SURVEY DATA

The relationships between available trout habitat and stream flow were investigated during the 2007, 2008 and 2009 field seasons in 21 locations using the PHABSIM (Physical Habitat Simulation) system (Bovee 1997; USGS 2001). The reaches were selected for study based upon several criteria, including stream flow magnitude, history of hydrologic alteration by water development, location within the County's river drainage network, relative importance for recreational and other water uses, and in most cases, the lack of previous detailed instream flow studies. These reaches and the study sites sampled are described in Appendix A. Specific survey sites, access information (Table 1 through 3) and photographs are presented here. Cross section locations are shown on the aerial photographs in the following sections.

Table E1. Site details for reaches selected for PHABSIM surveys in 2007

Site Description	ID	Access/Location
Vasquez Ck	F-VC	Vasquez Creek Road (FS Road 148) to creek spur, approximately 1/2 miles below DW diversion and 1 mile above GC Water & Sanitation Building); blue marker at spur
St Louis Ck	F-StL	St. Louis Creek Road (Cty Road 73) to St. Louis Campground, park at kiosk and hike access road directly to ditch headgate, immediately below St. Louis diversion ditch
Fraser River at CWWTP	F6	Wastewater treatment plant road, park near outbuilding by pond, and around barbwire fence to upstream reach, above treatment plant effluent
Fraser River at Granby Ranch	F9	From Hwy 40, turn east onto road into Granby Ranch just south of Granby; 1 mile to 2nd Granby Ranch anglers pullout overlooking reach, section on meander complex below golf course
Colorado River at Miller Ranch	CR3	From Hwy 34, turn west at Miller Ranch (opposite shortcut road); park near gate and walk across pasture; reach is downstream of ranch buildings
Colorado River above K-B ditch	CR5	From Hwy 40, turn south at CR 39, then east at CR 33, ~ 1 mile to lefthand access road down pasture to River (4WD); reach immediately below Reeder Creek
Colorado River below K-B ditch	CR6	From Hwy 40, turn south at CR 39, 1 mile to bridge; reach bisected by CR 39 bridge
Colorado River below Gore Canyon	CR7	Three sites with access along BLM and NCWCD property. See site descriptions
Blue River	BR	From Hwy 9; west on CR 10 to river; reach above/bisected by CR 10 (Spring Ck Rd)
Williams Fork	WR	From Hwy 40; south at DOW ranch 1 mile west of Parshall; left at fork after bridge; 1 mile to terrace above floodplain; walk down to river; reach 1/2 mile above confluence with Colorado R
Muddy Ck	MC	From 40, use dirt access road to campground; ~2 miles North of Kremmling; reach below diversion @ campground

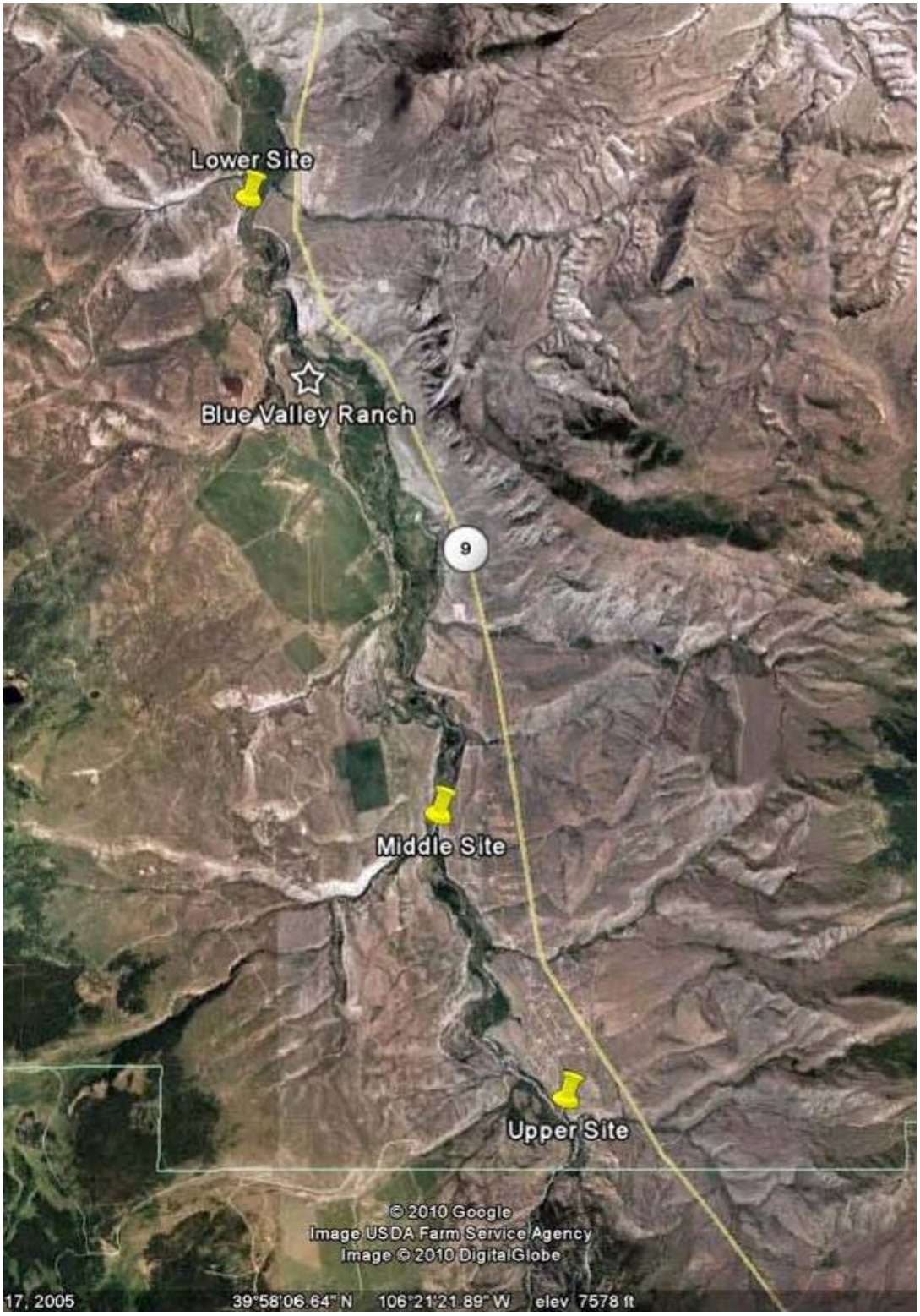
Table E2. Site details for reaches selected for PHABSIM surveys and modeling in 2008

