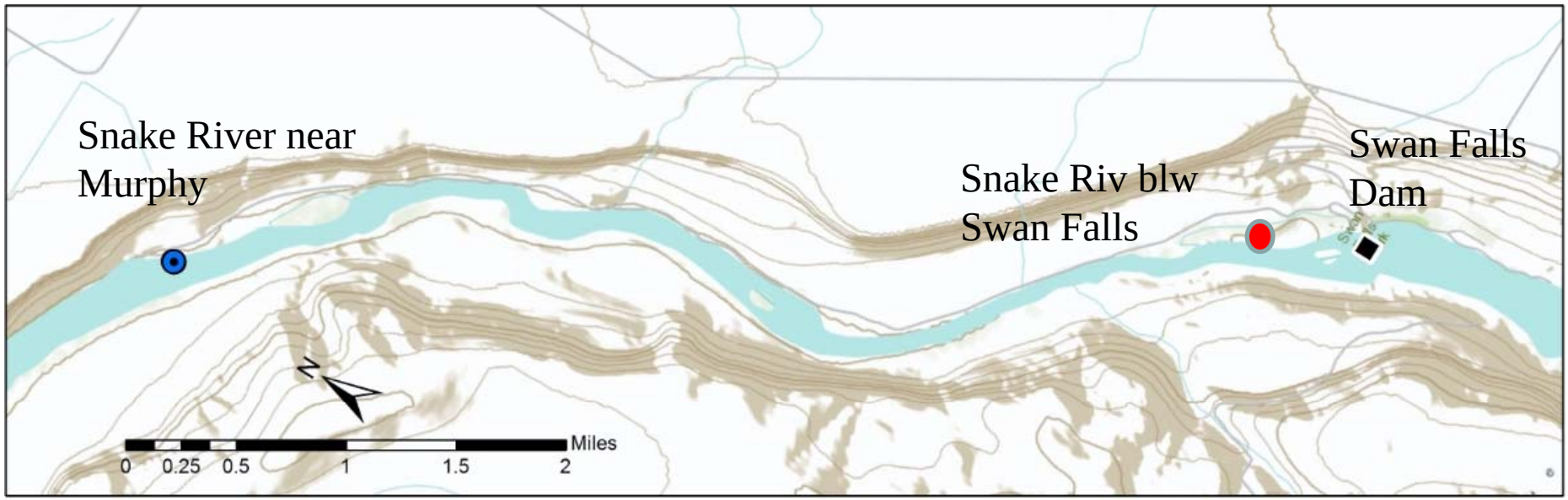
Snake River below Swan Falls (Ramp gage)
Snake River near Muprhy

