SJRRP Flow Bench Evaluation

October 28, 2013

The Restoration Administrator, as of October 22, 2013, recommends increasing releases from Friant Dam for Interim Flows and riparian diversions to 1050 cubic feet per second (cfs) on October 29, 2013. To date, the groundwater level in one monitoring well adjacent to the Eastside Bypass continues to restrict flows below Sack Dam to 0 cfs. The combined release from Friant Dam including Interim Flow and riparian releases will be increased to 1050 cfs on October 29, 2013 at 8:00 am.

As of October 28, 2013:

1. Channel conveyance: Flow rates are below known conveyance thresholds.

2. Operations Conference Call: During the week of October 21 and 28 the call has been held periodically for discussion of demand in Mendota Pool. Operators have raised concerns regarding the amount of exchangeable demand available in Mendota Pool. See below for additional analysis.

3. Seepage Hotline Calls: The San Joaquin River Restoration Program (SJRRP) received a concerned email from the project manager for the Highway 99 bridge replacement project on October 23, 2013. Falsework for the project was designed for a maximum flow of 1,060 cfs. The California Department of Water Resources visited the site and conducted hydraulic modeling. Their analysis determined that the falsework of the construction site should not overtop at a 1,050 cfs release from Friant Dam.

4. Real-time wells: Groundwater monitoring well levels are below thresholds. These wells do not restrict releases.

5. Priority wells: Weekly groundwater measurements in priority wells, Table 2, indicate the groundwater level is above the threshold in MW-10-95. This restricts releases below Sack Dam at this time.

6. Flow Stabilization: Flows between Friant Dam and Mendota Pool are stable.

7. Projected Groundwater Level Increases: Projected groundwater levels do not indicate levels will rise above thresholds, with the exception of the one well (MW-10-95) that is already above the threshold.

8. Levees: The LSJLD has not identified any concerns.

9. Water Districts: The SJRECWA and member agencies have identified concerns including the lack of exchangeable demand in Mendota Pool, and water quality in the lower DMC at flows less than 300 cfs. See analysis for further information. Daily operations calls will be held during the fall pulse.

Analysis

Mendota Pool Inflows: Water users have identified water quality concerns if Delta Mendota Canal flows drop below 300 cfs. Interim Flows into Mendota Pool at a 1050 cfs release are estimated at 700 cfs based on the unsteady HEC-RAS model and observed losses.

Mendota Pool Demands: Currently exchange contractor demand in Mendota Pool is approximately 1000 cfs, but is expected to decrease to between 500 and 800 cfs by November 1. Operational diversions will increase to 165 cfs of demand by November 1.

Below is the worst case scenario mass balance, with maximum predicted San Joaquin River inflows and minimum Mendota Pool demand. The SJRRP will be holding daily operations calls to manage pool demands during the pulse. Operators are aware of the potential need for changes to Delta Mendota Canal (DMC) groundwater pump-ins and seepage tile lines to improve water quality at low DMC flows.

Table 1: Approximate Predicted Mendota Pool Mass Balance

	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
Min Demand, cfs	700	500	500	500	500	500	500	500	500	500	500
WWD, cfs*			90	90	90	90	90	90	90	90	90
James, cfs*			50	50	50	50	50	50	50	50	50
Meyers, cfs*			25	25	25	25	25	25	25	25	25
Refuge or CCID, cfs*				35	35	35					
DMC, cfs*	625	425	165	0	0	0	205	205	205	205	205
Max Inflow, cfs	75	75	500	700	700	700	460	460	460	460	460

*Estimated agreements or deliveries needed

Priority well MW-10-95 (Reach 4B1 Eastside Bypass) measurements show depths to groundwater at 1.5 feet above the threshold. No water from the San Joaquin River currently reaches the Eastside Bypass. The projected water surface elevation in the Eastside Bypass adjacent to this well with 10 cfs in the channel is 92.7 feet above sea level. The threshold elevation in MW-10-95 is 92.8 feet above sea level. This does not provide enough of a gradient (0.1 feet) to allow groundwater levels to drain below the threshold. This well restricts releases past Sack Dam to 0 cfs at this time.

Data

Table 2 shows the groundwater depth in 7 realtime wells as of October 28, 2013 and manual measurements from field staff as reported in the weekly groundwater report with a publish date of October 26, 2013. 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. 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. See Figure 1 for a visual depiction and equation 1 for a mathematical one.

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

Table 2: 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	8.9	-3.7	2.5	7.7	5.0	Acceptable
MW-09-47	2A	8.9	-3.5	3.3	8.8	7.0	Acceptable
MA-4	2A	12.1	-6.1	4.6	10.6	7.0	Acceptable
MW-09-49B	2A	6.4	-1.7	2.4	7.2	4.5	Acceptable
MW-09-54B	2B	16.3	-7.9	5.5	13.9	10.0	Acceptable
MW-09-55B	2B	10.3	-3.7	3.0	9.7	7.0	Acceptable
PZ-09-R2B-1	2B	-	-1.3	0.0	-	5.0	-
PZ-09-R2B-2	2B	11.9	-3.9	0.0	8.0	4.5	Acceptable
PZ-09-R3-5	3	11.0	-1.2	0.0	9.9	5.0	Acceptable
PZ-09-R3-6	3	10.0	-1.5	0.0	8.5	4.0	Acceptable
PZ-09-R3-7	3	8.4	-0.7	0.0	7.7	3.5	Acceptable
MW-10-75	3	22.0	-0.5	0.2	21.7	6.3	Acceptable
MW-11-130	4A	12.2	0.0	0.0	12.2	5.0	Acceptable
MW-09-87B	4A	Dry	-1.9	1.0	-	4.2	-
MW-10-89	4A	24.9	-3.4	0.0	21.4	7.6	Acceptable
MW-10-92	4A	9.4	-2.6	0.0	6.8	5.0	Acceptable
MW-10-90	4B1	8.0	0.8	0.0	8.8	7.0	Acceptable
MW-10-94	4B1	15.4	0.0	1.0	16.4	7.0	Acceptable
MW-10-95	4B1	4.7	-2.2	1.0	3.5	5.0	Above Threshold
MW-11-142	4B1	7.3	0.0	0.0	7.3	4.0	Acceptable

bgs = below ground surface; GW = groundwater

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.

Table 3: Anticipated Change in Flows

	Recent Flows (cfs)	Projected Flows for Evaluation (cfs)
Reach 1	350	1050
Reach 2A	195	840
Reach 2B	115	700
Reach 3	200	200
Reach 4A	0	0
Reach 4B1 (ESB)	0	0

Table 4 shows the current and maximum rise in groundwater based on estimated changes in river stage and the conceptual model shown in Figures 1 and 2. Field depths are calculated by taking the most recent measurements from Table 1, adding the ground surface and the lateral gradient buffer, and subtracting the maximum predicted stage increase, as shown below in Equation 2.

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

See Figure 4 and the last pages for the locations of these monitoring wells and 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. These rating curves are used to determine the maximum predicted increase in water surface elevation, as shown in Figure 1.

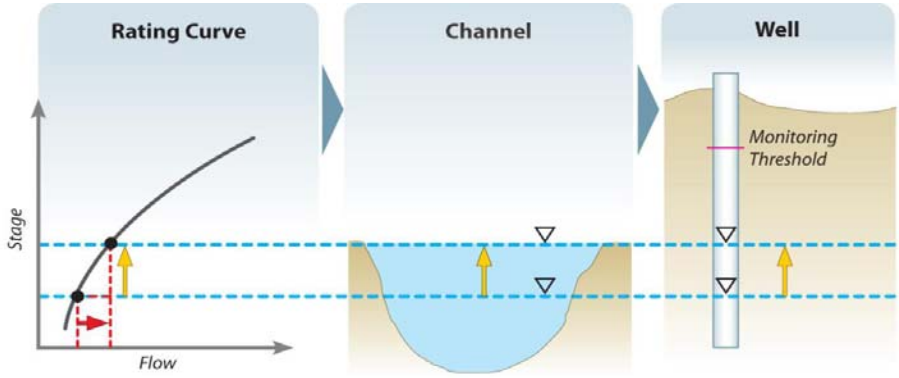


Figure 1: One to one surface to groundwater relationship for Increase in Stage Method

