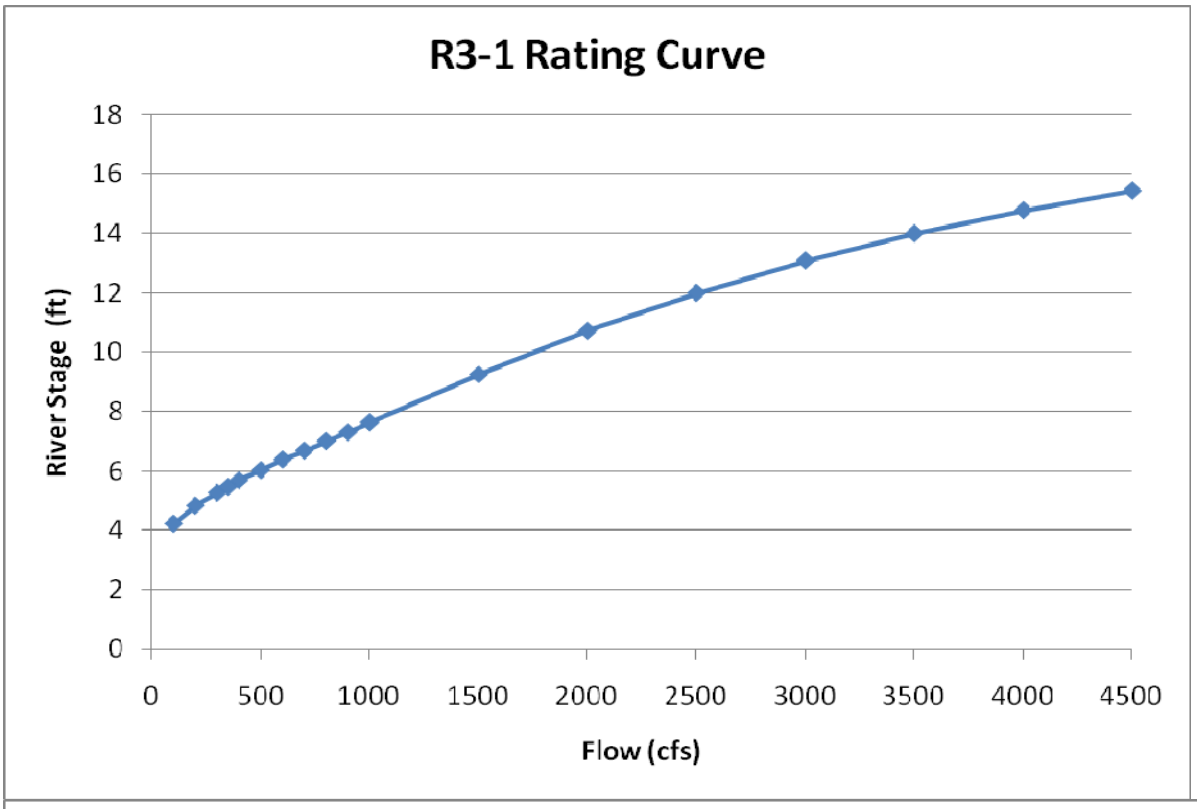

MW-49B Rating Curve
River Stage (ft)
Flow (cfs)
0
2
4
6
8
10
12
14
0
1000
2000
3000
4000
5000
6000
7000
8000