Carl Rundburg

Gage Locations



Rating curve development

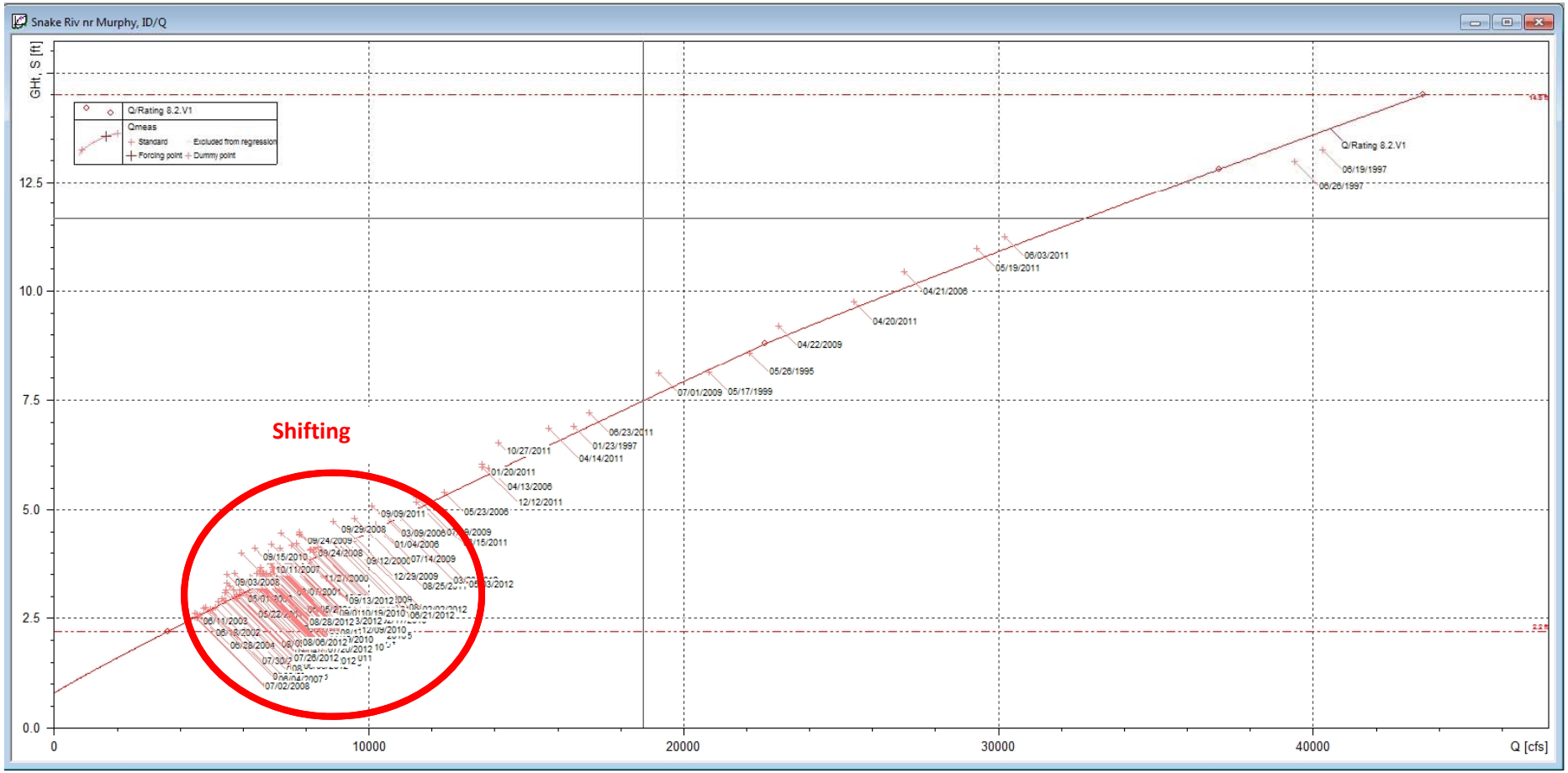
- Snake River below Swan Falls Rating curve development
  - Calibrated with142 measurements
  - Measurements made during steady state conditions to remove travel time
  - Measurements over wide range of time 1995 to 2013
