POST-CONSTRUCTION CHANNEL MONITORING OF SALT RIVER, PHASE ONE - Year 2

November 2015 (revised July 2016)

Submitted by: and Daniel O'Shea and Susannah Manning

Introduction

In compliance with the Salt River Ecosystem Restoration Project Adaptive Management Plan, cross-sectional and longitudinal surveys were conducted across the project area during May 2015. The cross-sectional surveys were conducted on the main channel of the lower Salt River (SR), and of the newly excavated slough channels, in both the northern and southern regions excavated during the summer of 2013 (Figure 1). A longitudinal survey was conducted of the lower main Salt River channel from Cutoff Slough to the Riverside Ranch barn, the North slough channel (NC) and a north branch of that channel, and of the South slough channel (SC). This effort concentrates on Phase Two of the restoration project in the estuarine and salt marsh portions. All elevations are geo-referenced, in feet, to the 1988 North American Vertical Datum (NAVD88).

In 2013 the Salt River Ecosystem Restoration Project converted 330 acres of dairy ranch into a salt marsh estuary. Two and a half miles of the Salt River channel was excavated, expanded, and deepened. Over 3-miles of new slough channels were excavated and enhanced. In 2014, an additional 1.2 miles of channel was excavated. These new channels are being monitored using cross-surveys for sediment deposition and erosion. The results of the surveys are designed to help determine any necessary management actions.

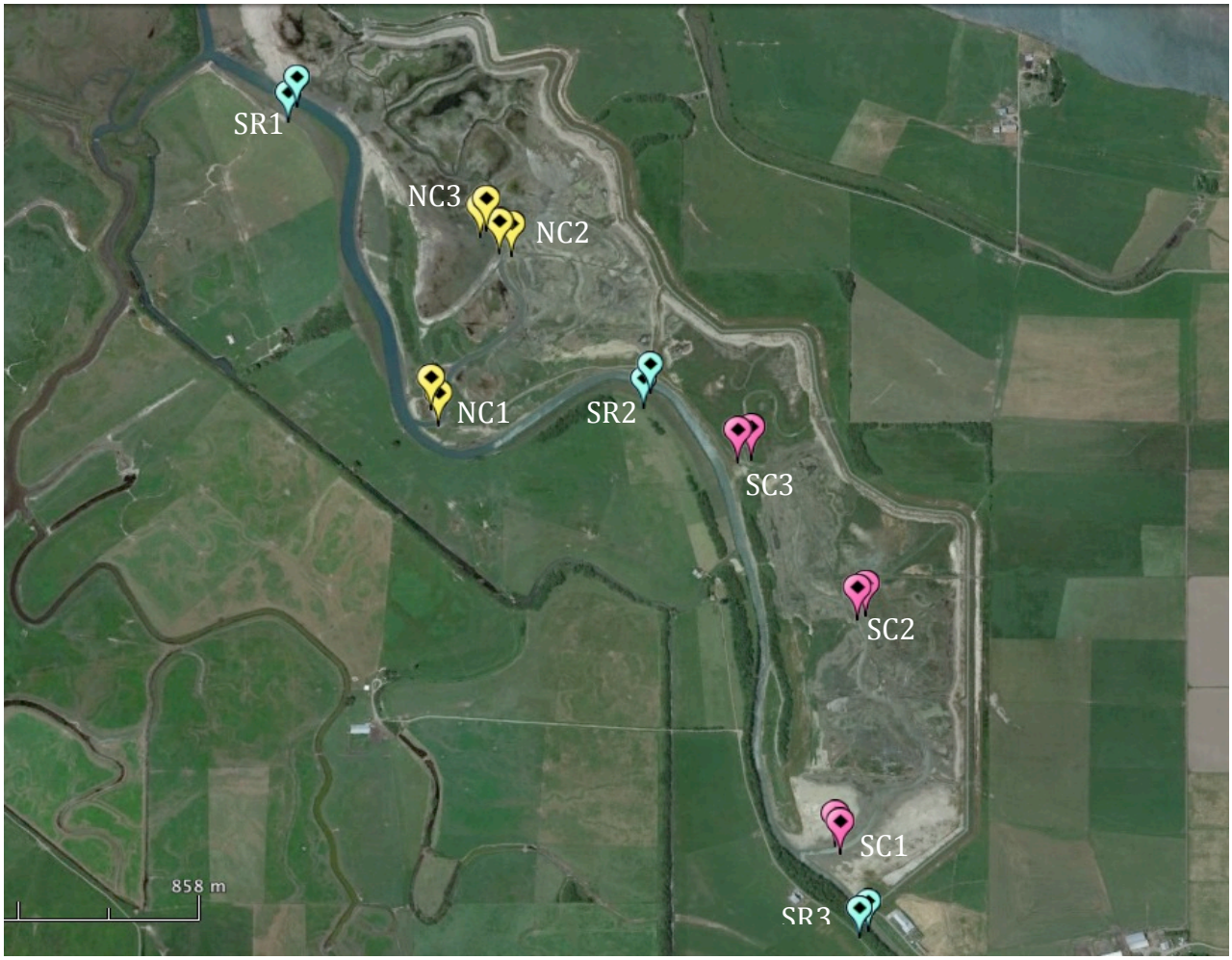

Figure 1: Location of the cross-section profiles for Salt River Ecosystem Restoration Survey Project, Fall 2014 and Spring 2015. SR = Salt River cross-sections; NC= new North Channels cross-sections; SC= new South Channel cross-sections.

Methods and Results

Salt River Main Channel Cross section profile

Data for three cross-sectional profiles of the main Salt River channel were collected using a Nikon DTM-352 Total Station laser theodolite, tripod, prism pole and single prism along the lower, middle and upper sections of the main Salt River channel using the monuments established in 2013 (Figure 2). All elevations are reported in feet using the NAVD88 datum.

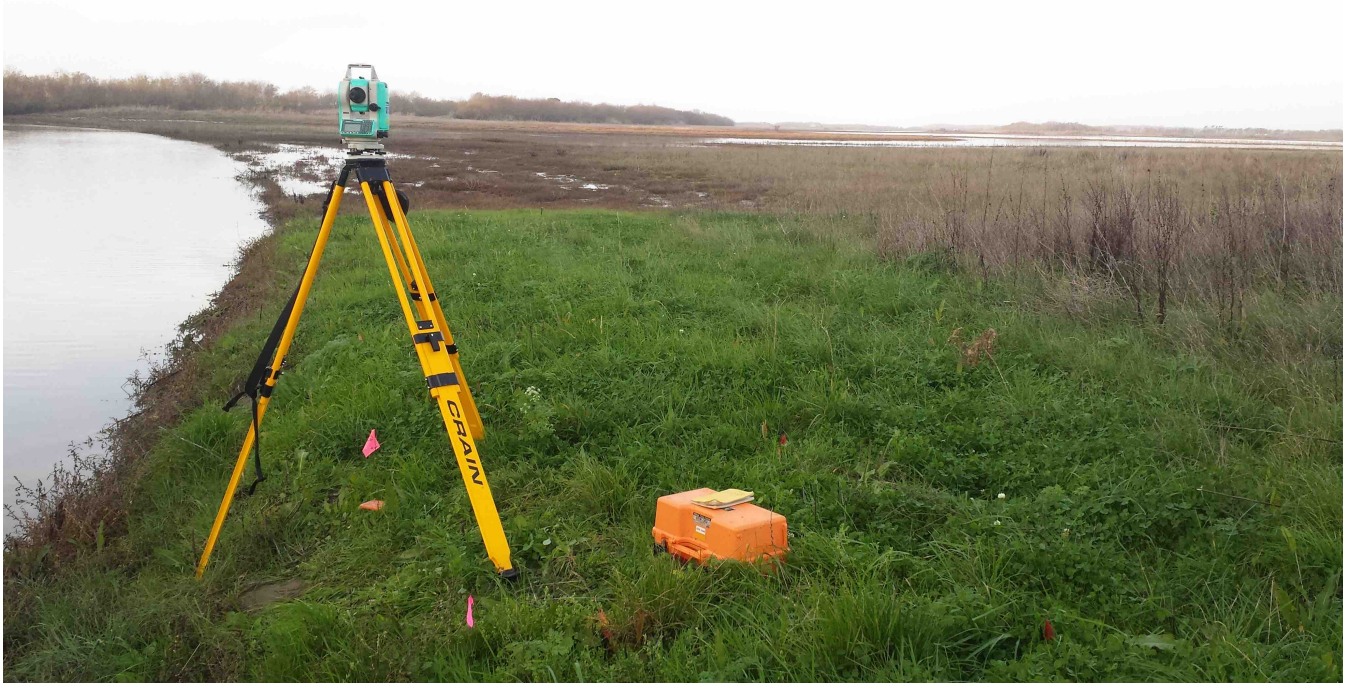

Figure 2: Nikon DTM-352 Total Station laser theodolite used in the 2015 Salt River channel surveys. (all photos by D. O'Shea)

Elevations and distances were collected at each major break in slope, vegetation edge (dotted line), waters edge, mid-channel, and at least 2 locations on either side of mid-channel. These are indicated by the tick marks (+) on the cross-section graphs. Flood plain measurements were collected approximately 200-feet on either side of the main channel. Cross-section profiles are viewed from the west or north with the zero-point on the left side of the graph and extending approximately 450 feet toward the south and east. Results for these cross sections are presented in Figures 3A-F and tables are presented in the appendix. Data from 2014 are included for cross-reference.

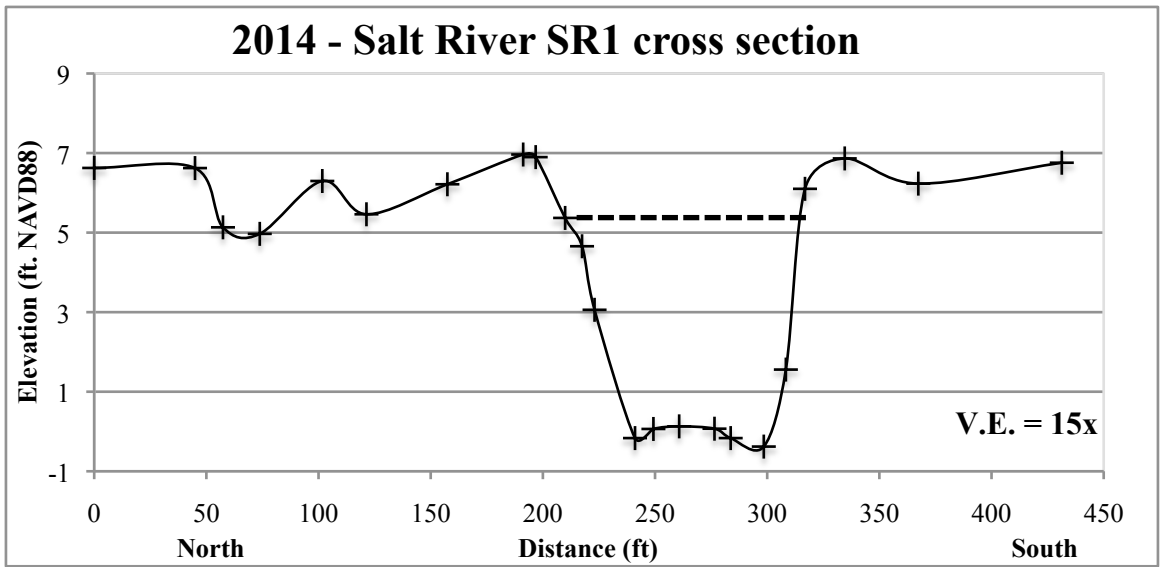

Figure 3A: 2014 Salt River Main Channel cross-section 1. In all graphs, V.E. is the vertical exaggeration and direction runs north to south, beginning at zero on the x axis.