Table 4: Predicted Groundwater Levels for Key Wells – Increase in Stage Method

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 Field GW Depth (feet bgs)	5 - Field Threshold (feet bgs)	Comment
FA-9	2A	8.9	-3.7	2.5	7.7	1.5	6.2	5.0	Acceptable
MW-09-47	2A	8.9	-3.5	3.3	8.8	1.5	7.3	7.0	Acceptable
MA-4	2A	12.1	-6.1	4.6	10.6	2.2	8.5	7.0	Acceptable
MW-09-49B	2A	6.4	-1.7	2.4	7.2	2.1	5.1	4.5	Acceptable
MW-09-54B	2B	16.3	-7.9	5.5	13.9	2.4	11.5	10.0	Acceptable
MW-09-55B	2B	10.3	-3.7	3.0	9.7	2.4	7.3	7.0	Acceptable
PZ-09-R2B-1	2B	-	-1.3	0.0	-	0.3	-	5.0	-
PZ-09-R2B-2	2B	11.9	-3.9	0.0	8.0	0.0	-	4.5	Acceptable
PZ-09-R3-5	3	11.0	-1.2	0.0	9.9	0.0	9.9	5.0	Acceptable
PZ-09-R3-6	3	10.0	-1.5	0.0	8.5	0.0	8.5	4.0	Acceptable
PZ-09-R3-7	3	8.4	-0.7	0.0	7.7	0.0	7.7	3.5	Acceptable
MW-10-75	3	22.0	-0.5	0.2	21.7	0.0	21.7	6.3	Acceptable
MW-11-130	4A	12.2	0.0	0.0	12.2	0.0	12.2	5.0	Acceptable
MW-09-87B	4A	Dry	-1.9	1.0	-	0.0	-	4.2	-
MW-10-89	4A	24.9	-3.4	0.0	21.4	0.0	21.4	7.6	Acceptable
MW-10-92	4A	9.4	-2.6	0.0	6.8	0.0	6.8	5.0	Acceptable
MW-10-90	4B1	8.0	0.8	0.0	8.8	0.0	8.8	7.0	Acceptable
MW-10-94	4B1	15.4	0.0	1.0	16.4	0.0	16.4	7.0	Acceptable
MW-10-95	4B1	4.7	-2.2	1.0	3.5	0.0	3.5	5.0	Above Threshold
MW-11-142	4B1	7.3	0.0	0.0	7.3	0.0	7.3	4.0	Acceptable

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

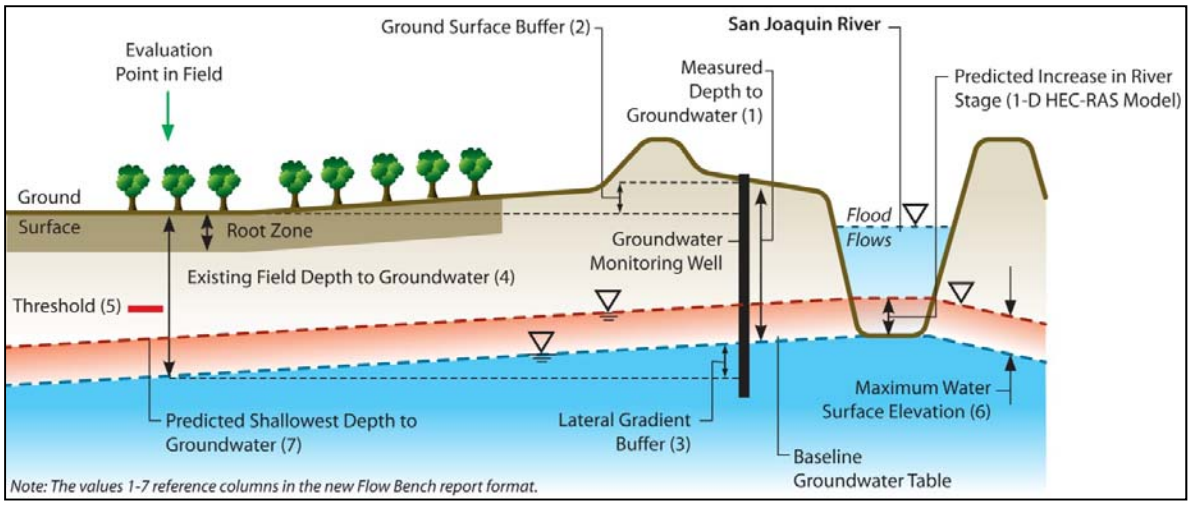


Figure 2: Conceptual Model for Increase in Stage Method

Table 4 shows the predicted maximum rise in groundwater based the elevation of the water surface in the river and the conceptual model shown in Figure 3. Reclamation uses this drainage method where current groundwater levels are higher than thresholds without flows in the San Joaquin River. A predicted water surface elevation (WSEL) above (or within 0.3 feet) of the threshold elevation does not allow drainage and therefore restricts flows.

Table 5: Predicted Groundwater Elevation for Key Wells – Drainage Method

Well	Reach	10 - Existing Field GW Elevation (feet)	11 - Predicted WSEL (feet)	12 - Threshold Elevation (feet)	Drainage Method Comment
MW-10-90	4B1	93.3	94.0	95.1	Acceptable
MW-10-94	4B1	85.2	92.4	95.6	Acceptable
MW-10-95	4B1	93.3	92.4	92.8	Acceptable