  - Range in flows from 4,370 cfs to 40,300 cfs

Control features

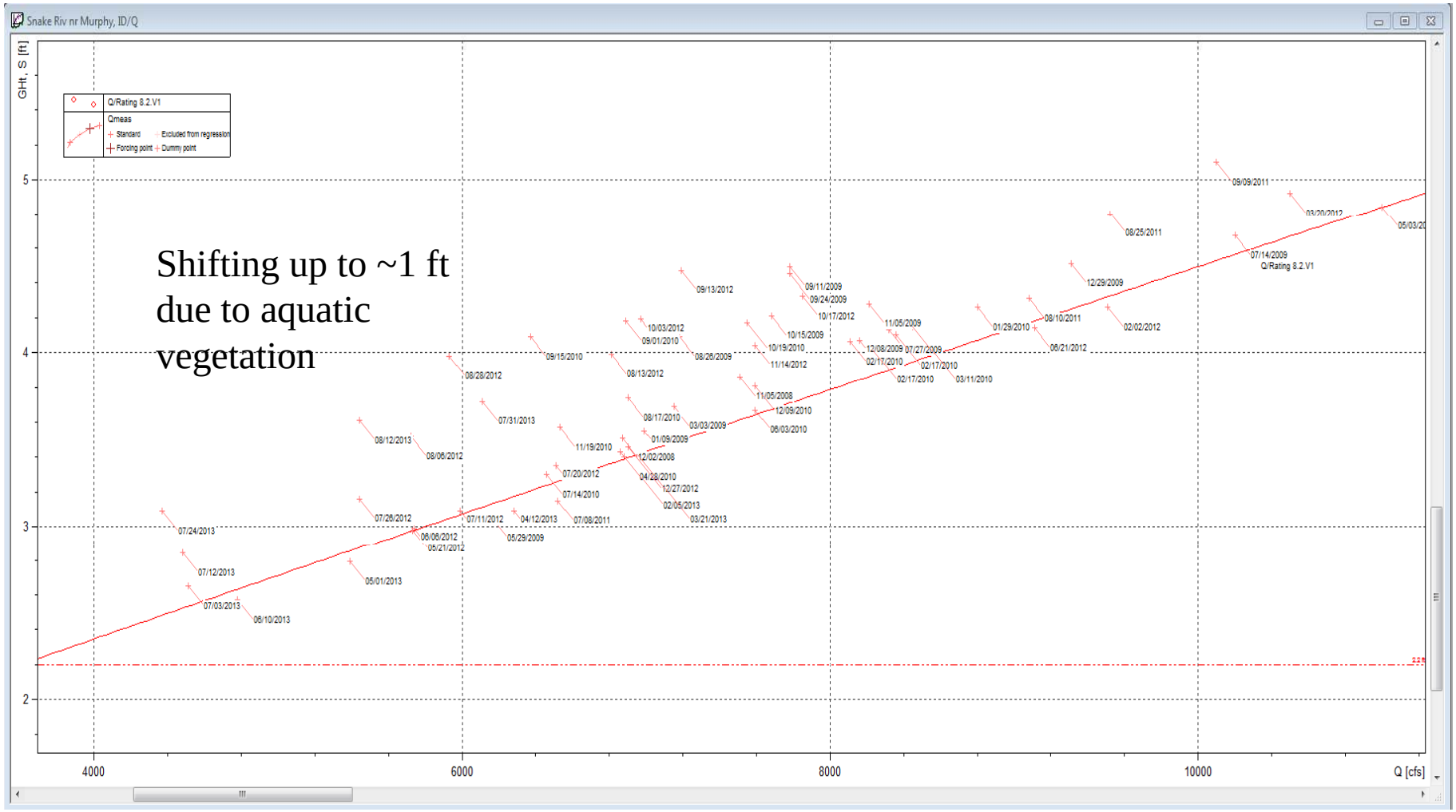
- Snake River near Murphy:
  - Rock riffle ~300yds downstream of gage.
  - Riffle no longer controls when aquatic growth is in channel.
  - Aquatic vegetation grows rapidly during warm season with low flows