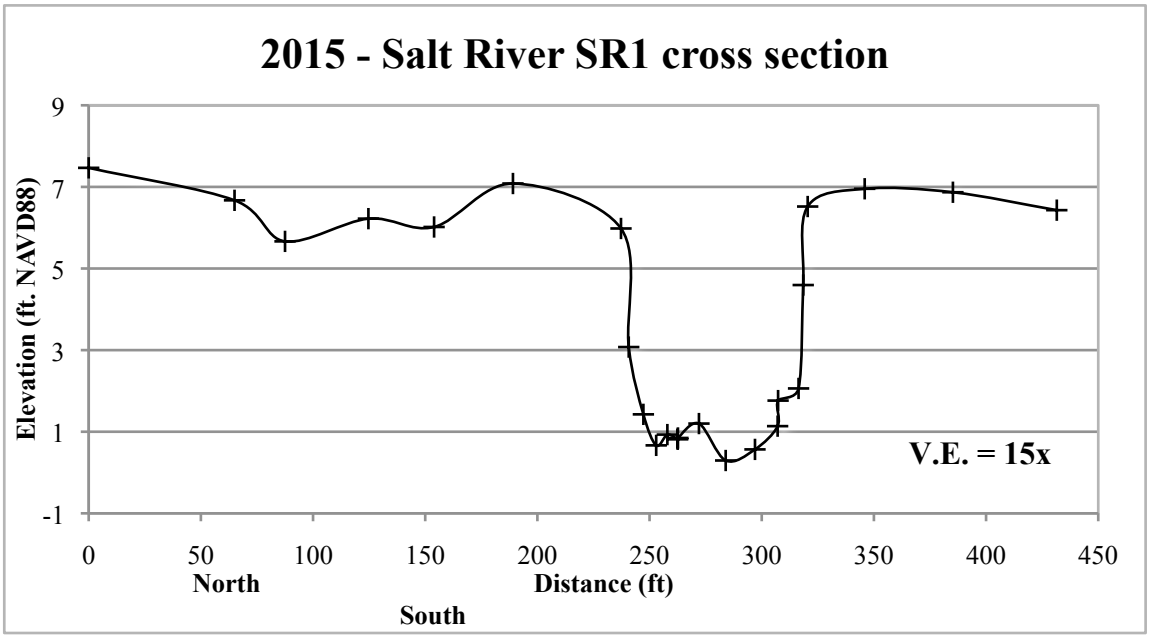

Figure 3B: 2015 Salt River Main Channel cross-section 1.

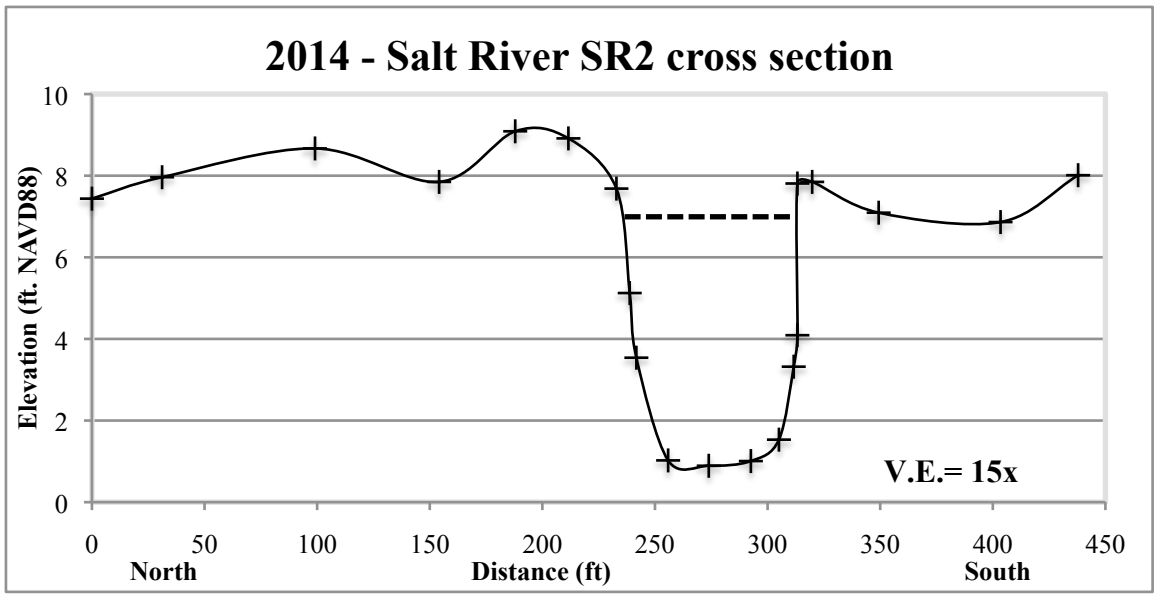

Figure 3C: 2014 Salt River Main Channel cross-section 2.

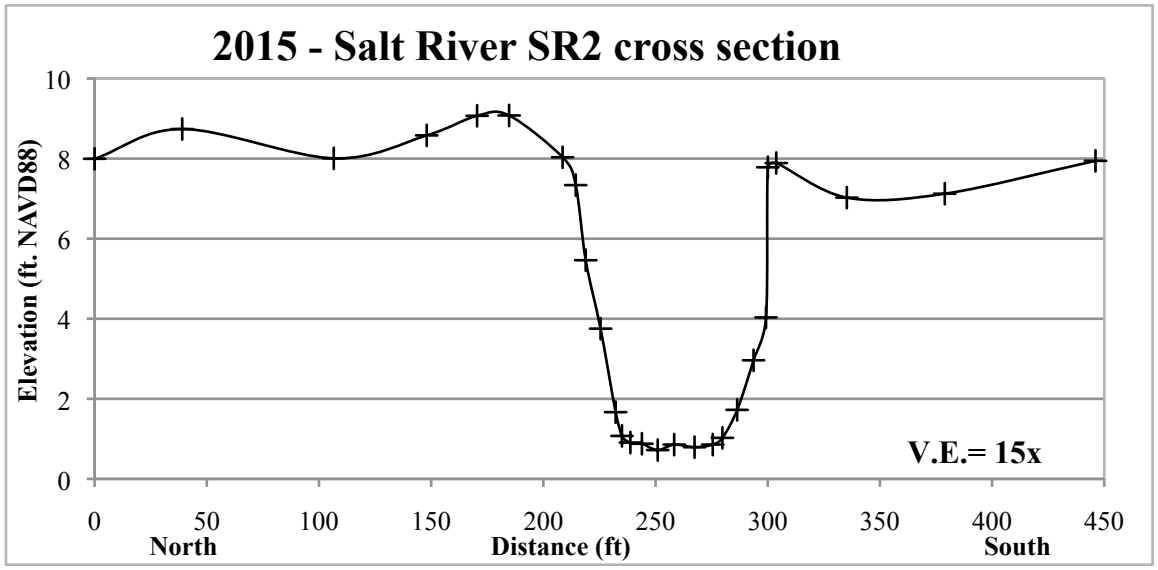

Figure 3D: 2015 Salt River Main Channel cross-section 2.

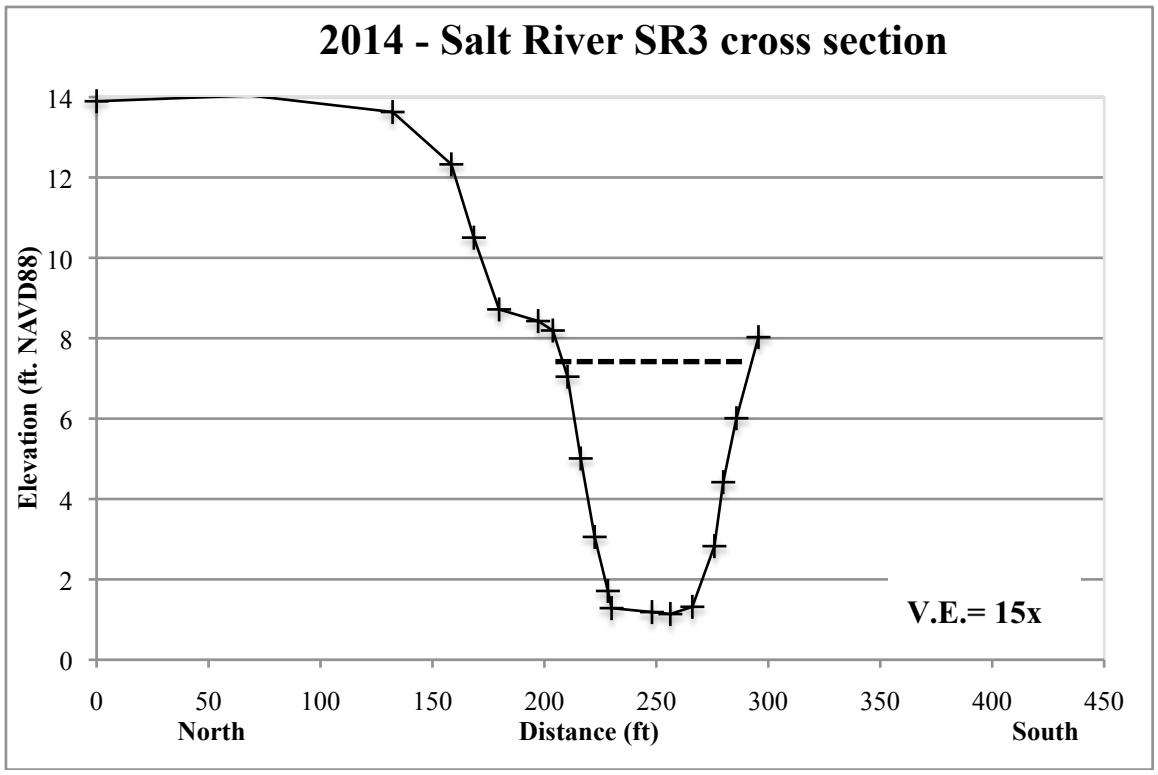

Figure 3E: 2014 Salt River Main Channel cross-section 3.