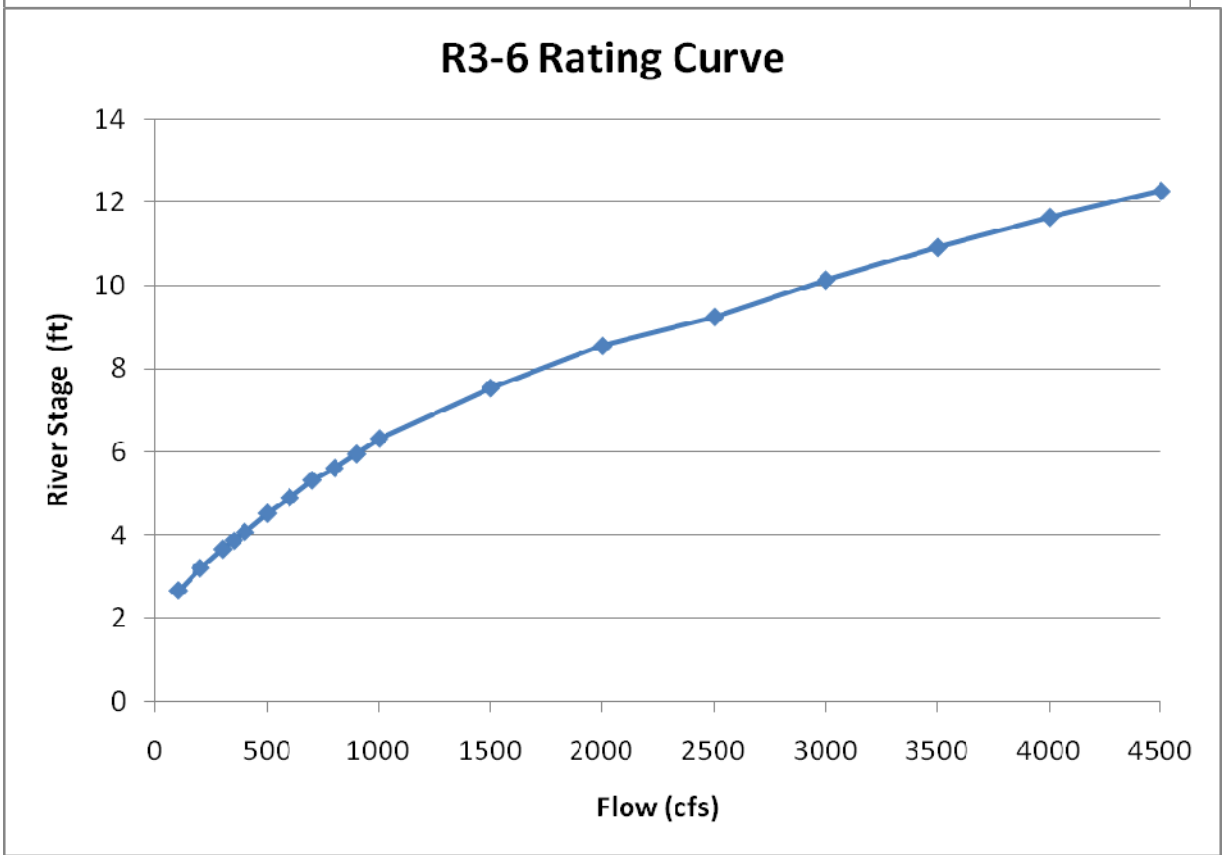

MW-54B Rating Curve
River Stage (ft)
0
2
4
6
8
10
12
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Flow (cfs)