- Snake River below Swan Falls:
  - Rock riffle control regardless of season

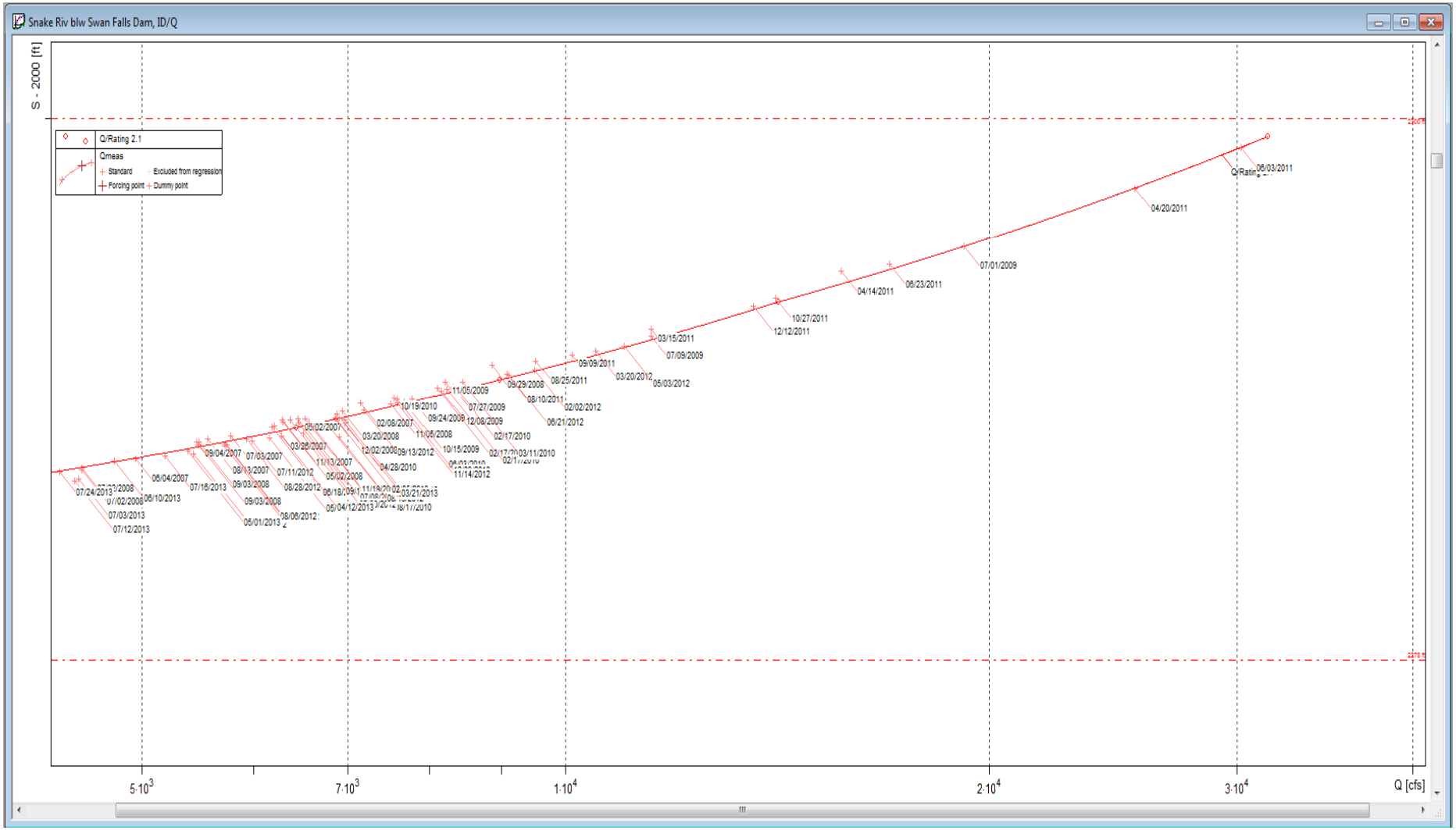