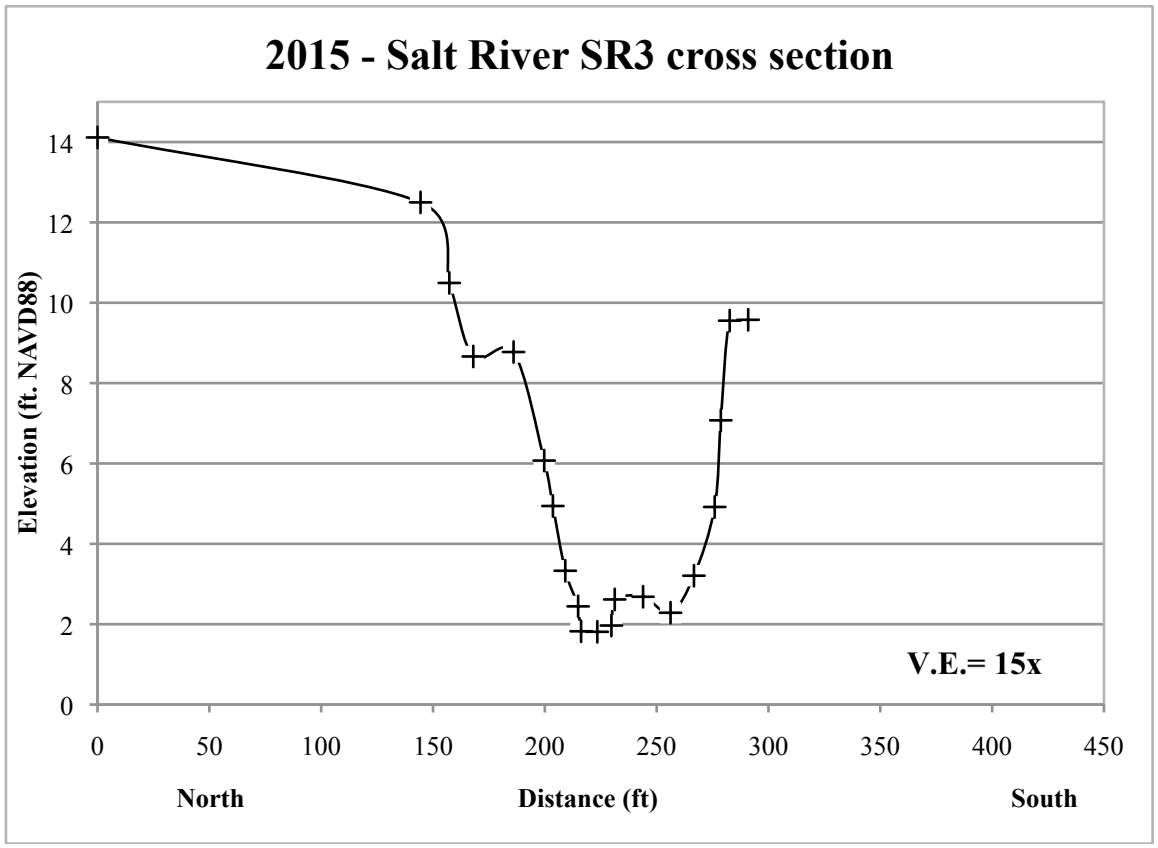

Figure 3F: 2015 Salt River Main Channel cross-section 3.

New Slough Channel Cross Sections

Three cross-sections were collected for each of the newly developed slough channels. The northern slough network drains into the main Salt River channel approximately 3,800 feet upstream from the confluence of the Salt River and Cutoff Slough, and the southern slough network drains into the main Salt River channel another 9,000 feet upstream of Cutoff Slough. The methods described for the Salt River cross-sections were repeated for these slough locations. All elevations are reported in feet using the NAVD88 vertical datum. All cross section profiles are viewed with the north (or west) side at the zero-point on the horizontal (distance) axis.

Elevations and distances were collected at each major break in slope, vegetation edge (dotted line), waters edge, mid-channel, and at least 2 locations on either side of mid-channel. These are indicated by the tick marks (+) on the cross-section graphs. Flood plain measurements were collected approximately 200-feet on either side of the main channel. Results for these cross sections are presented in Figures 4A-5F and tables are presented in the appendix.

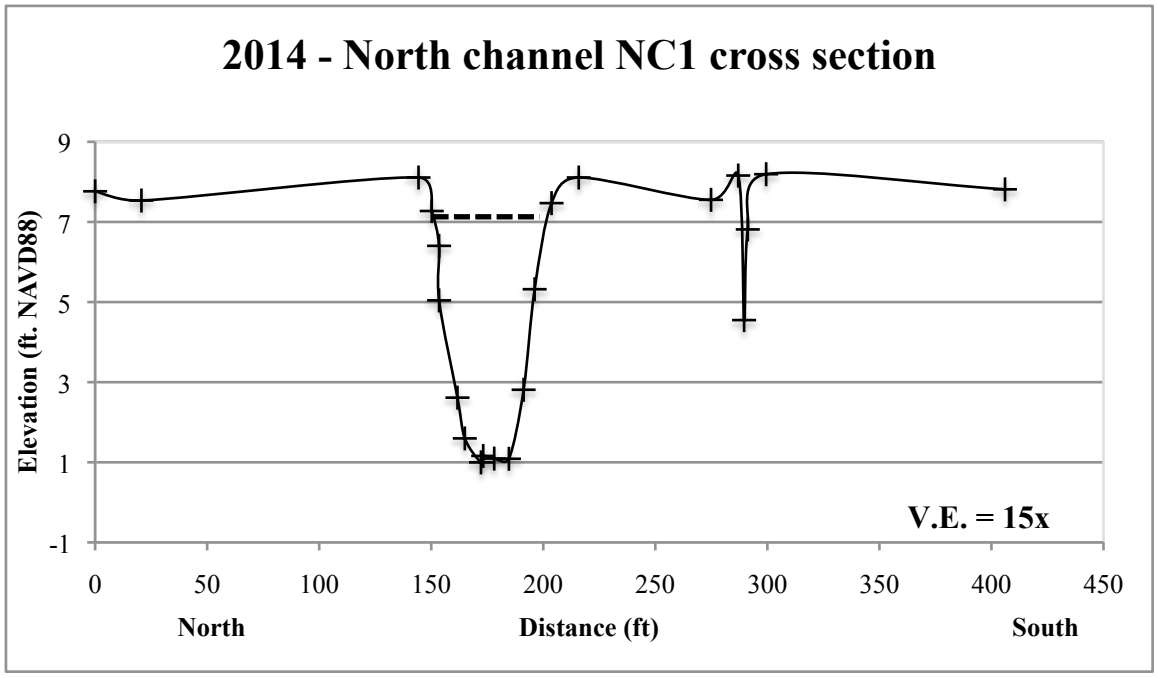

Figure 4A: 2014 North Channel cross-section 1.

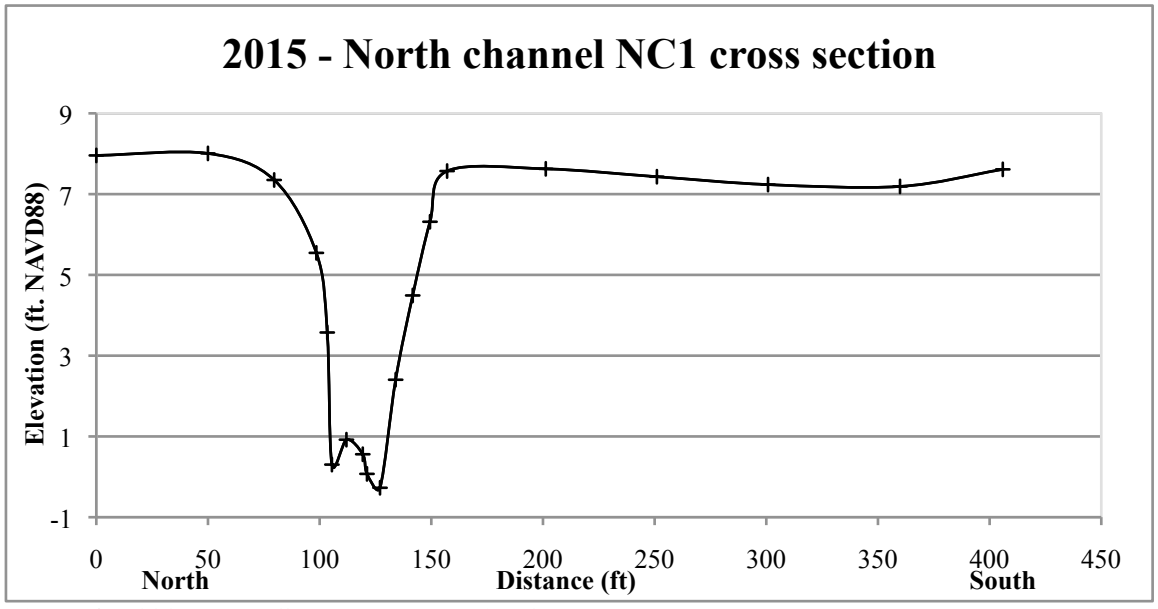

Figure 4B: 2015 North Channel cross-section 1.

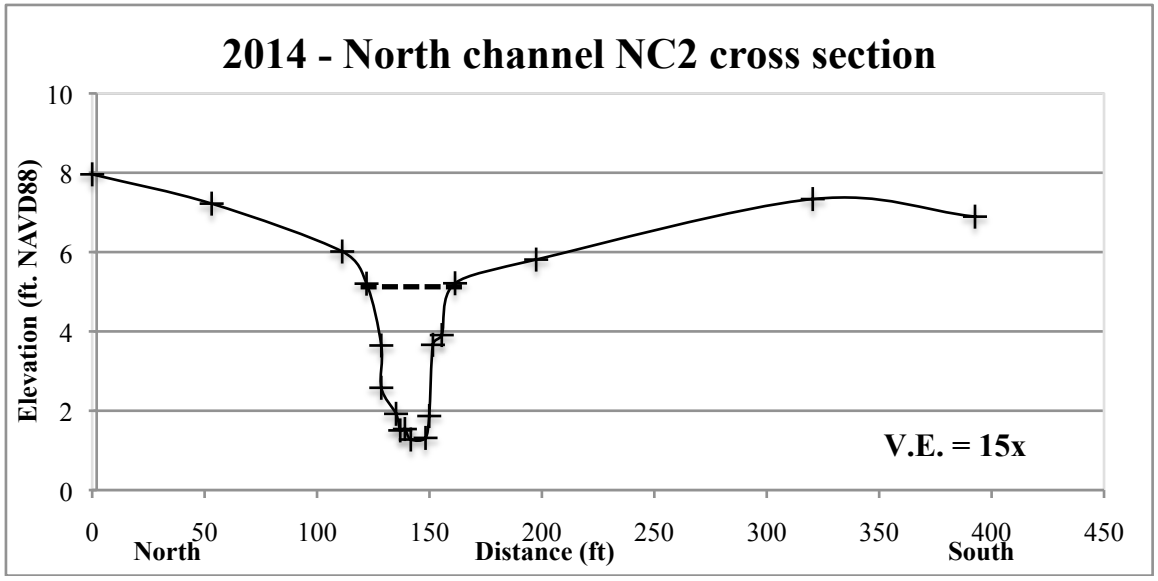

Figure 4C: 2014 North Channel cross-section 2.