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

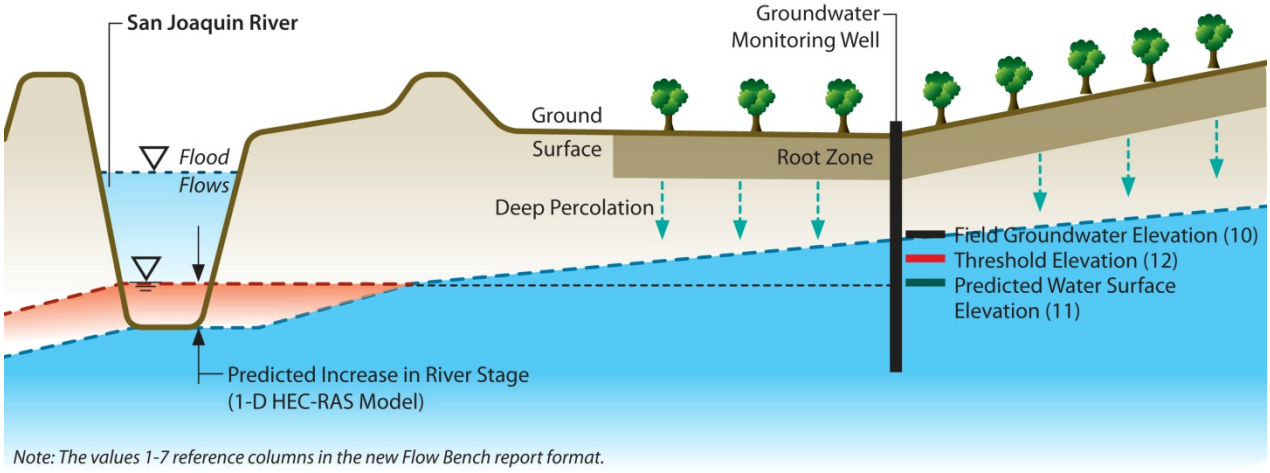


Figure 3: Conceptual Model for Drainage Method

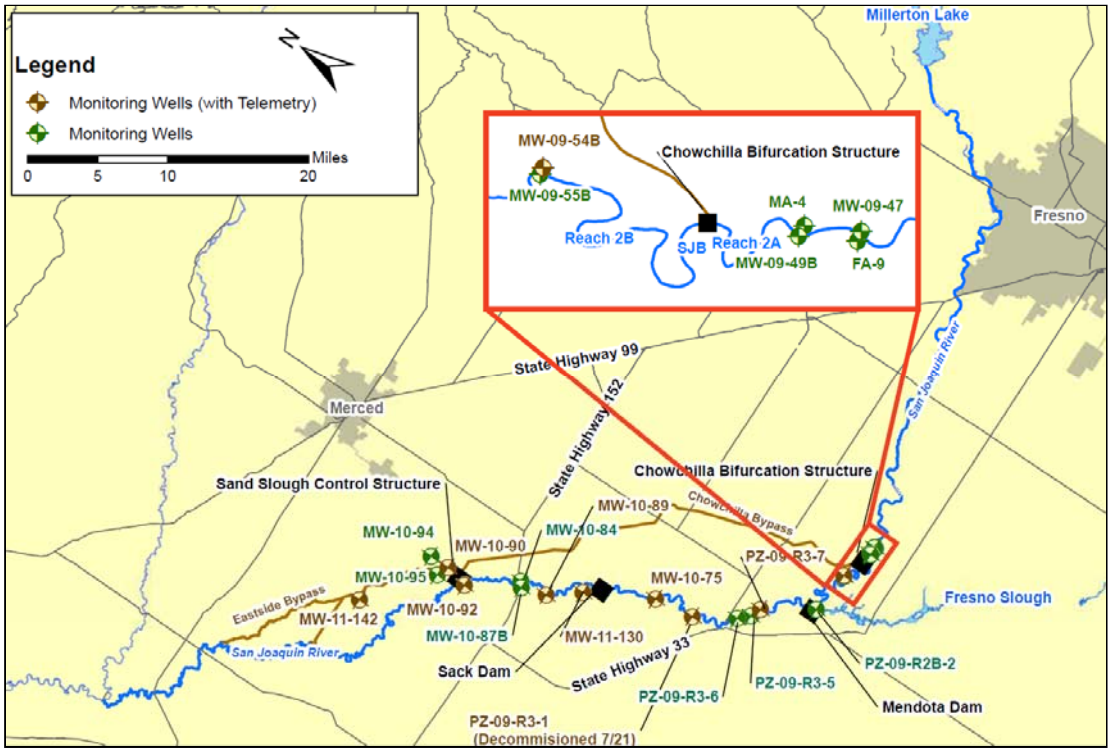