Snake River near Murphy: Rating curve



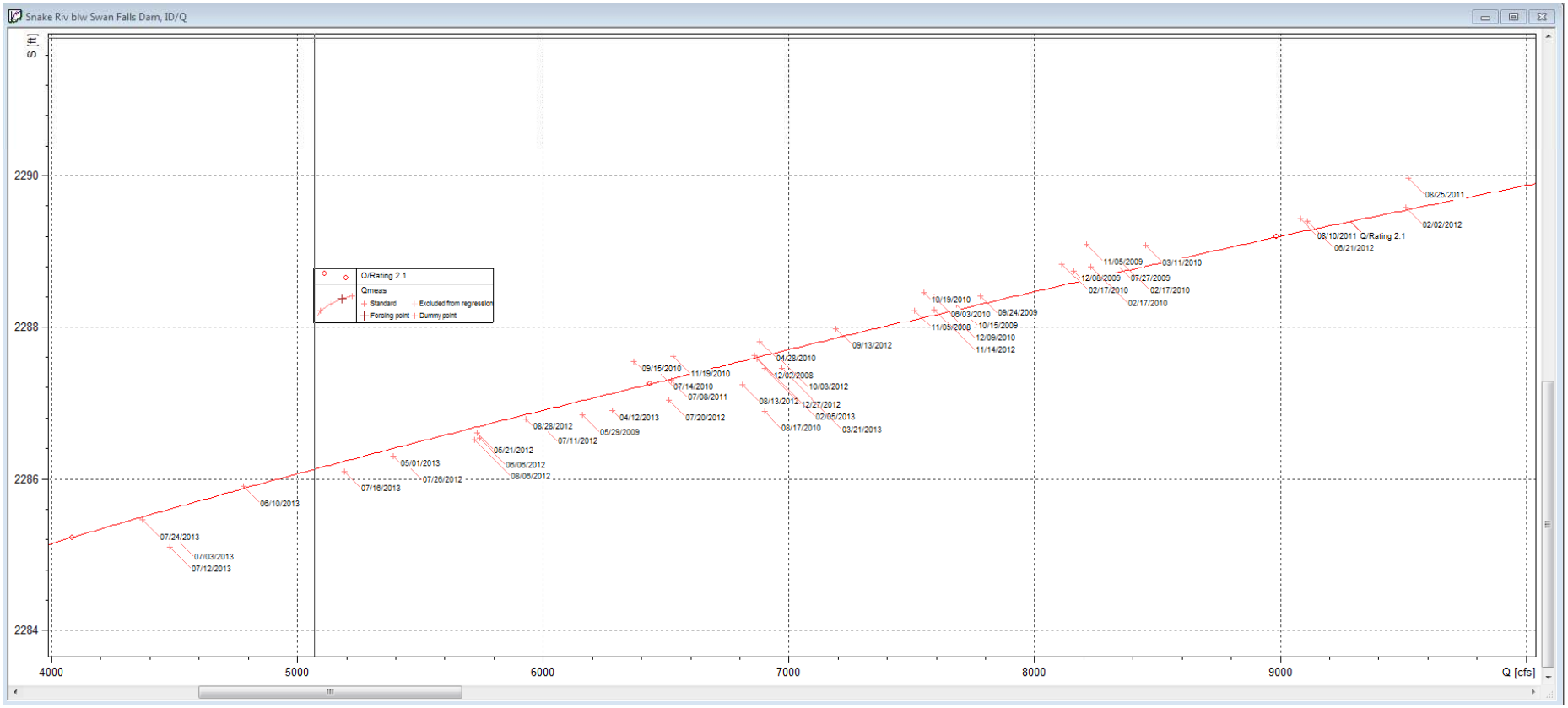
Snake River near Murphy Rating zoomed: seasonal trends