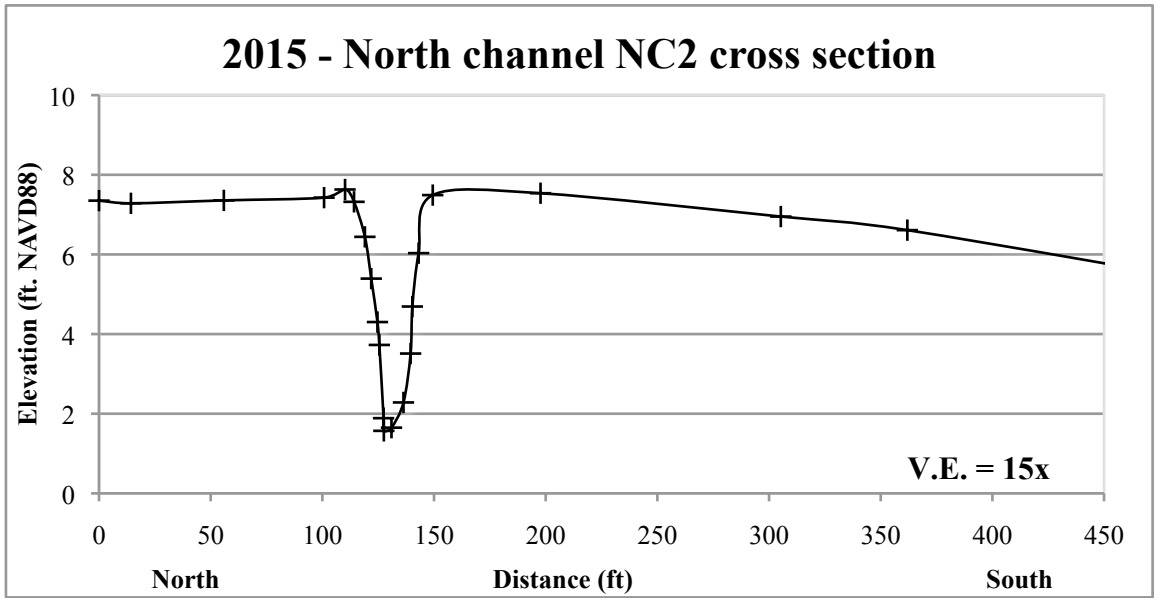

Figure 4D: 2015 North Channel cross-section 2.

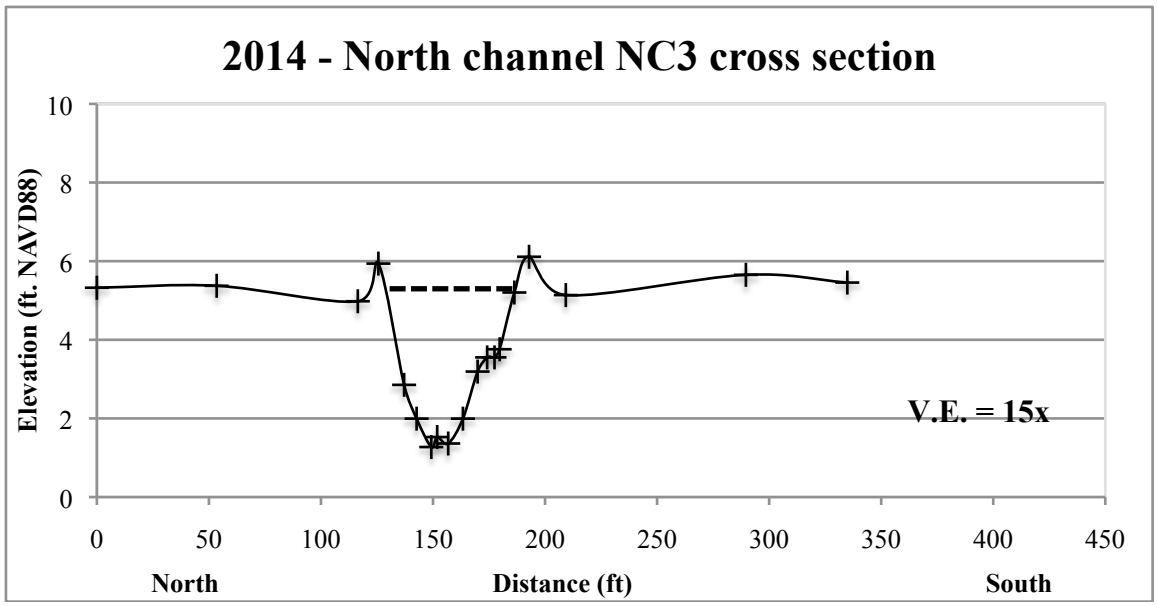

Figure 4E: 2014 North Channel cross-section 3.

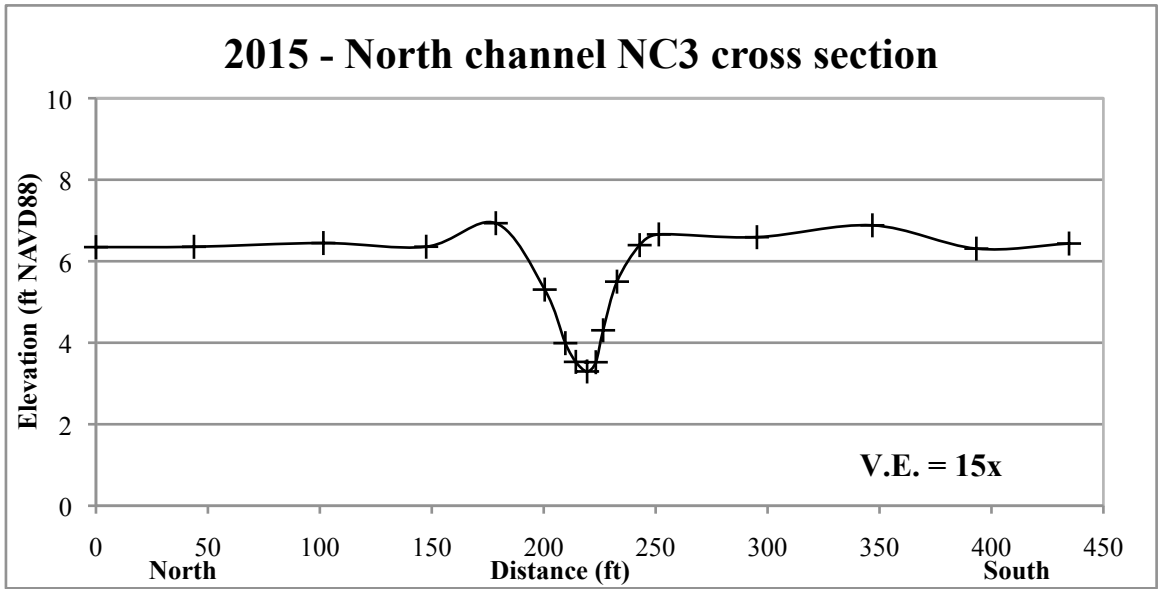

Figure 4F: 2015 North Channel cross-section 3.

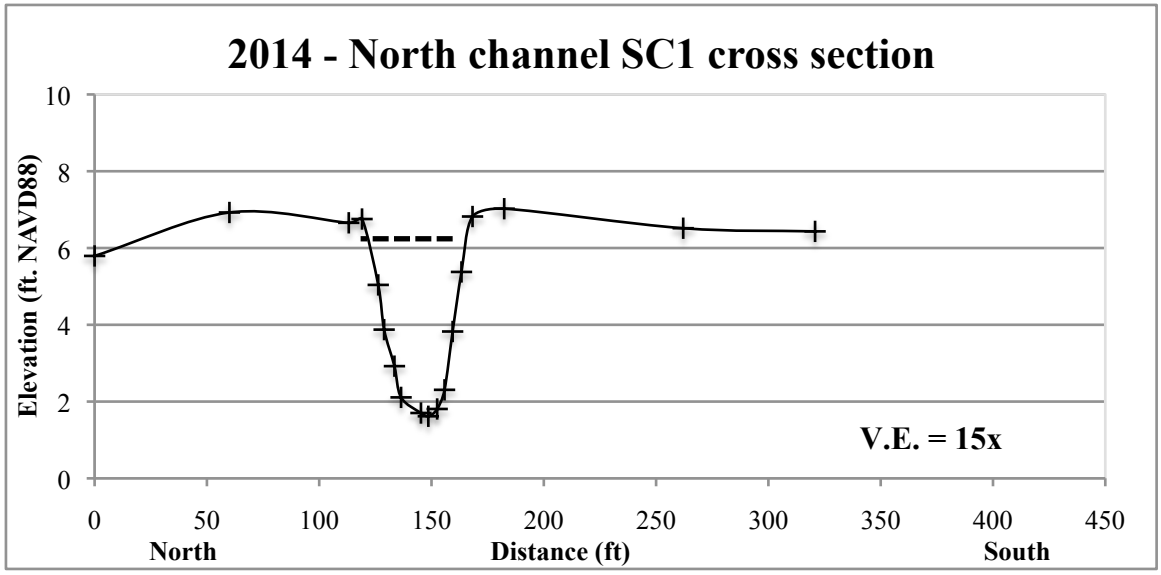

Figure 5A: 2014 South Channel cross-section 1.