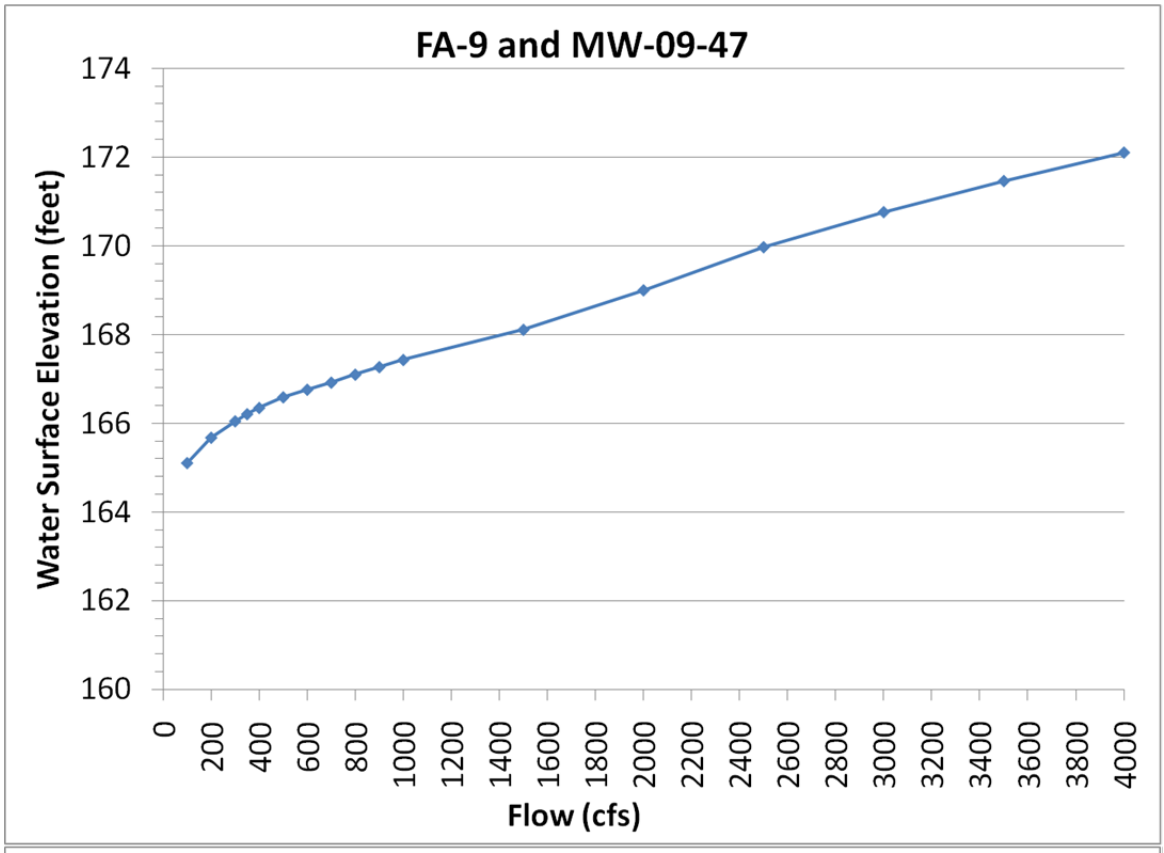
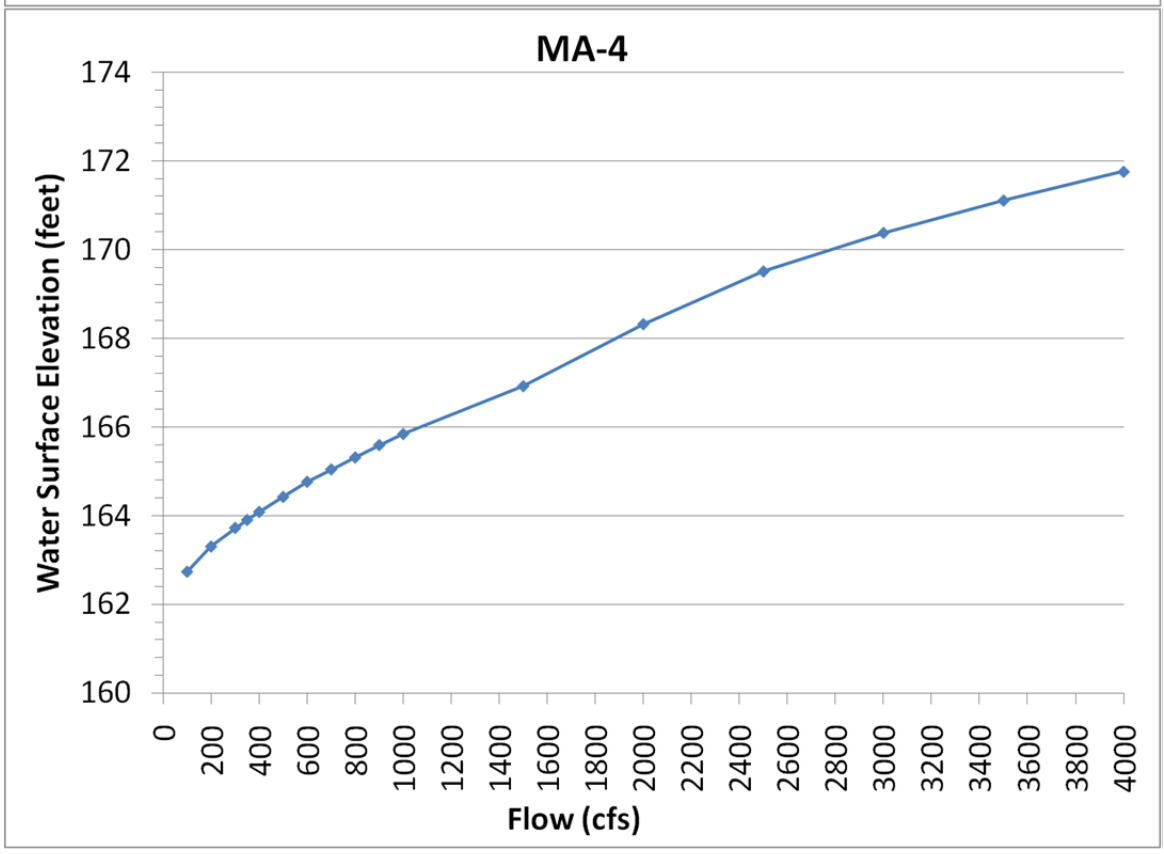
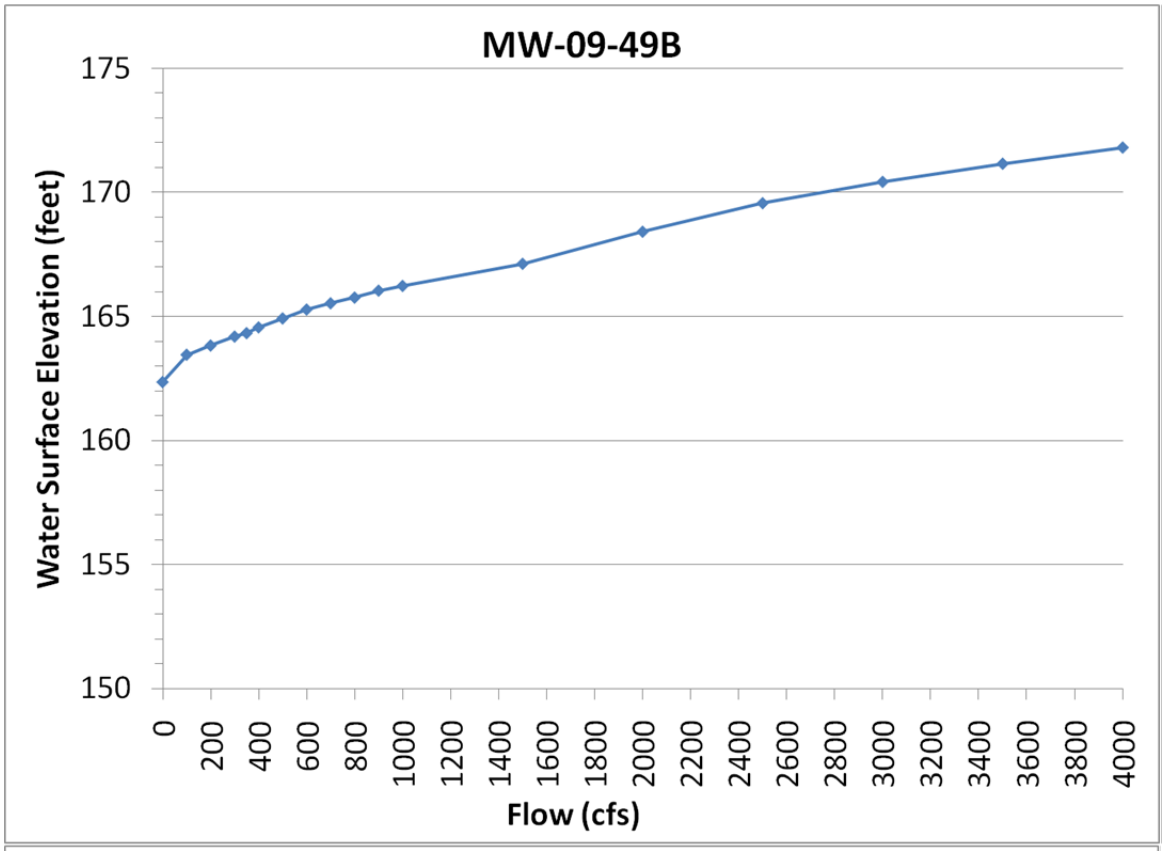
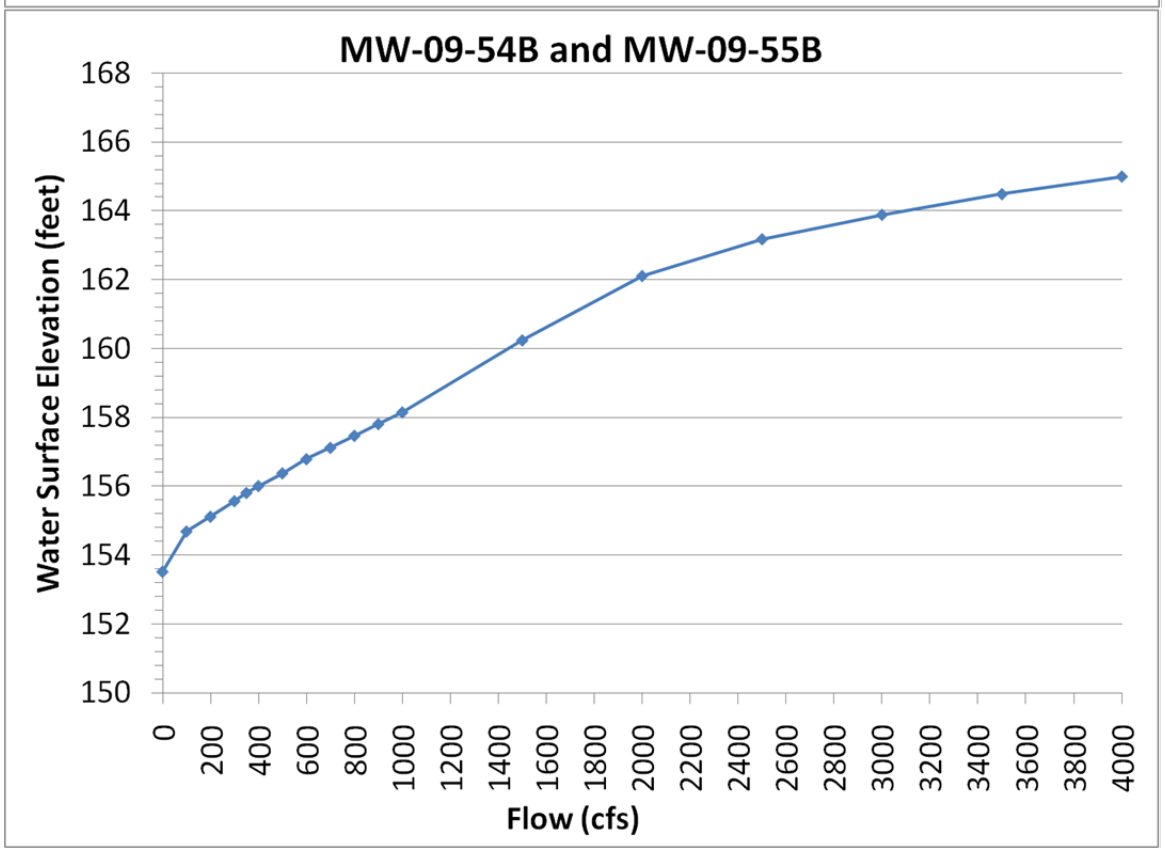