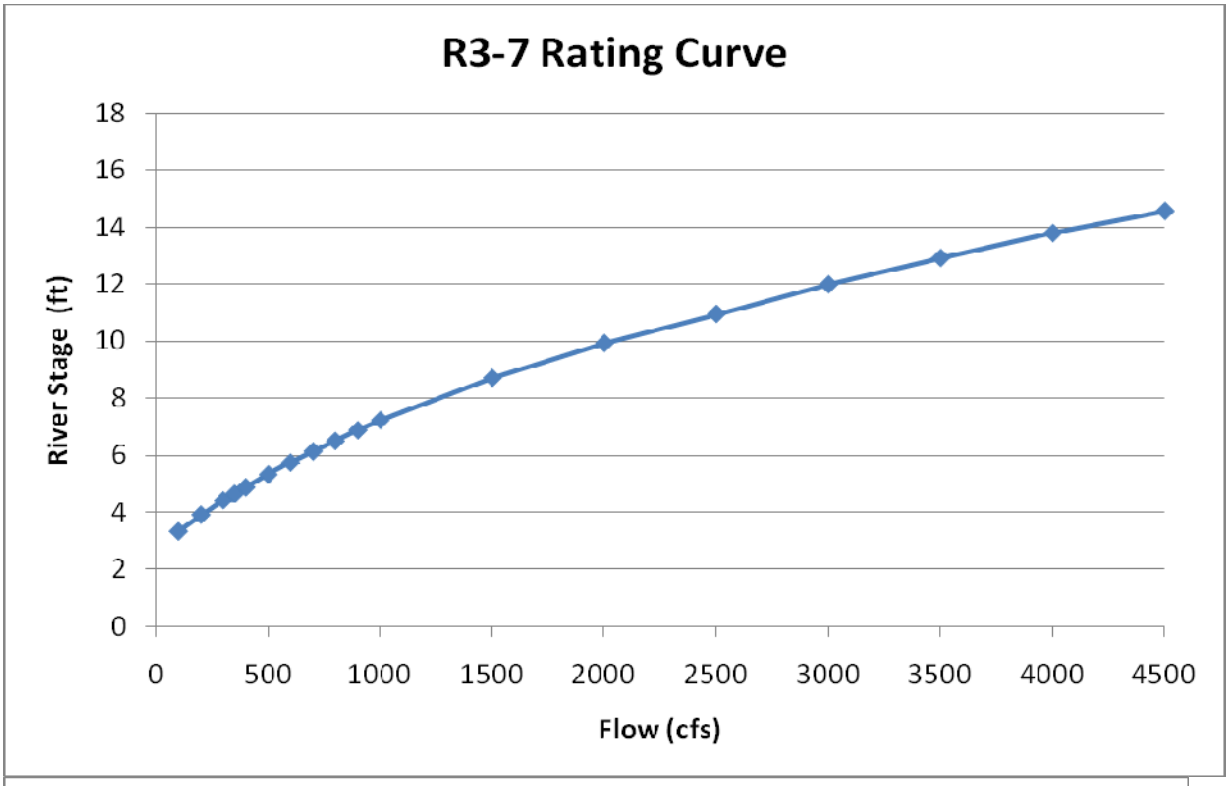

MW-55B Rating Curve
River Stage (ft)
0
2
4
6
8
10
12
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Flow (cfs)

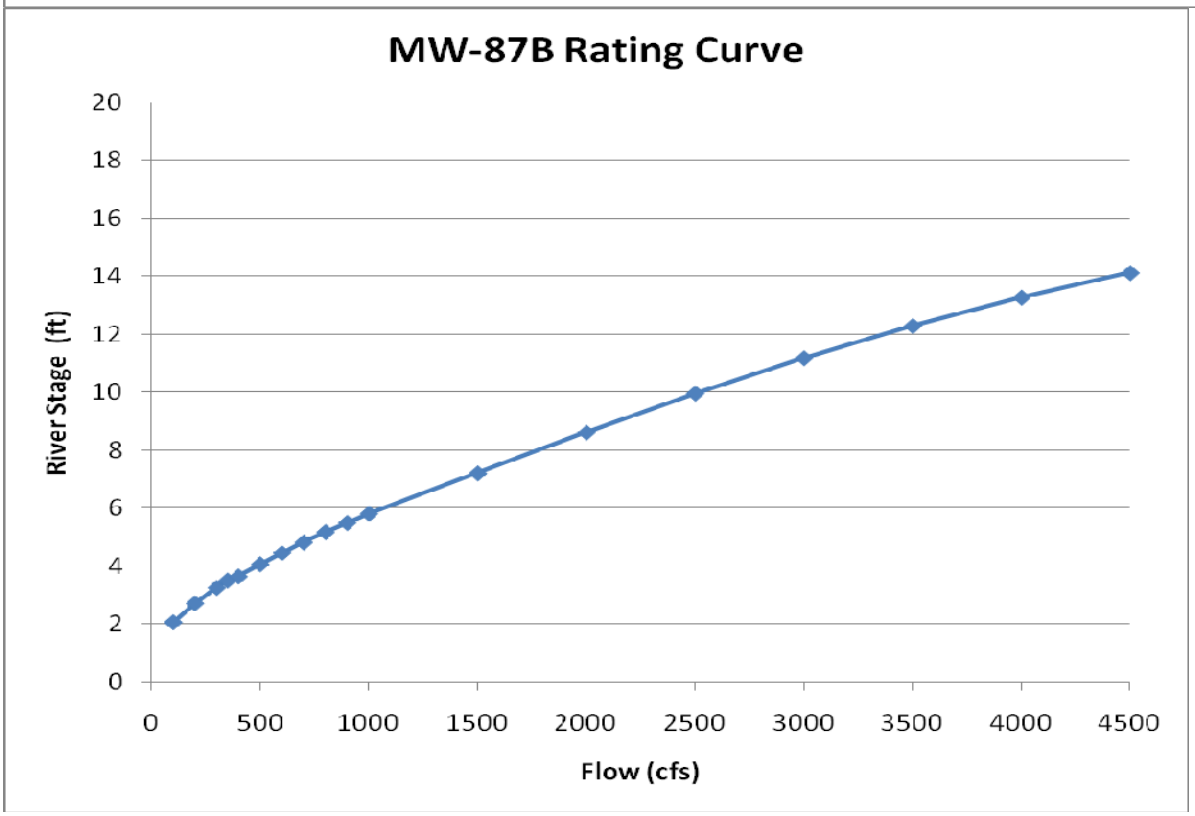

R2B-1 Rating Curve
River Stage (ft)
0
1
2
3
4
5
6
7
8
9
10
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Flow (cfs)