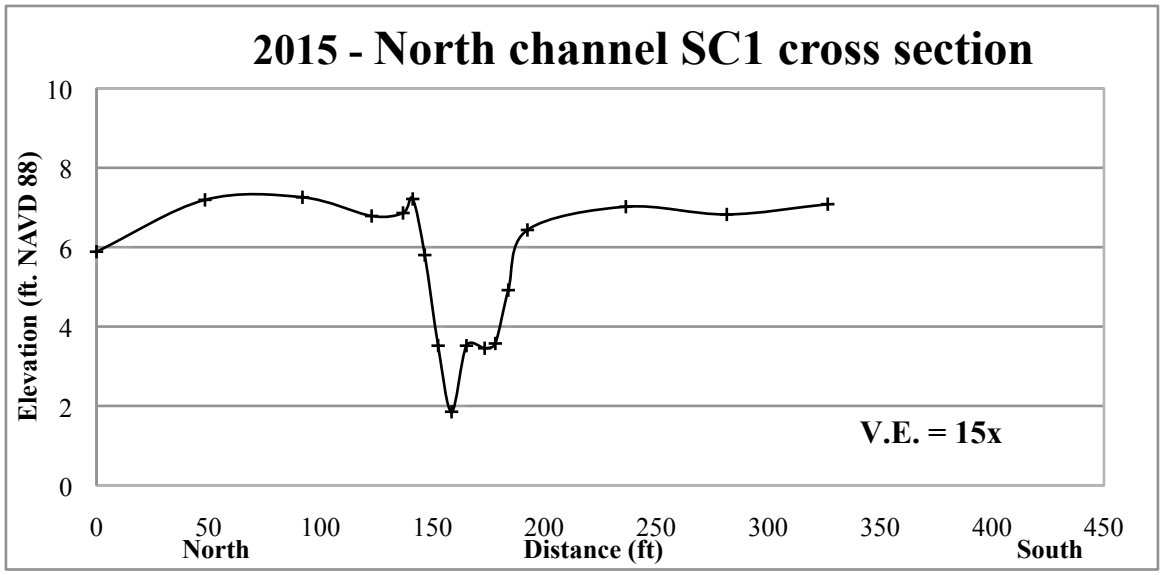

Figure 5B: 2015 South Channel cross-section 1.

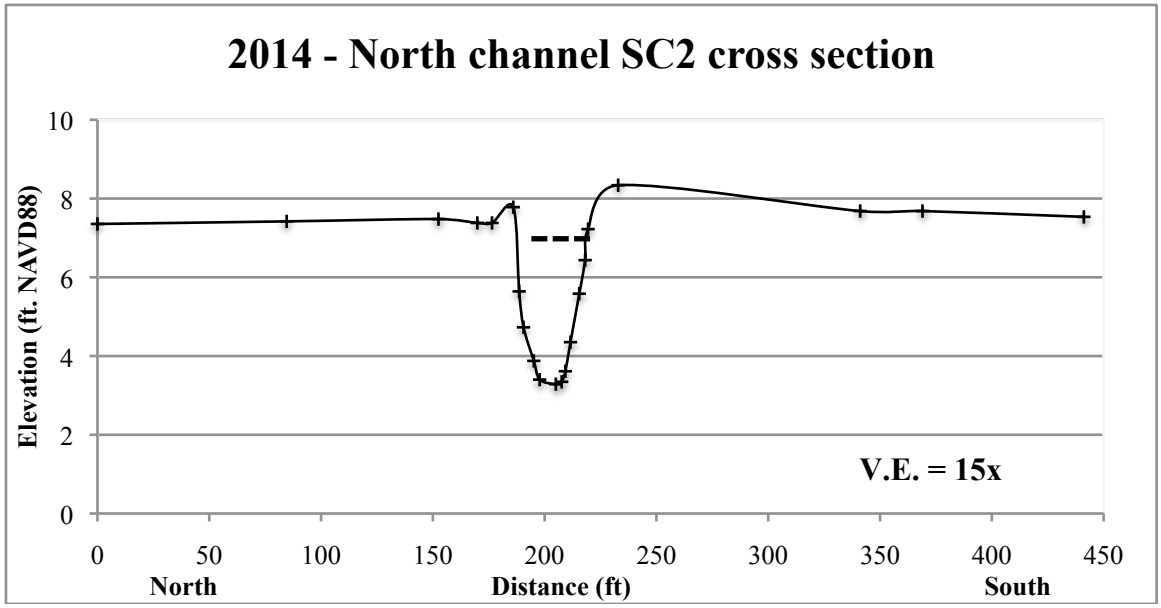

Figure 5C: 2014 South Channel cross-section 2.

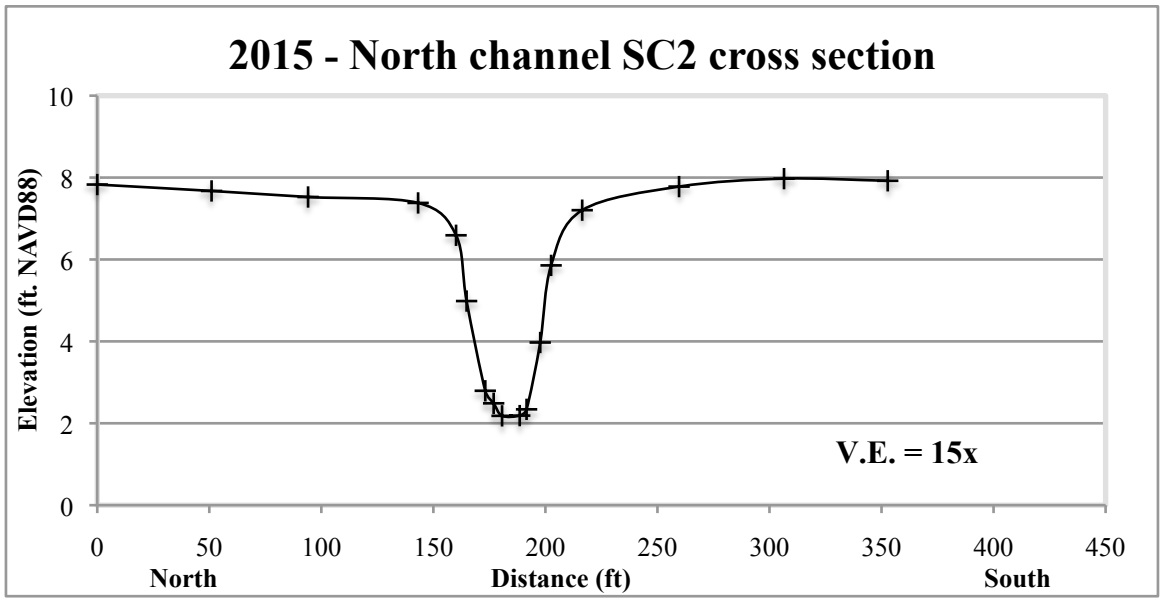

Figure 5D: 2015 South Channel cross-section 2.

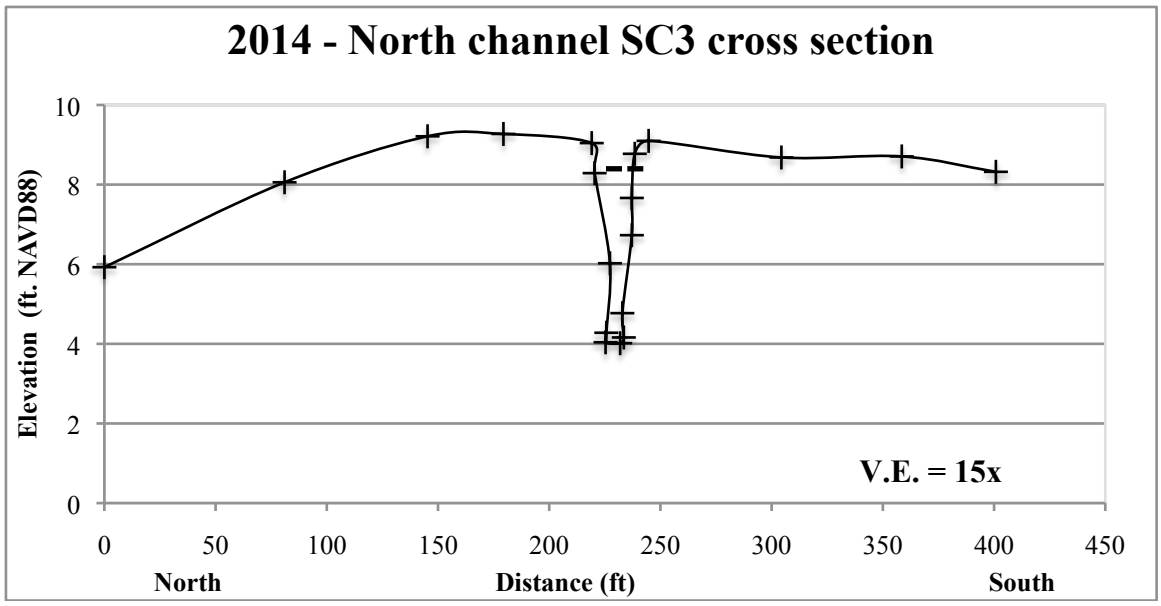

Figure 5E: 2014 South Channel cross-section 3.

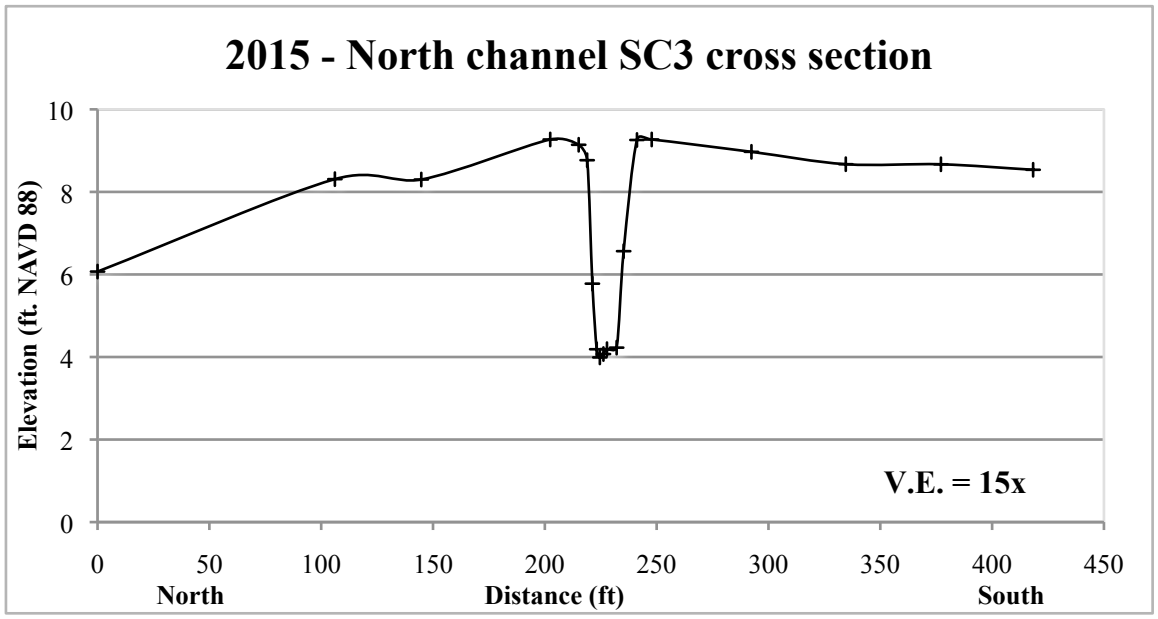

Figure 5F: 2015 South Channel cross-section 3.