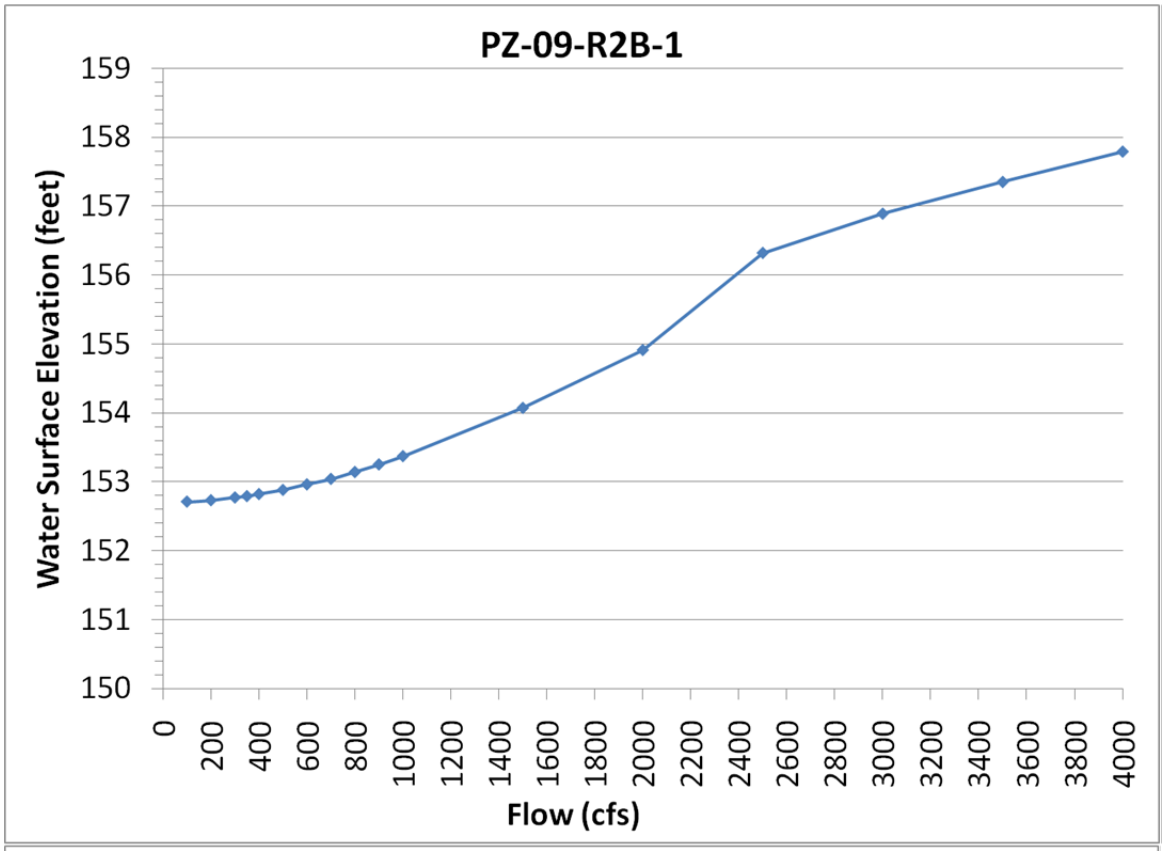
Figure 4: Key Monitoring Well Locations

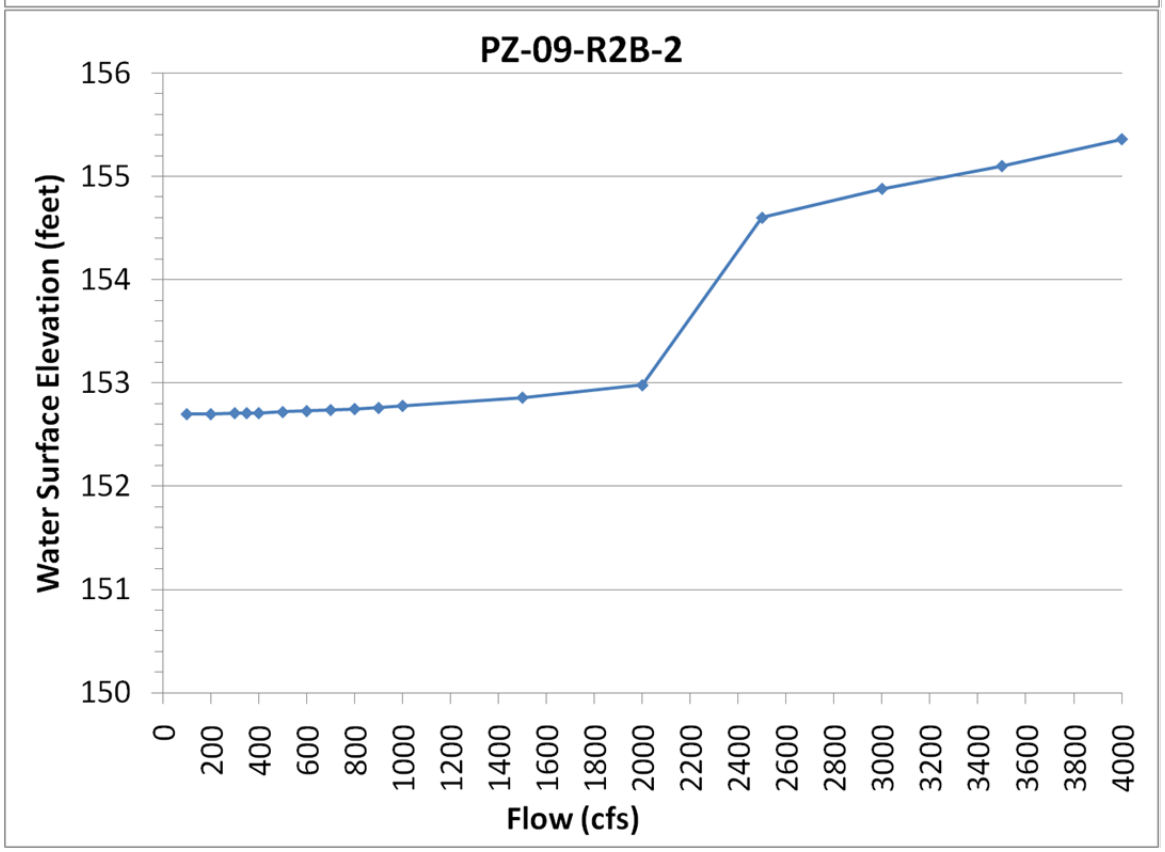

FA-9 and MW-09-47
Water Surface Elevation (feet)
174
172
170
168
166
164
162
160
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

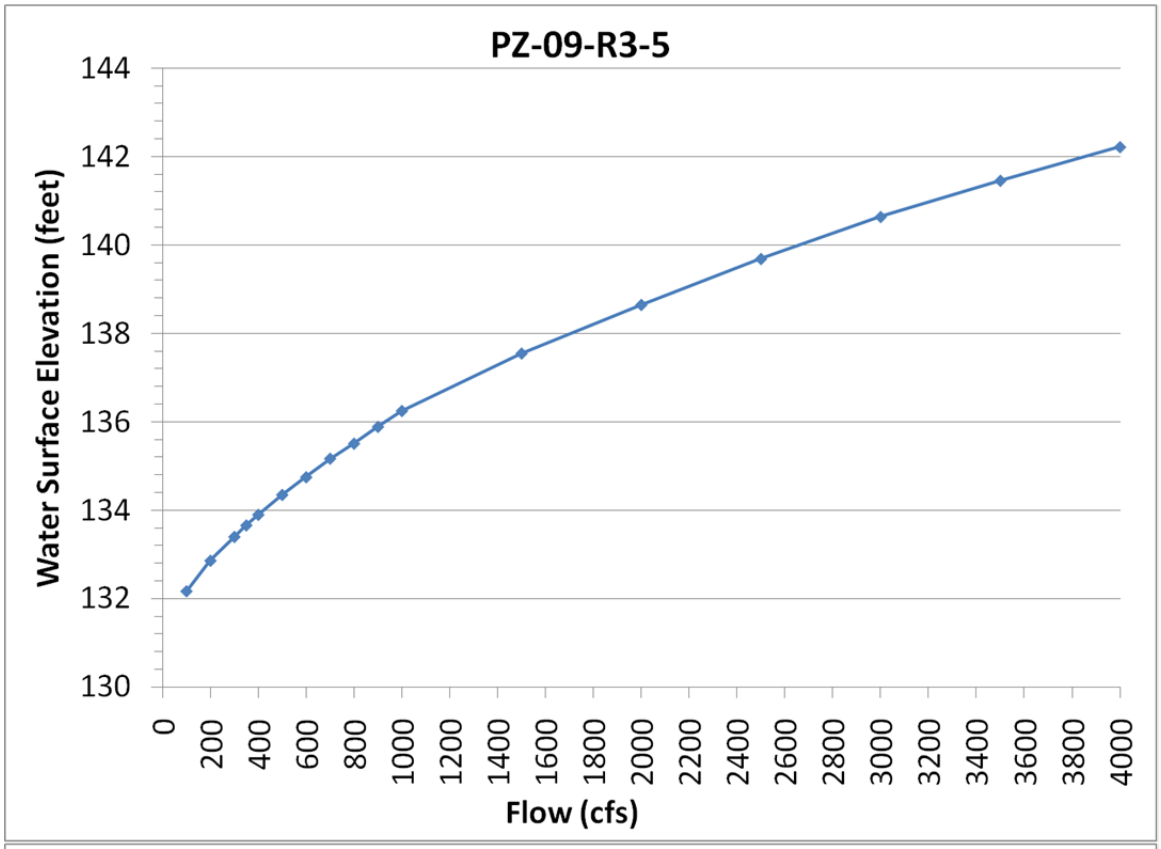

MA-4
Water Surface Elevation (feet)
174
172
170
168
166
164
162
160
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