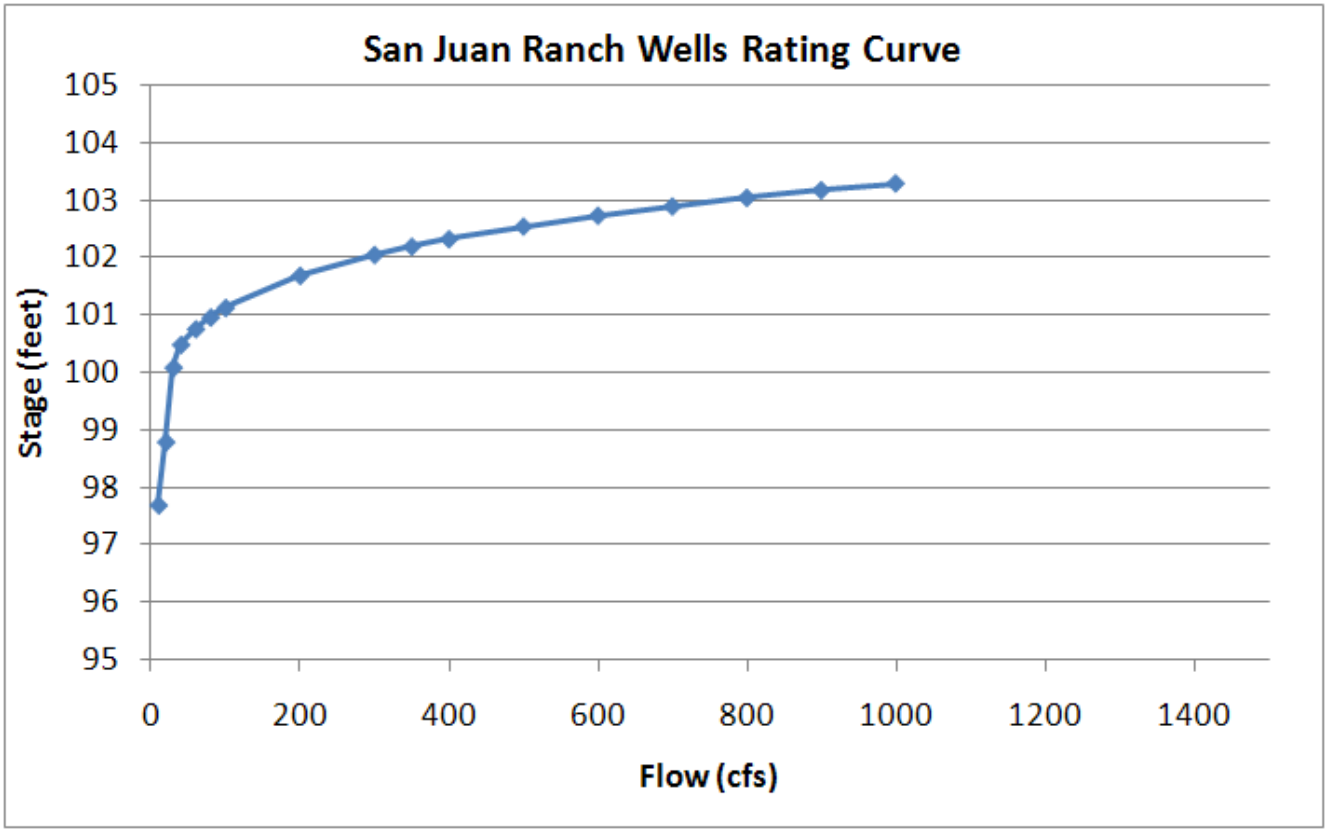

R2B-2 Rating Curve
River Stage (ft)
0
1
2
3
4
5
6
7
8
9
10
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Flow (cfs)


R3-1 Rating Curve
River Stage (ft)
0
2
4
6
8
10
12
14
16
18
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Flow (cfs)


R3-6 Rating Curve
River Stage (ft)
0
2
4
6
8
10
12
14
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Flow (cfs)


R3-7 Rating Curve
River Stage (ft)
Flow (cfs)
0
2
4
6
8
10
12
14
16
18
0
500
1000
1500
2000
2500
3000
3500
4000
4500


MW-87B Rating Curve
River Stage (ft)
Flow (cfs)
0
2
4
6
8
10
12
14
16
18
20
0
500
1000
1500
2000
2500
3000
3500
4000
4500


San Juan Ranch Wells Rating Curve
Stage (feet)
105
104
103
102
101
100
99
98
97
96
95
0
200
400
600
800
1000
1200
1400
Flow (cfs)