Salt River Longitudinal Survey

The longitudinal profile survey of the main Salt River channel from Cutoff Slough to the Riverside Ranch barn was collected using a Nikon DTM-352 Total Station laser theodolite, tripod, prism pole and single prism (Figure 6). The prism pole was placed in the thalwag approximately every 200-feet with the total station located at one of four locations along the north bank of the main Salt River channel and geo-referenced to the Salt River Restoration Project's survey control points SR11, SR 14 and SR 12. A total of 48 measurements were taken along the Salt River. All elevations are reported in feet using the NAVD88 vertical datum. Results for these longitudinal profiles are presented in Figures 7A-9A and tables are presented in the appendix.

Figure 6: Total station set up at SR3 (near the River Ranch barn) used for the longitudinal profile.

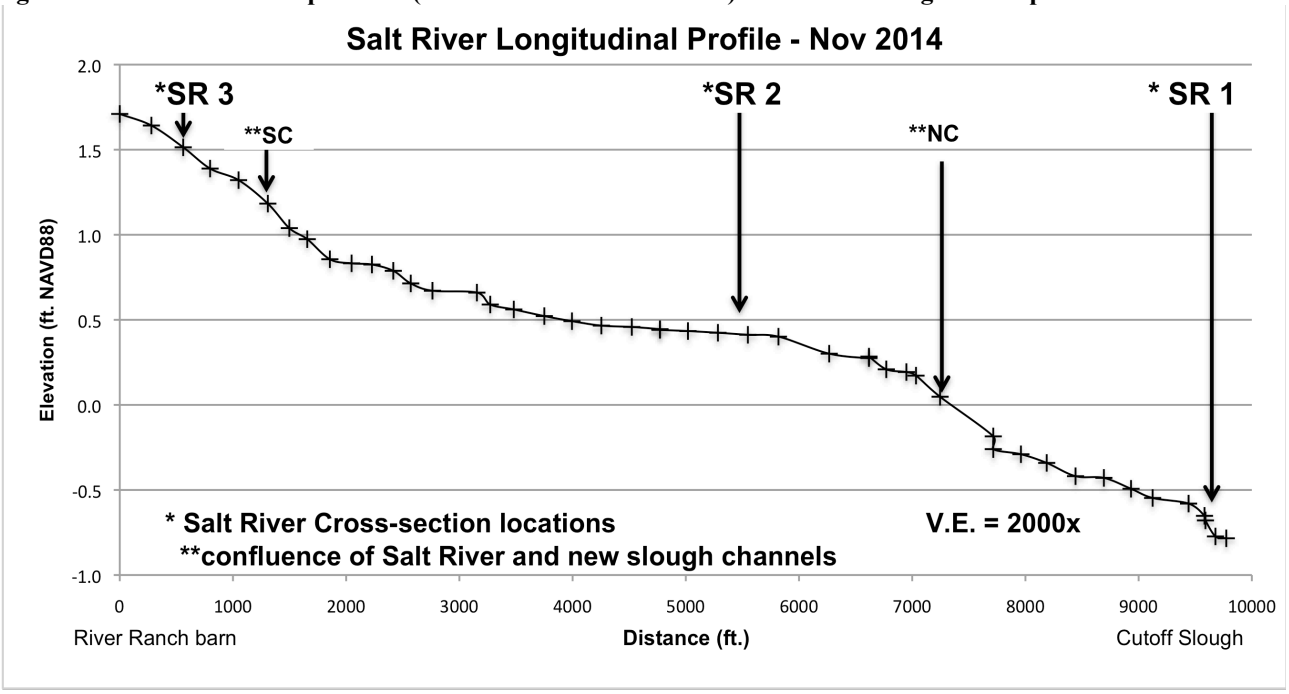

Figure 7A: 2014 longitudinal profile of the main channel of the Salt River – November 2014 from River Ranch barn to Cutoff Slough. The locations of Salt River main channel cross sections, and the confluence with the new South Channel (SC) and North Channel (NC) are indicated.

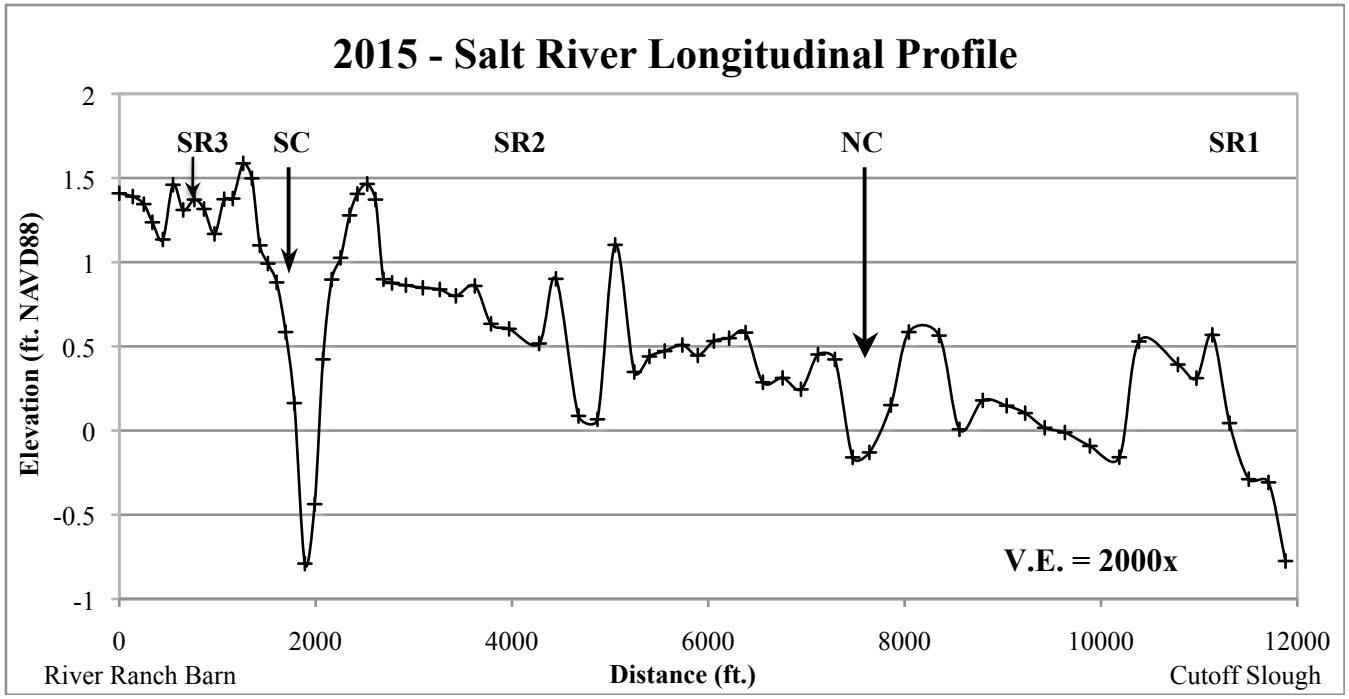

Figure 7B: June 2015 longitudinal profile of the main channel of the Salt River. SR1, SR2 and SR3 are locations of cross sections; NC and SC are the locations of the confluence with the Nouth and South Channels, respectively.

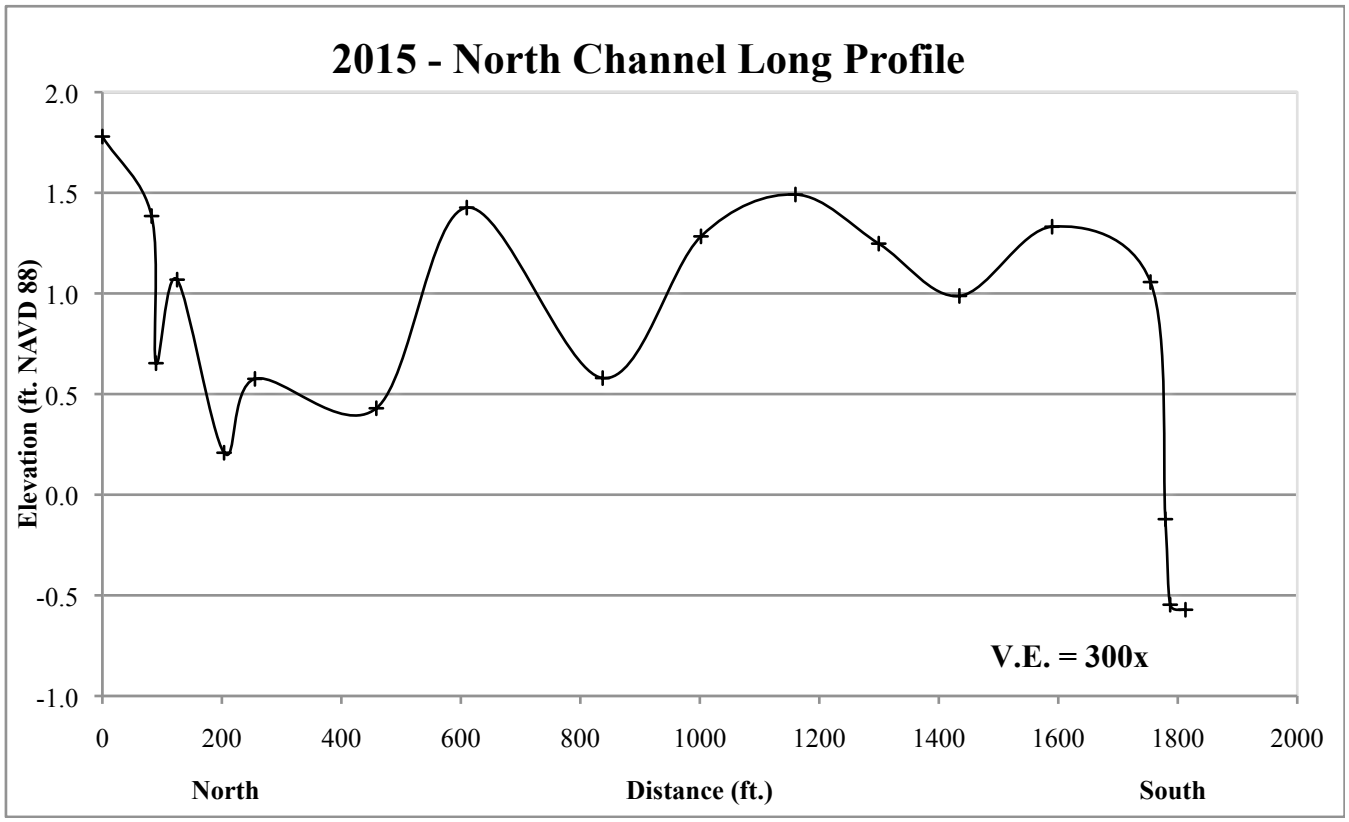

Figure 8A: 2015 longitudinal profile of the north channel of the Salt River.