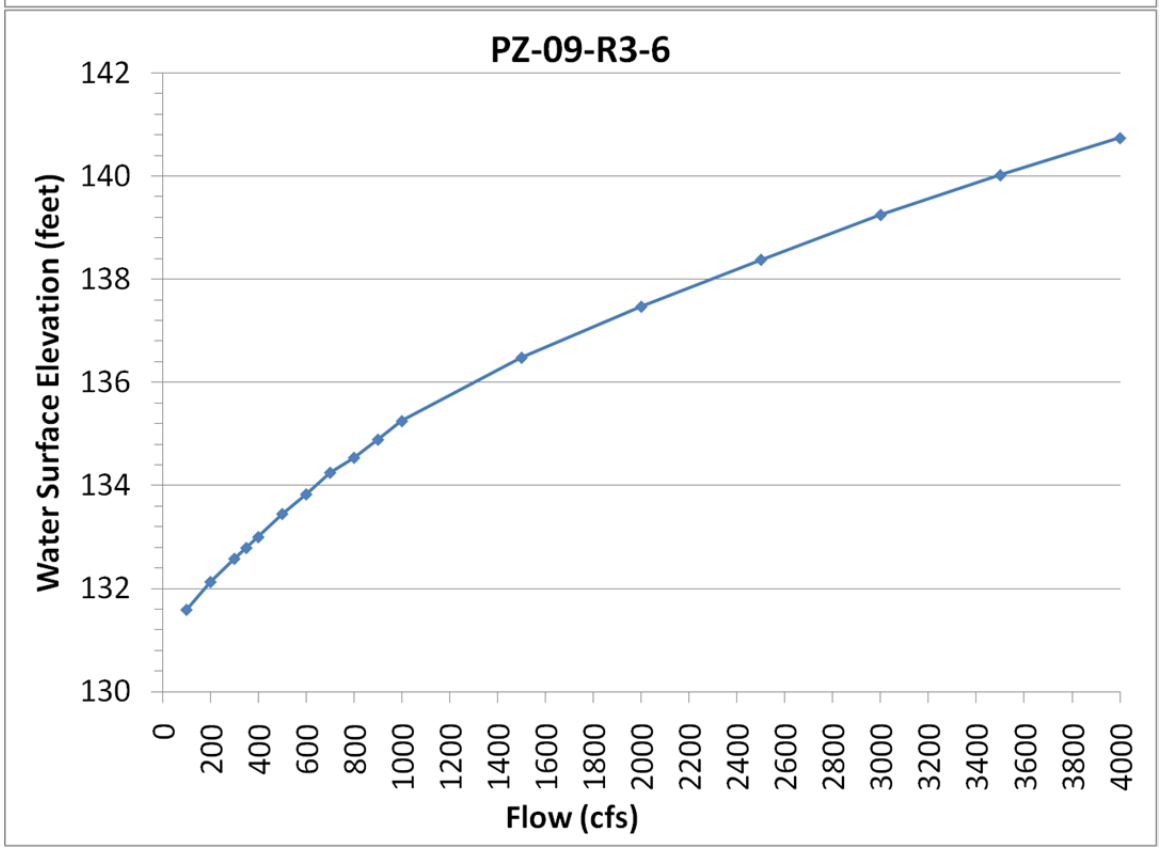

MW-09-49B
Water Surface Elevation (feet)
175
170
165
160
155
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

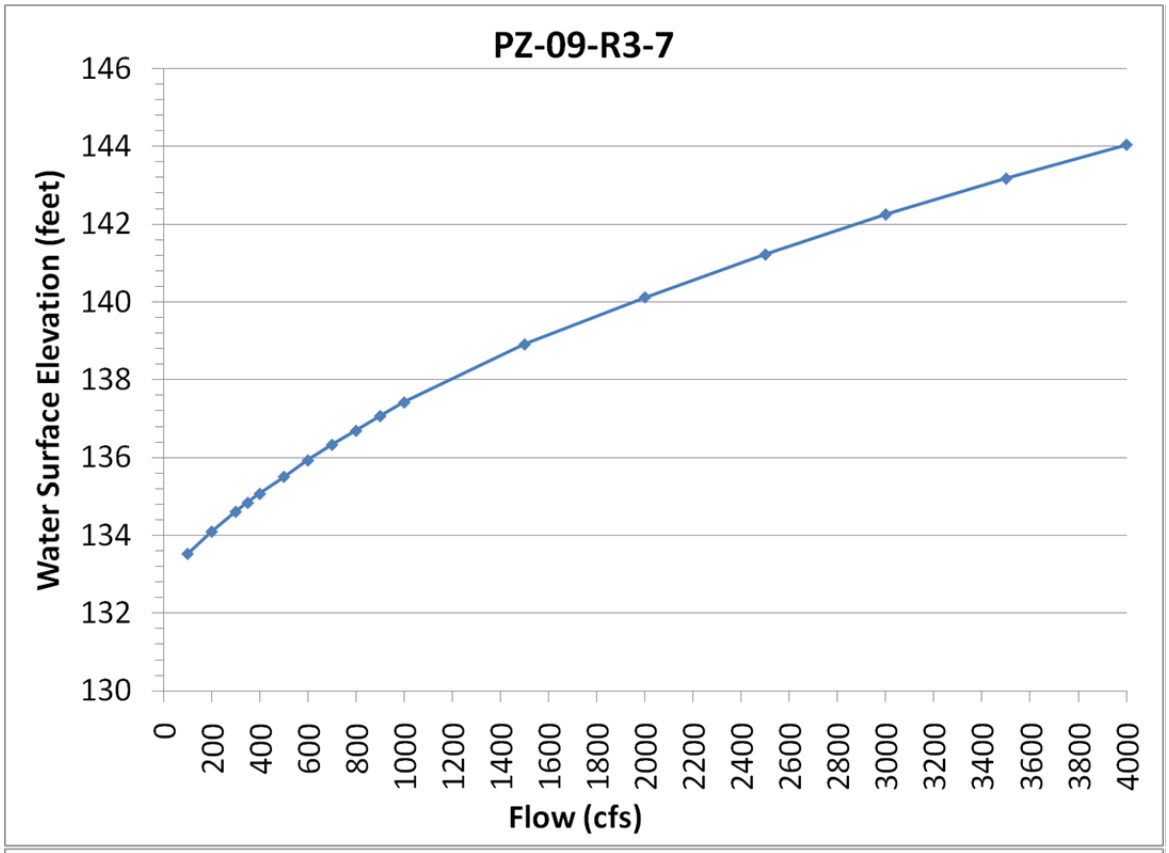

MW-09-54B and MW-09-55B
Water Surface Elevation (feet)
168
166
164
162
160
158
156
154
152
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

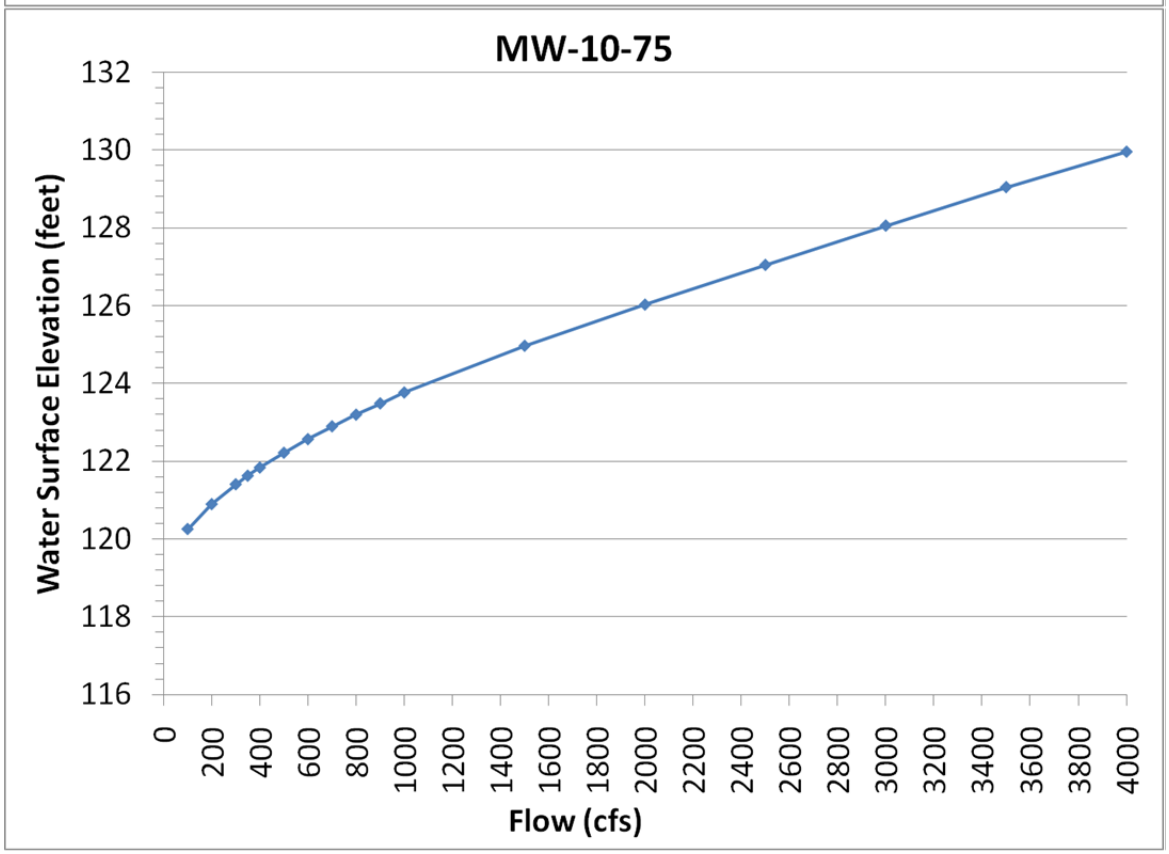

PZ-09-R2B-1
Water Surface Elevation (feet)
159
158
157
156
155
154
153
152
151
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