Site Description	ID	Access/Location
Fraser River at Idlewild Campground	F3	Access through Idlewild Campground, follow bike path from campground back upstream for less than ¼ mile
Ranch Creek, upper	F-RC1	From Hwy 40 at Fraser, driver ¼ mile north of town and turn east on County Rd 8. Follow County Rd 8 for approx. 2 ¾ miles until road crosses Ranch Creek. Site is immediately upstream of road crossing.
Ranch Creek, lower	F-RC2	From Hwy 40 at Fraser, driver 2 ¾ miles north of town and turn east on County Rd 84. Follow County Rd 84 for approx. 1 mile until road crosses Ranch Creek. Site is downstream of road crossing.
Colorado River at Chimney Rock	CR4	Downstream of Windy Gap, follow Hwy 40 approx. 1 ¼ miles west of County Rd 57 (referred to as Hitching Post Rd), turn south into ranch driveway. Follow river back upstream for approximately ½ mile.
Reeder Creek	RE	From Hwy 40 turn south on County Rd 39, follow to Cty Rd 33, turn east and follow to fishing access parking area
Troublesome Creek	TR	Immediately north of Hwy 40 and west of County Rd 2
Blue River below Trough Rd	BR-L	From Hwy 9 turn west on Trough Road (Cty Rd 1, follow for 4 miles to dirt road. Turn north on dirt road for .1 miles. Site is just upstream of old railroad crossing

Table E3. Site details for reaches selected for PHABSIM surveys in 2009

Site Description	ID	Access/Location
Blue River at BVR, Upper	BRV-U	From Hwy 9; west on CR 10 to river; turn south along west bank (gated road) and follow for approximately ½ mile.
Blue River at BVR, Middle	BRV-M	Site is approximately 3 miles south of Ranch office and bridge. Contact ranch manager for access details.
Blue River at BVR, Lower	BRV-L	Site is accessed off of Hwy 9, approximately 1 mile north of the Ranch entrance. Contact ranch manager for access details.

BLUE RIVER, BR 2009 PHABSIM SITES



Aerial of 2009 PHABSIM Sites on Blue Valley Ranch

BLUE RIVER, BR 2009 PHABSIM SITES

Photo 1. 2009 PHABSIM Lower Site on Blue Valley Ranch

Photo 2. 2009 PHABSIM Middle Site on Blue Valley Ranch

BLUE RIVER, BR 2009 PHABSIM SITES

Photo 3. 2009 PHABSIM Upper Site on Blue Valley Ranch

FRASER RIVER, F3 PHABSIM SITE 2008

Aerial of PHABSIM Site on Fraser River, ¼ mile upstream of Idlewild Campground across from entrance to Winter Park Ski Area

FRASER RIVER, F3 PHABSIM SITE 2008

Photo 1. F3 PHABSIM Site looking south toward USGS Gage and Highway 40.