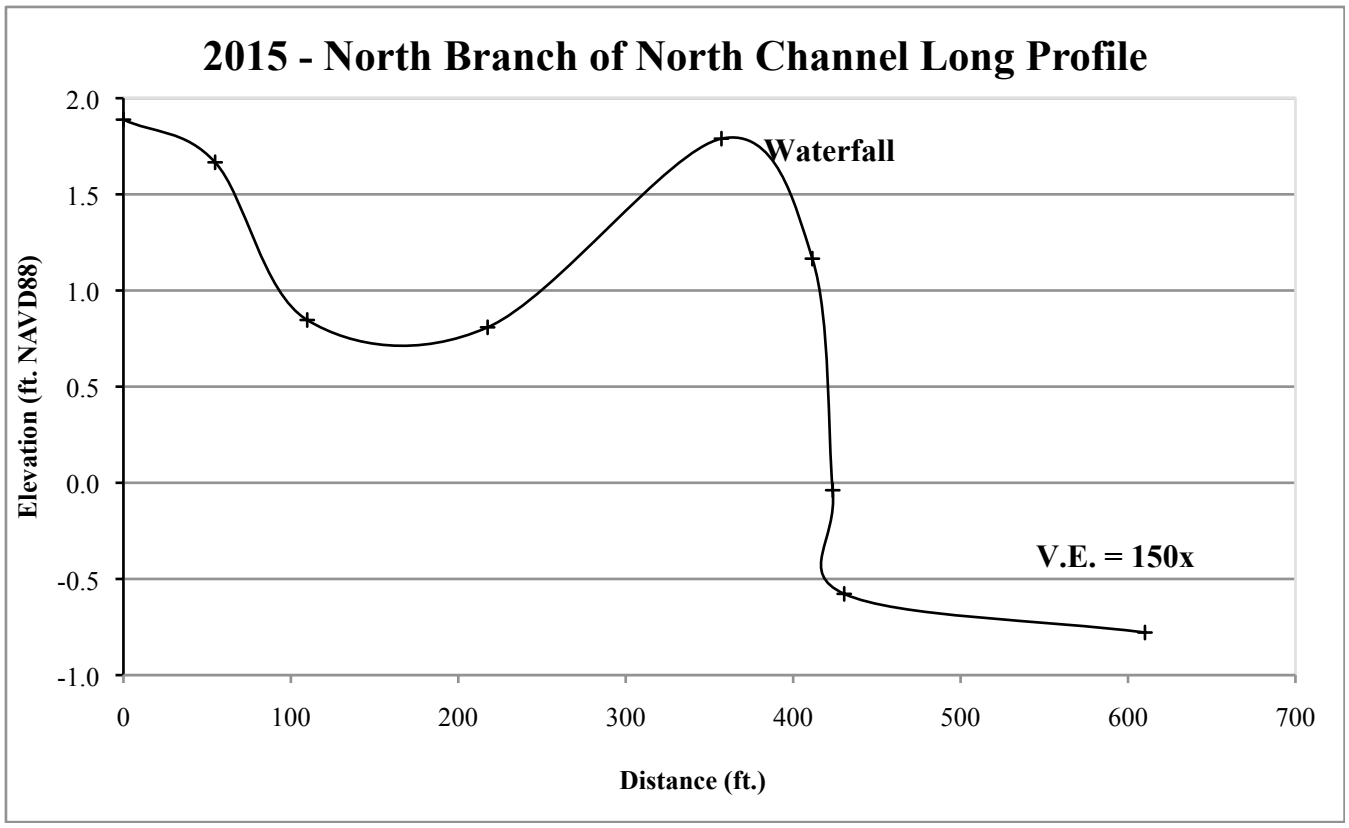

Figure 8B: 2015 longitudinal profile of the north branch of the north channel of the Salt River.

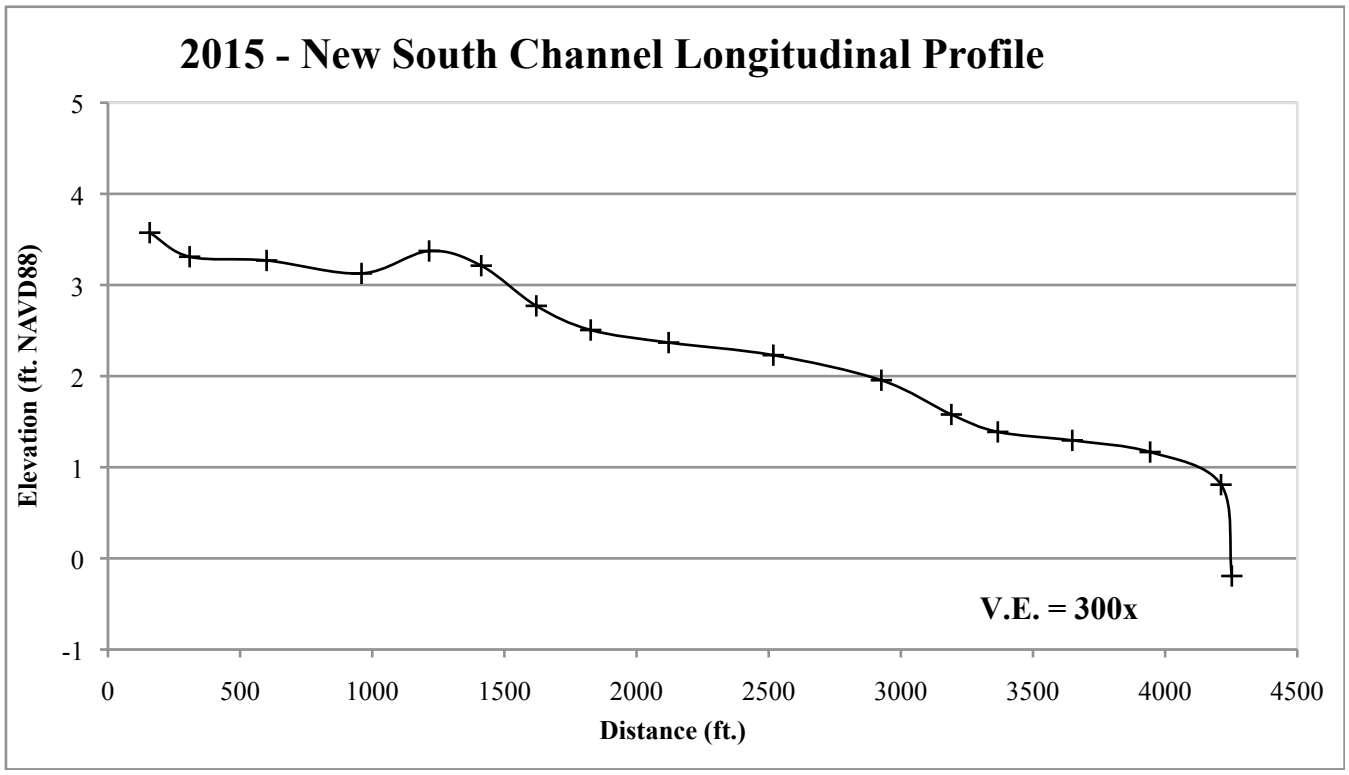

Figure 9A: 2015 longitudinal profile of the south channel of the Salt River.

Discussion

Total relief of the 9775-foot section of the main Salt River channel surveyed in 2014, from River Ranch barn to the confluence with Cutoff Slough, was 2.5 feet in 2014. An additional 2,100 feet of channel that was excavated in 2014, upstream of the River Ranch barn, were included in the 2015 longitudinal survey. The total relief on the 11,897-foot section of the main Salt River channel in 2015 was 2.4 feet. Channel aggradation in the upper portion of the Salt River near the River Ranch barn in 2015 relief is the result of minor sediment deposition in the channel. A deep scour pool (~1.7 ft) has developed near the confluence of the new South channel and the main Salt River channel at about 2000 feet downstream distance. Longitudinal profiles of the new North and South slough channels were not collected in 2014. Longitudinal surveys in 2015 show total relief on the North channel was 2.5 feet, and the total relief on the north branch of the north channel was 2.7 feet. Total relief on the South channel for 2015 was 2.8 feet.

In 2015, scouring and slumping on several channel banks was observed throughout the project area and most evidently downstream of the confluence of the Salt River and the South slough channel. Sedimentation was observed along the main Salt River channel that was deposited on the 2014 excavated surface. Suspended sediments were observed moving upstream during flood tide, and it is suspected that these fine grained sediments are deposited upstream during slack high tide, and explain the deposition that was observed at the main channel cross sections SR1 and SR3, as well as the 2-4" aggredation of Salt River and South channel confluence. Overall, there appears to be downstream transport of sediment, which is balanced by upstream transport. The net transport direction and quantity of sediment will be resolved in future channel surveys.

The 2015 Salt River and slough channel surveys were conducted using a Nikon DTM-352 Total Station laser theodolite with mirror prism, which delivers much higher resolution than the (optical) auto level and stadia that was used in the 2014 surveys.

Appendix I: <u>2014</u> Salt River Main Channel Cross-section data.