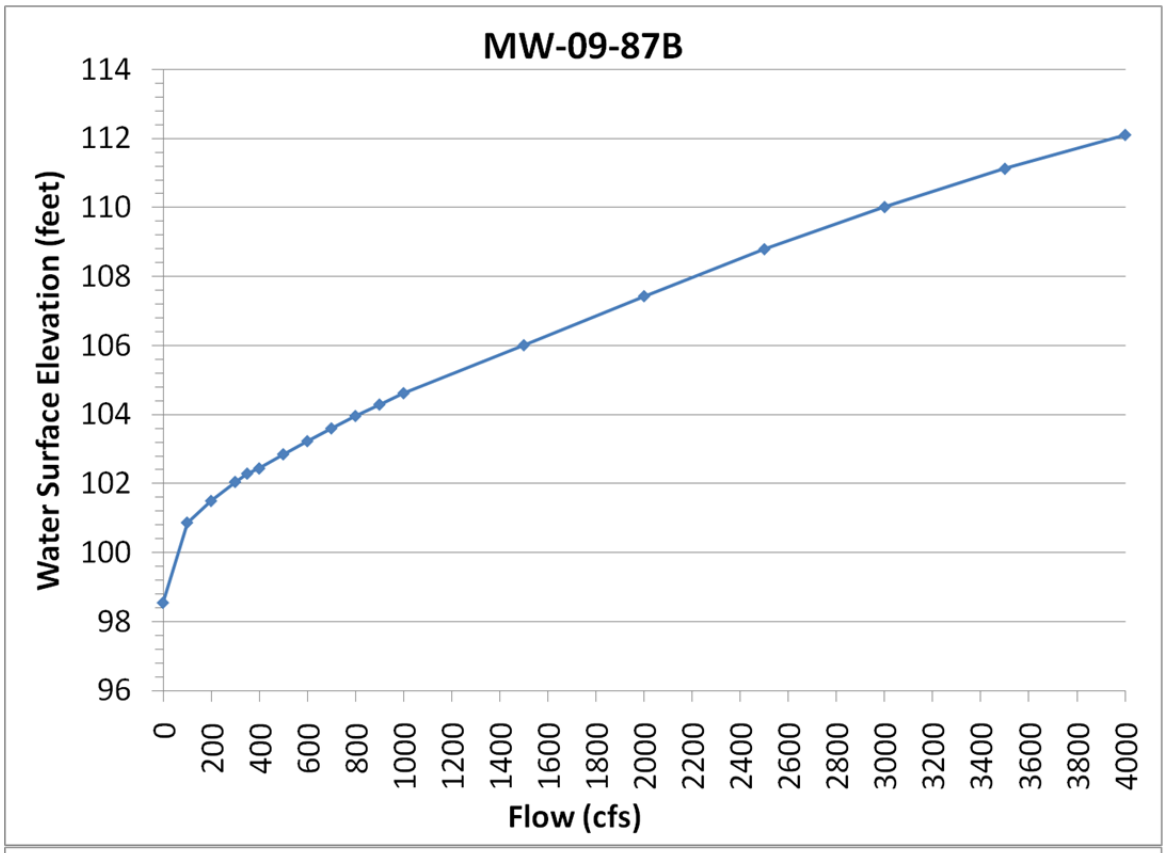

PZ-09-R2B-2
Water Surface Elevation (feet)
156
155
154
153
152
151
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

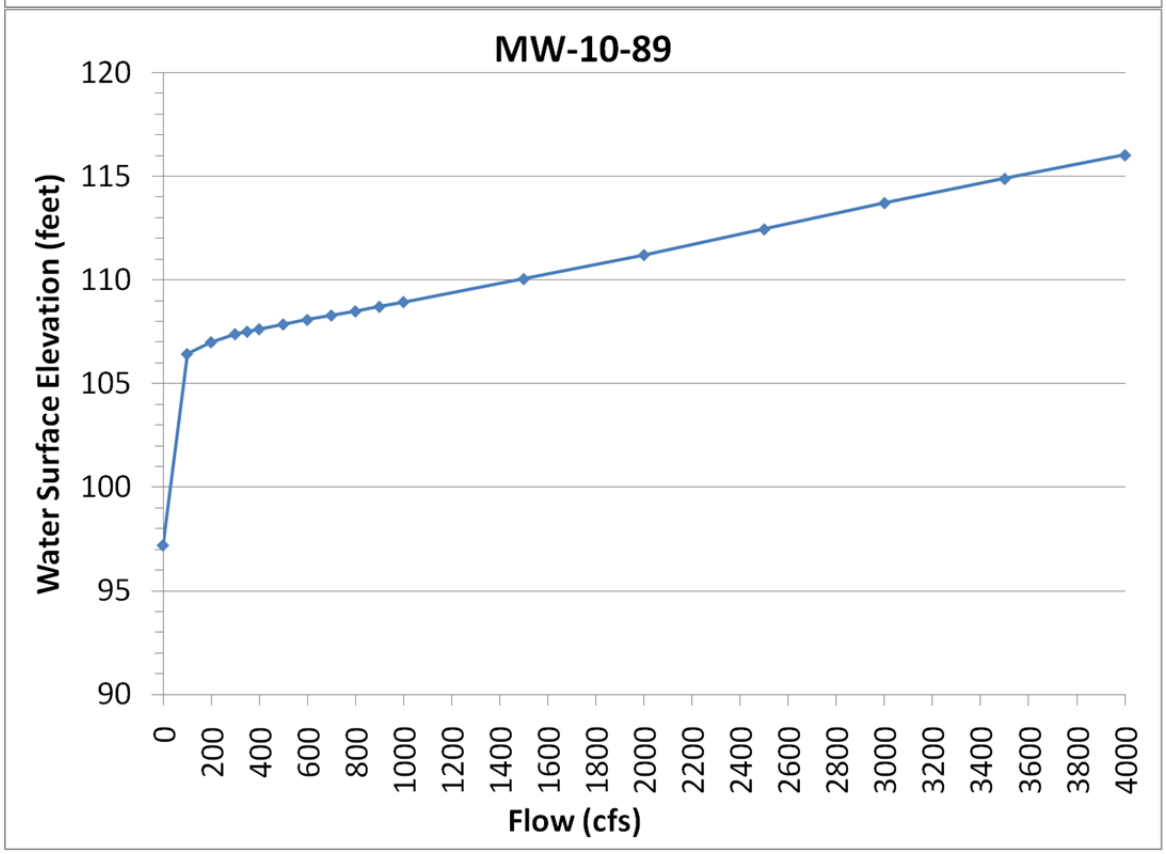

PZ-09-R3-5
Water Surface Elevation (feet)
144
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


PZ-09-R3-6
Water Surface Elevation (feet)
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