Snake River below Swan Falls Rating



Snake River below Swan Falls Rating
Zoomed: small random scatter



Murphy discharge up to 31% from rating
Ramp discharge only 6% from rating

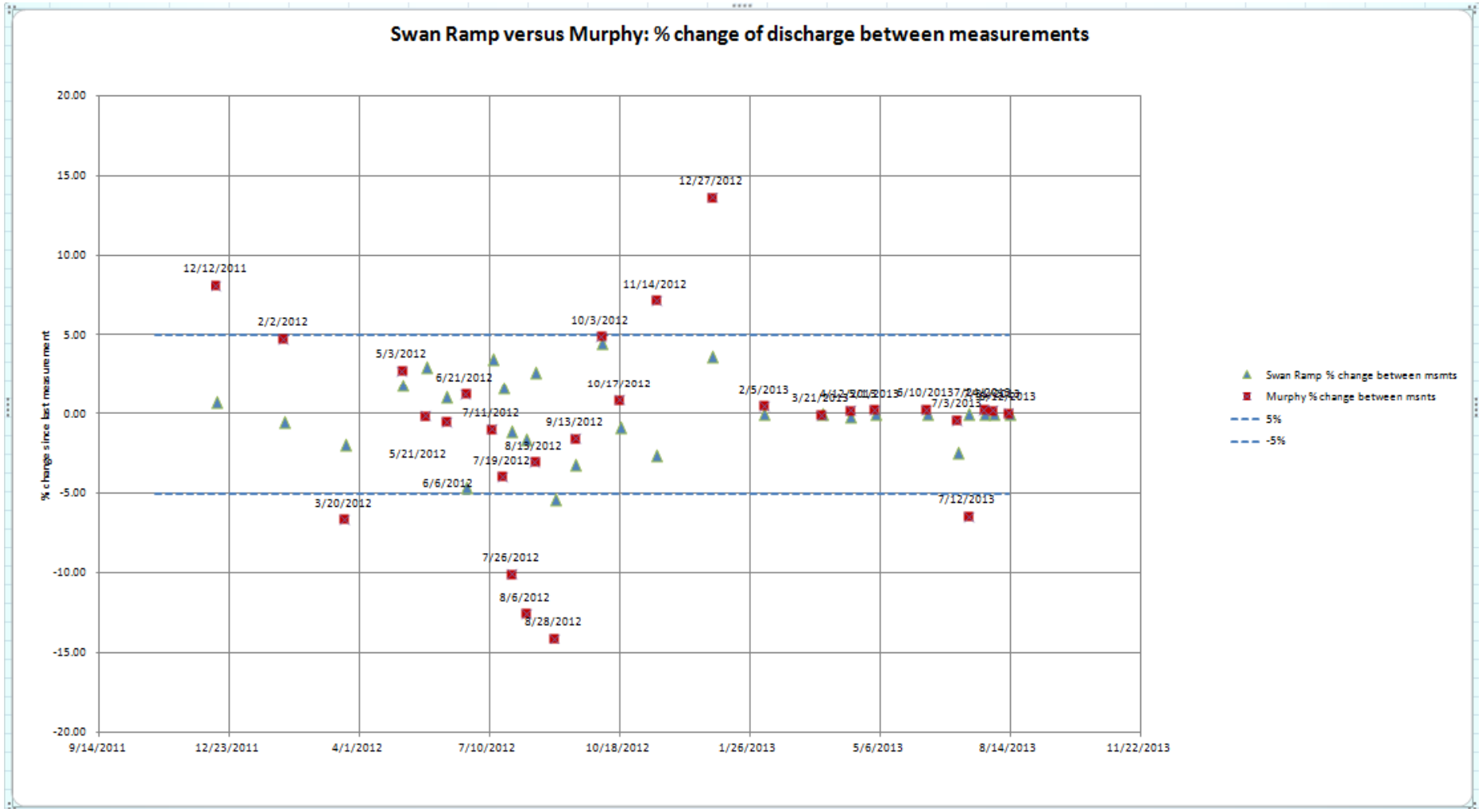
Murphy gage

Msmt	Date	Time (MST)	Quality	Width (ft)	Area (ft^2)	Mean Vel (ft/sec)	Stage (ft)	Discharge(cfs)	Calc. shift (ft)	Percent Diff
115	10/27/2011	13:15:00	Good	400	3660	3.85	6.53	14100	-0.61	-11.3%
116	12/12/2011	12:00:00	Good	516	4000	3.4	5.98	13600	-0.24	-4.9%
117	2/2/2012	14:45:00	Good	487	3240	2.94	4.26	9510	0.06	1.8%
118	3/20/2012	13:45:00	Good	247	3460	3.03	4.92	10500	-0.25	-6.3%
119	5/3/2012	11:15:00	Good	306	3500	3.14	4.84	11000	0	0.0%
120	5/21/2012	07:15:00	Good	252	2890	1.98	2.98	5730	0	-0.2%
121	6/6/2012	10:30:00	Good	223	2670	2.15	2.99	5740	-0.01	-0.5%
122	6/21/2012	07:30:00	Good	215	2630	3.46	4.14	9110	0.04	1.2%
123	7/11/2012	07:30:00	Good	257	2960	2.02	3.09	5990	-0.03	-1.0%
124	7/20/2012	08:00:00	Fair	231	2660	2.45	3.35	6510	-0.09	-3.8%
125	7/26/2012	07:15:00	Good	254	2910	1.87	3.16	5440	-0.29	-12.8%
126	8/6/2012	07:30:00	Good	256	3030	1.89	3.52	5720	-0.55	-21.1%
127	8/13/2012	10:40:00	Good	237	2840	2.4	3.99	6810	-0.63	-20.5%
128	8/28/2012	12:45:00	Good	265	3190	1.86	3.98	5930	-0.93	-30.6%
129	9/13/2012	07:15:00	Good	276	3390	2.12	4.47	7190	-0.97	-27.7%
130	10/3/2012	07:45:00	Good	236	2880	2.42	4.19	6970	-0.82	-21.4%
131	10/17/2012	10:25:00	Good	220	2780	2.82	4.32	7850	-0.56	-14.5%
132	11/14/2012	12:30:00	Good	273	3250	2.34	4.04	7590	-0.4	-10.7%