SR1	
Distance (feet)	Elevation (feet NAVD88)
0.0	6.63
44.9	6.62
57.4	5.13
73.8	4.97
101.7	6.30
121.4	5.46
157.4	6.22
191.2	6.96
196.8	6.90
209.9	5.37
217.5	4.66
223.0	3.06
241.1	-0.17
249.3	0.06
260.8	0.13
276.5	0.07
283.7	-0.17
308.3	1.56
316.8	6.10
334.6	6.87
367.4	6.23
431.3	6.76

SR2	
Distance (feet)	Elevation (feet NAVD88
0.0	7.44
31.2	7.96
99.1	8.67
154.2	7.85
187.9	9.09
211.6	8.91
232.9	7.68
238.8	5.12
241.7	3.54
255.8	1.02
273.9	0.89
292.6	1.01
305.0	1.53
311.6	3.32
313.2	4.09
313.2	7.81
319.8	7.85
349.3	7.09
403.4	6.86
437.9	8.01

SR3	
Distance (feet)	Elevation (feet NAVD88)
0.0	13.90
68.5	14.04
132.2	13.63
158.4	12.33
168.5	10.50
179.8	8.72
197.2	8.43
203.8	8.19
210.3	7.04
216.2	5.01
222.5	3.06
228.4	1.71
230.0	1.29
248.0	1.19
256.2	1.14
266.1	1.32
275.9	2.83
279.9	4.42
285.8	6.01
295.6	8.03

2015 Salt River Main Channel Cross-section data.

SR1	
Distance (feet)	Elevation (feet NAVD88)
431.5	7.52
385.2	7.61
345.9	7.17
320.5	5.25
318.5	0.71
316.4	0.42
307.3	-0.21
307.1	-0.78
297.0	-0.51
283.9	0.40
272.0	0.04
262.6	0.01
262.5	0.13
257.9	-0.14
253.0	0.62
247.3	2.27
240.7	5.18
237.3	6.28
189.1	6.79
154.0	5.73
124.7	5.93
87.5	5.38
65.0	6.38
0.0	7.18

SR2	
Distance (feet)	Elevation (feet NAVD88)
446.1	7.94
378.9	7.12
335.3	7.03
303.8	7.89
300.1	7.78
299.3	4.03
293.7	2.96
286.4	1.73
279.8	1.03
275.5	0.86
267.4	0.79
258.3	0.86
251.0	0.72
243.9	0.88
238.8	0.91
235.0	1.07
232.2	1.67
225.5	3.75
218.9	5.46
214.4	7.34
208.6	8.03
184.7	9.08
170.5	9.07
148.0	8.58
106.6	8.01
39.1	8.74
0.0	8.00

SR3	
Distance (feet)	Elevation (feet NAVD88)
290.9	9.58
282.7	9.55
278.7	7.07
276.0	4.92
266.7	3.21
256.2	2.29
243.9	2.68
231.3	2.62
229.8	1.97
223.5	1.81
216.2	1.82
214.9	2.44
209.1	3.33
203.6	4.94
199.7	6.07
186.0	8.77
168.0	8.66
157.3	10.49
144.4	12.50
0.0	14.11

Appendix II: <u>2014</u> Salt River North Slough Channel Cross-section data.

NC 1	
Distance (feet)	Elevation (feet NAVD88)
0	7.77
21	7.54
144	8.11
150	7.27
154	6.40
154	5.04
162	2.61
165	1.60
173	1.16
178	1.09
191	2.81
196	5.32
204	7.47
216	8.11
275	7.55
287	8.16
290	4.55
291	6.81
299	8.19
406	7.81

NC2	
Distance (feet)	Elevation (feet NAVD88)
0	4.91
53	5.65
111	6.85
122	6.45
129	4.89
129	3.82
135	2.17
137	0.74
142	0.97
148	1.56
150	3.11
152	4.91
155	5.15
161	6.46
197	7.24
320	5.35
393	5.79

NC3	
Distance (feet)	Elevation (feet NAVD88)
0	5.32
53	5.37
116	4.98
126	5.94
137	2.85
143	1.99
152	1.53
163	1.99
170	3.19
174	3.55
180	3.76
186	5.20
193	6.11
209	5.14
290	5.65
335	5.46

2015 Salt River North Slough Channel Cross-section Data.

NC1	
Distance (feet)	Elevation (feet NAVD88)
0	9.1
50	8.4
80	8.3
92	7.2
99	5.4
103	3.4
106	0.2
112	-0.5
119	-0.1
121	-0.6
127	-0.2
134	2.4
142	4.5
149	6.3
157	7.6
201	7.5
251	7.4
301	7.2
360	7.1
406	7.5

NC2	
Distance (feet)	Elevation (feet NAVD88)
0.0	7.3
56.7	7.0
164.2	8.5
212.5	8.1
218.8	6.3
221.6	4.8
222.4	3.5
225.6	2.3
231.0	2.1
234.4	1.4
234.5	1.4
236.4	1.7
237.3	3.6
240.0	4.2
242.9	5.3
247.7	7.3
251.8	8.2
261.2	8.5
306.0	7.3
347.6	6.5
361.9	6.2
430.6	6.8

NC3	
Distance (feet)	Elevation (feet NAVD88)
0	6.3
44	6.4
102	6.4
148	6.4
179	6.9
200	5.3
210	4.0
214	3.5
219	3.3
223	3.5
227	4.3
233	5.5
243	6.4
251	6.7
295	6.6
347	6.9
393	6.3
435	6.4

Appendix III: <u>2014</u> Salt River South Slough Channel Cross-section Data.

SC1	
Distance (feet)	Elevation (feet NAVD88)
0.0	5.79
60.0	6.93
113.2	6.66
119.1	6.75
126.3	5.04
128.9	3.87
133.5	2.92
136.4	2.11
145.3	1.70
148.6	1.62
152.5	1.81
155.8	2.31
159.4	3.83
163.3	5.38
168.3	6.82
182.4	7.02
262.1	6.52
320.8	6.43

SC2	
Distance (feet)	Elevation (feet NAVD88)
0	7.35
85	7.42
153	7.48
170	7.38
176	7.38
186	7.78
189	5.64
191	4.73
195	3.88
198	3.40
205	3.29
208	3.35
209	3.61
212	4.35
215	5.58
218	6.44
219	7.22
233	8.34
341	7.68
369	7.68
441	7.53

SC3	
Distance (feet)	Elevation (feet NAVD88)
0	5.93
81	8.06
145	9.21
179	9.27
205	9.04
206	8.29
213	6.02
212	4.28
211	4.04
218	4.02
219	4.16
219	4.77
223	6.73
223	7.66
224	8.77
231	9.10
290	8.68
344	8.71
387	8.32

2015 Salt River South Slough Channel Cross-section Data.

SC1	
Distance (feet)	Elevation (feet NAVD88)
0.0	5.89
48.4	7.19
92.0	7.26
122.9	6.79
136.9	6.86
141.2	7.22
146.6	5.80
152.6	3.52
158.6	1.85
165.2	3.52
173.4	3.45
178.1	3.57
183.9	4.92
192.5	6.43
236.4	7.02
281.5	6.83
326.6	7.08

SC2	
Distance (feet)	Elevation (feet NAVD88)
352.8	6.77
306.5	6.82
259.6	6.63
216.4	7.20
202.5	5.86
197.7	3.97
191.6	2.34
188.5	2.19
180.7	2.18
176.9	2.49
173.2	2.79
164.8	4.98
160.1	6.59
143.2	7.38
94.1	7.53
51.0	8.37
0.0	8.53

SC3	
Distance (feet)	Elevation (feet NAVD88)
0.0	6.51
106.1	9.75
144.8	9.74
202.4	9.83
215.1	9.14
218.9	8.77
221.3	5.78
223.2	4.19
224.6	3.99
226.2	4.07
227.8	4.19
232.1	4.23
235.2	6.56
241.2	9.26
247.8	9.27
292.4	8.97
334.6	8.67
377.1	7.67
418.3	6.84

Appendix IV: <u>2014</u> Salt River Main Channel longitudinal profile data.

Distance (feet)	Elevation (feet NAVD88)
0	1.71
279	1.64
560	1.51
798	1.39
1049	1.32
1308	1.18
1498	1.04
1656	0.97
1856	0.86
2048	0.83
2228	0.82
2416	0.79
2570	0.71
2762	0.67
3155	0.66
3273	0.59
3481	0.56
3750	0.52
3994	0.49
4254	0.47
4523	0.46
4772	0.44
4772	0.44
5019	0.43
continued at right	

continued from left	
Distance (feet)	Elevation (feet NAVD88)
5284	0.42
5548	0.41
5818	0.40
5995	0.35
6267	0.30
6618	0.28
6618	0.28
6771	0.21
6949	0.19
7034	0.17
7246	0.05
7482	-0.08
7716	-0.19
7716	-0.26
7960	-0.29
8188	-0.34
8442	-0.42
8693	-0.43
8933	-0.49
9124	-0.55
9441	-0.58
9582	-0.65
9590	-0.68
9679	-0.77
9774	-0.78

2015 Salt River Main Channel longitudinal profile data.

Distance (feet)	Elevation (feet NAVD88)
0	1.409
137	1.390
250	1.345
337	1.237
444	1.135
547	1.460
651	1.310
765	1.372
863	1.316
970	1.168
1069	1.374
1156	1.378
1262	1.587
1351	1.498
1432	1.100
1514	0.992
1603	0.880
1694	0.585
1783	0.163
1890	-0.790
1990	-0.437
2075	0.423
2164	0.897
2254	1.026
2345	1.278
2426	1.406
2526	1.465
2609	1.372
2691	0.899
2778	0.877
2920	0.863
3092	0.848
3265	0.838
3429	0.800
3622	0.859
3787	0.634
3971	0.604
4087	1.585
3971	0.604
4087	1.585
4277	0.517
4448	0.901
4678	0.087
4871	0.067
5051	1.103
5246	0.348
5400	0.440
5556	0.472
5736	0.508
5893	0.446
6057	0.532
6212	0.549
6380	0.582
6556	0.287
6757	0.313
6944	0.245
7117	0.452
7289	0.423
7471	-0.159
7641	-0.130
7860	0.151
8043	0.585
8351	0.564
8558	0.007
8796	0.179
9039	0.148
9228	0.104
9427	0.017
9632	-0.011
9887	-0.091
10187	-0.158
10387	0.529
10784	0.392
10973	0.311
11134	0.568
11309	0.044
11505	-0.289
11706	-0.308
11879	-0.775

2015 North Channel longitudinal profile data.

Distance (feet)	Elevation (feet NAVD88)
0	1.780
82	1.385
90	0.654
125	1.069
204	0.209
255	0.576
459	0.430
610	1.427
837	0.580
858	0.670
1002	1.284
1160	1.492
1299	1.248
1435	0.988
1590	1.332
1754	1.057
1779	-0.121
1787	-0.546
1813	-0.751
1991	-0.082

2015 North branch of North channel longitudinal profile data.

Distance (feet)	Elevation (feet NAVD88)
0	1.889
55	1.667
110	0.847
218	0.809
357	1.790
411	1.166
424	-0.039
430	-0.578
610	-0.779

2015 Salt River South Channel longitudinal profile data.

Distance (feet)	Elevation (feet NAVD88)
0	3.574
158	3.310
309	3.269
600	3.127
959	3.373
1215	3.212
1412	2.771
1621	2.506
1827	2.368
2121	2.230
2518	1.955
2926	1.579
3191	1.388
3367	1.295
3649	1.167
3943	0.809

Appendix V: 2015 Photographs of Salt River and new slough channel cross-sections:

2015 Salt River Channel Cross section 1 –SR1. View is looking south.
(All photos by Daniel O'Shea)

2015 Salt River Channel Cross section 2 –SR2. View is looking south.

2015 Salt River Channel Cross section 3 –SR3. View is looking upstream.

2015 North Channel Cross section 1 –NC1. View is looking south. Note scour on south bank indicated by arrow.

2015 North Channel Cross section 2 –NC2. View is looking west.

2015 South Channel Cross section 1 –SC1. View is looking west.

2015 South Channel Cross section 3 –SC3. View is looking south.