PZ-09-R3-7
Water Surface Elevation (feet)
146
144
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-75
Water Surface Elevation (feet)
132
130
128
126
124
122
120
118
116
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-09-87B
Water Surface Elevation (feet)
114
112
110
108
106
104
102
100
98
96
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-89
Water Surface Elevation (feet)
120
115
110
105
100
95
90
0
200
400
600
800
1000
1200
1400
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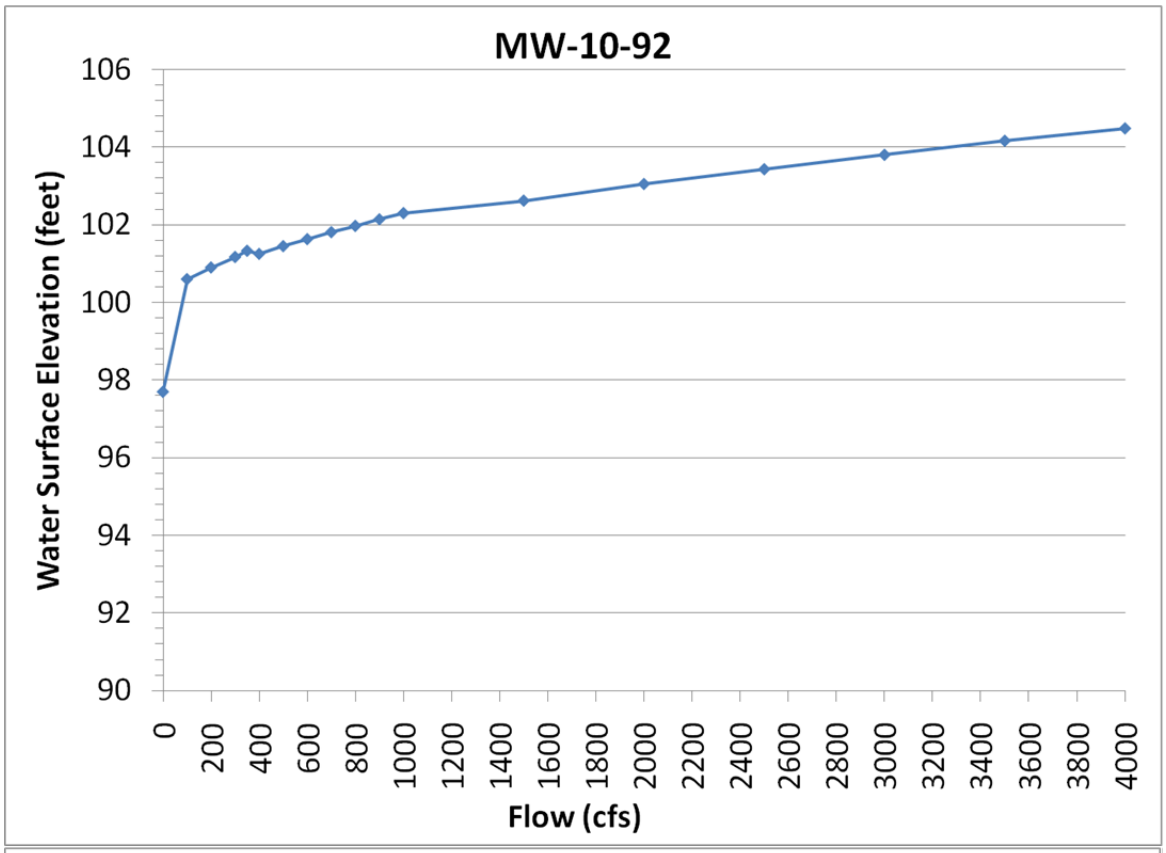
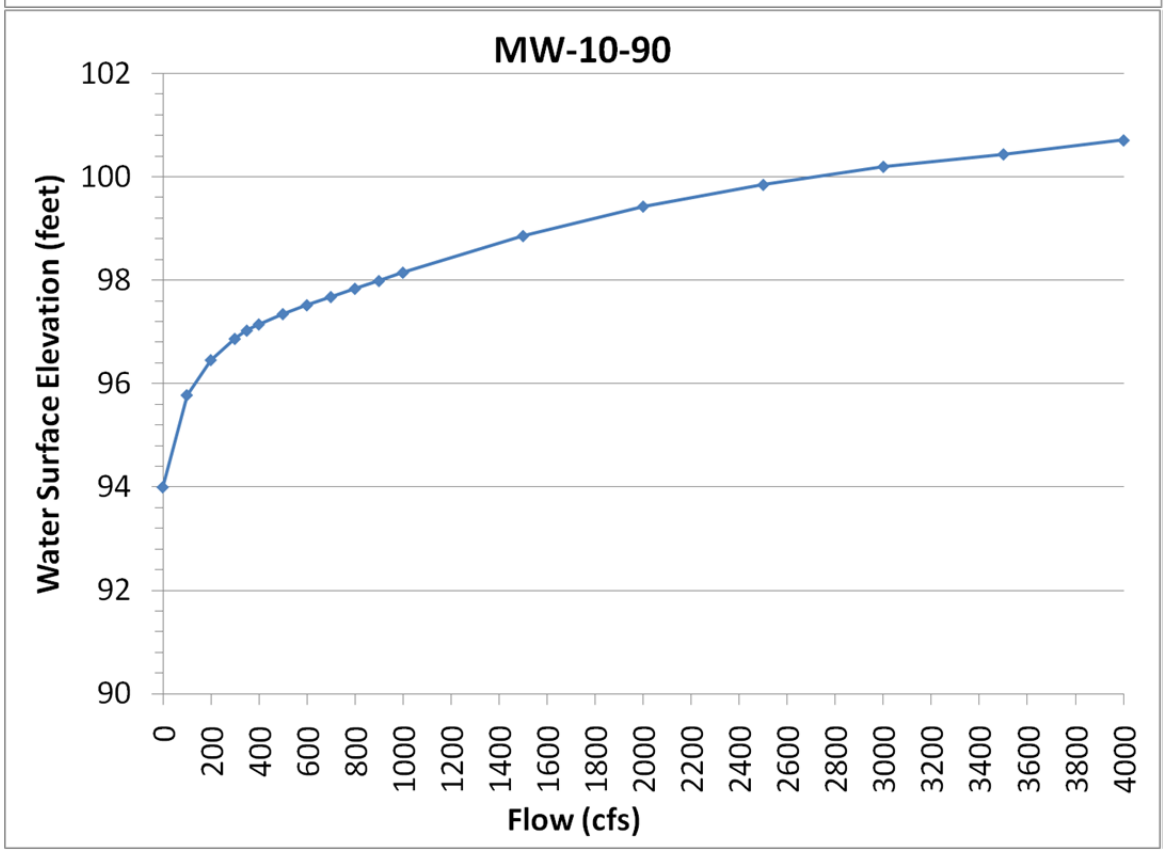
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-92
Water Surface Elevation (feet)
106
104
102
100
98
96
94
92
90
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-90
Water Surface Elevation (feet)
102
100
98
96
94
92
90
0
200
400
600
800
1000
1200
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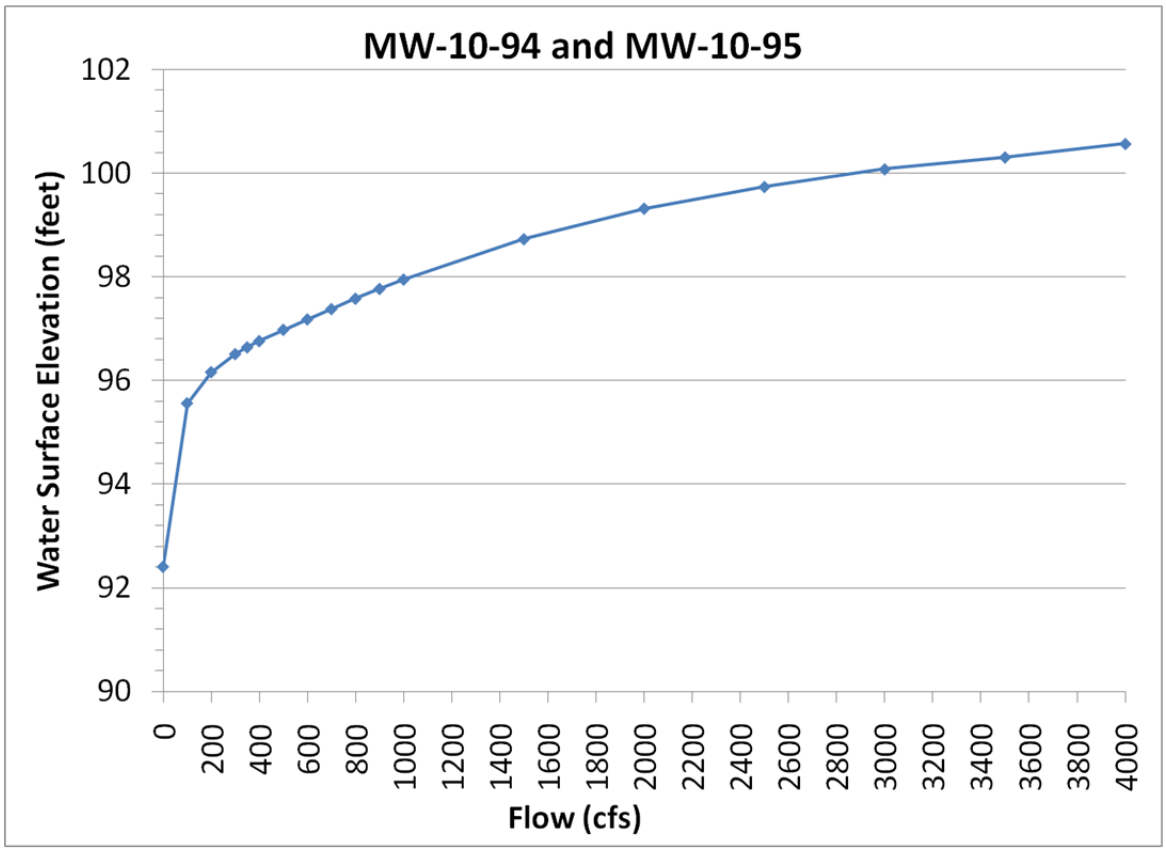
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-94 and MW-10-95
Water Surface Elevation (feet)
102
100
98
96
94
92
90
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)