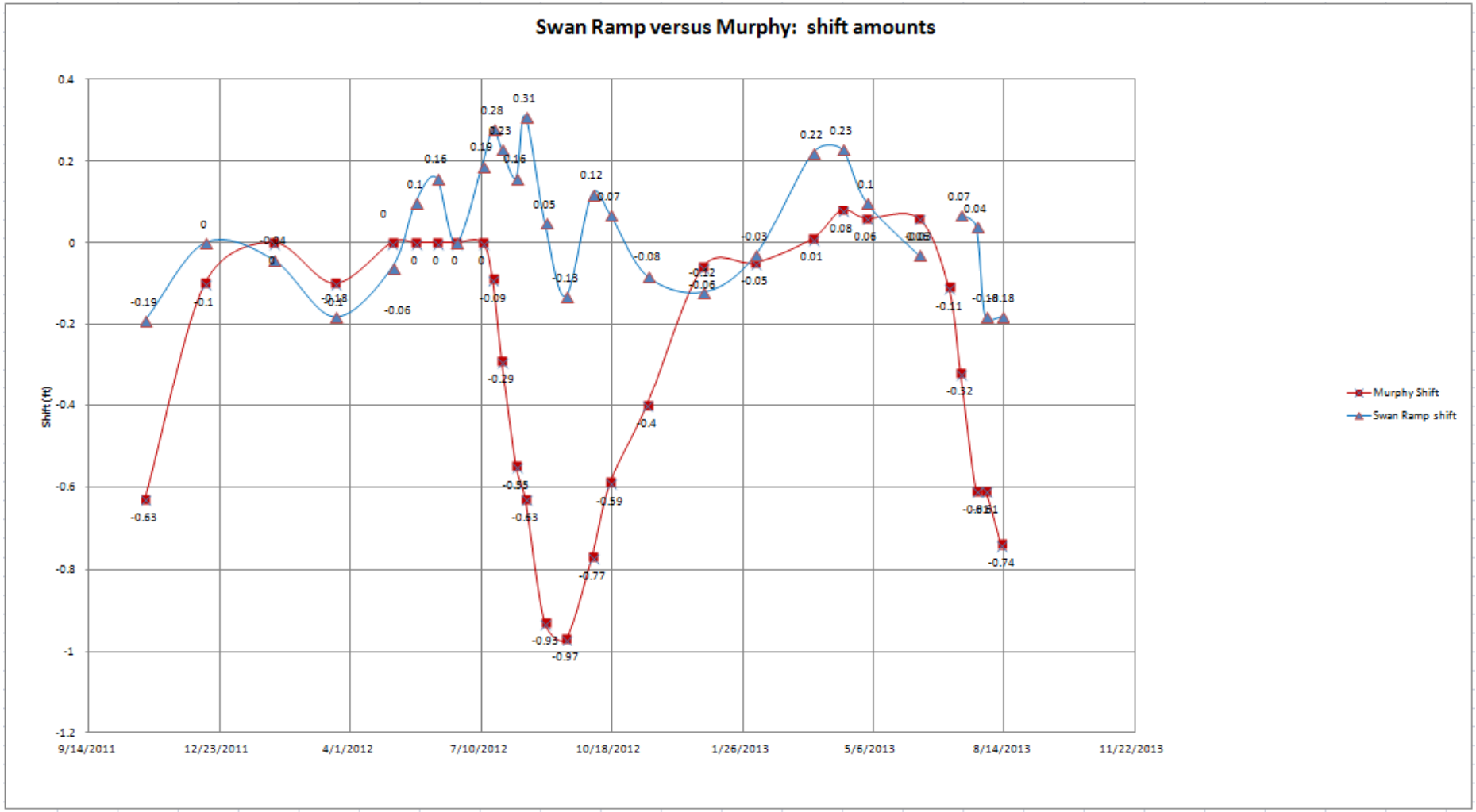
Swan Falls Ramp gage

Msmt	Date	Time (MST)	Quality	Width (ft)	Area (ft^2)	Mean Vel (ft/sec)	Stage (ft)	Discharge(cfs)	Calc. shift (ft)	Percent Diff
115	10/27/2011	13:15:00	Good	400	3660	3.85	2292.52	14100	-0.17	-2.8%
116	12/12/2011	12:00:00	Good	516	4000	2.94	2292.21	13600	-0.14	-2.2%
117	2/2/2012	14:45:00	Good	487	3240	2.94	2289.58	9510	-0.03	-0.5%
118	3/20/2012	13:45:00	Good	247	3460	3.03	2290.37	10500	-0.15	-2.8%
119	5/3/2012	11:15:00	Good	306	3500	3.14	2290.56	11000	-0.03	0.0%
120	5/21/2012	07:15:00	Good	252	2890	1.98	2286.6	5730	0.1	1.8%
121	6/6/2012	10:15:00	Good	223	2670	2.15	2286.54	5740	0.15	3.2%
122	6/21/2012	10:30:00	Good	215	2630	3.46	2289.4	9110	-0.12	-1.9%
123	7/11/2012	07:30:00	Good	257	2960	2.02	2286.72	5990	0.17	3.6%
124	7/20/2012	08:00:00	Good	231	2660	2.45	2287.03	6510	0.28	5.7%
125	7/26/2012	07:15:00	Good	256	3030	1.8	2286.21	5440	0.23	5.2%
126	8/6/2012	07:30:00	Good	256	3030	1.89	2286.52	5720	0.15	3.4%
127	8/13/2012	10:40:00	Fair	237	2840	2.4	2287.24	6810	0.31	5.9%
128	8/28/2012	12:45:00	Good	265	3190	1.86	2286.79	5930	0.05	1.2%
129	9/13/2012	07:15:00	good	276	3390		2287.98	7190	-0.13	-2.3%
130	10/3/2012	07:45:00	Good	236	2880	2.42	2287.56	6970	0.12	2.2%
131	10/17/2012	10:25:00	Good	220	2780	2.82	2288.23	7850	0.13	2.2%
132	11/14/2012	12:30:00	Good	273	3250	2.34	2288.24	7590	-0.08	-1.3%

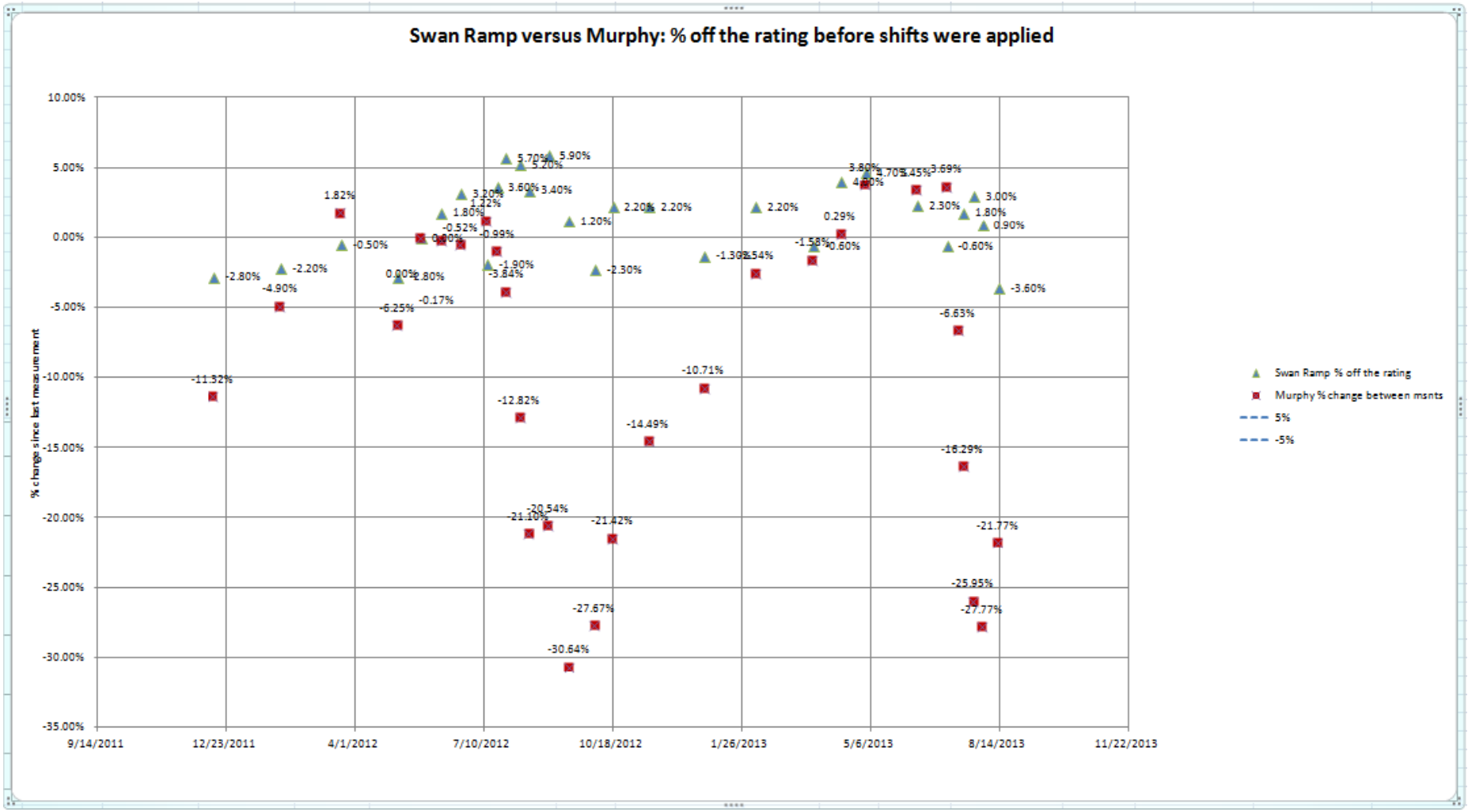
% change in flow due to shifts



Shifts in feet over time



% difference


Swan Ramp versus Murphy: % off the rating before shifts were applied
% change since last measurement
10.00%
5.00%
0.00%
-5.00%
-10.00%
-15.00%
-20.00%
-25.00%
-30.00%
-35.00%
9/14/2011
12/23/2011
4/1/2012
7/10/2012
10/18/2012
1/26/2013
5/6/2013
8/14/2013
11/22/2013
Swan Ramp % off the rating
Murphy % change between msnts
5%
-5%

Summary…

- Snake River near Murphy
  - Aquatic growth causes shifting
  - Shifts > 0.90 ft
  - % difference from rating > 30%
  - Change in flow between measurements can be as much as + -15%

- Snake River below Swan Falls
  - No apparent aquatic growth
  - Shifts scatter up to 0.3ft (likely due to gage calibration)
  - % difference from rating < 6%
  - Change in flow between measurements generally+ - 5%
  - Some of these inaccuracies are due to different standard of calibration and less precise measuring equipment at the gage.