Photo 2. F3 PHABSIM Site looking downstream

RANCH CREEK, F-RC1 (UPPER) PHABSIM SITE 2008

Aerial of PHABSIM Site F-RC1upstream of County Road 8

Photo 1. Downstream of RC1 PHABSIM Site at culvert under County Road 8

RANCH CREEK, F-RC2 (LOWER) PHABSIM SITE 2008

Aerial of PHABSIM Site F-RC2 downstream of County Road 84


Photo 1. Downstream of County Road 84 near old gage and upstream of RC2 PHABSIM site.

COLORADO RIVER AT CHIMNEY ROCK, CR 4 PHABSIM SITE 2008

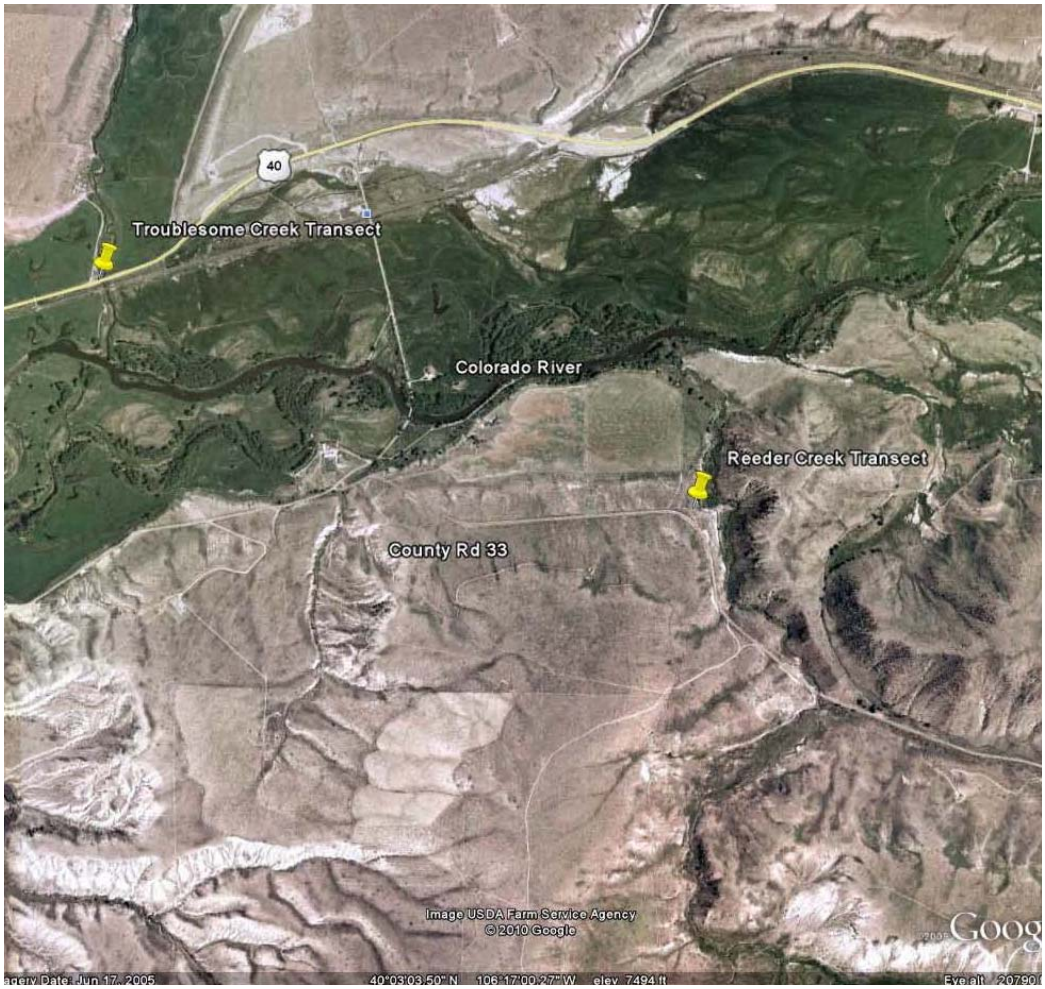
Aerial of PHABSIM Site on Colorado River approximately 1 ¼ miles west of County Rd 57

COLORADO RIVER AT CHIMNEY ROCK, CR 4 PHABSIM SITE 2008

Photo 1. Chimney Rock PHABSIM site

Photo 2. Chimney Rock PHASIM site

TRANSECT SITES 2008: REEDER (RE) AND TROUBLESOME CREEK (TC)



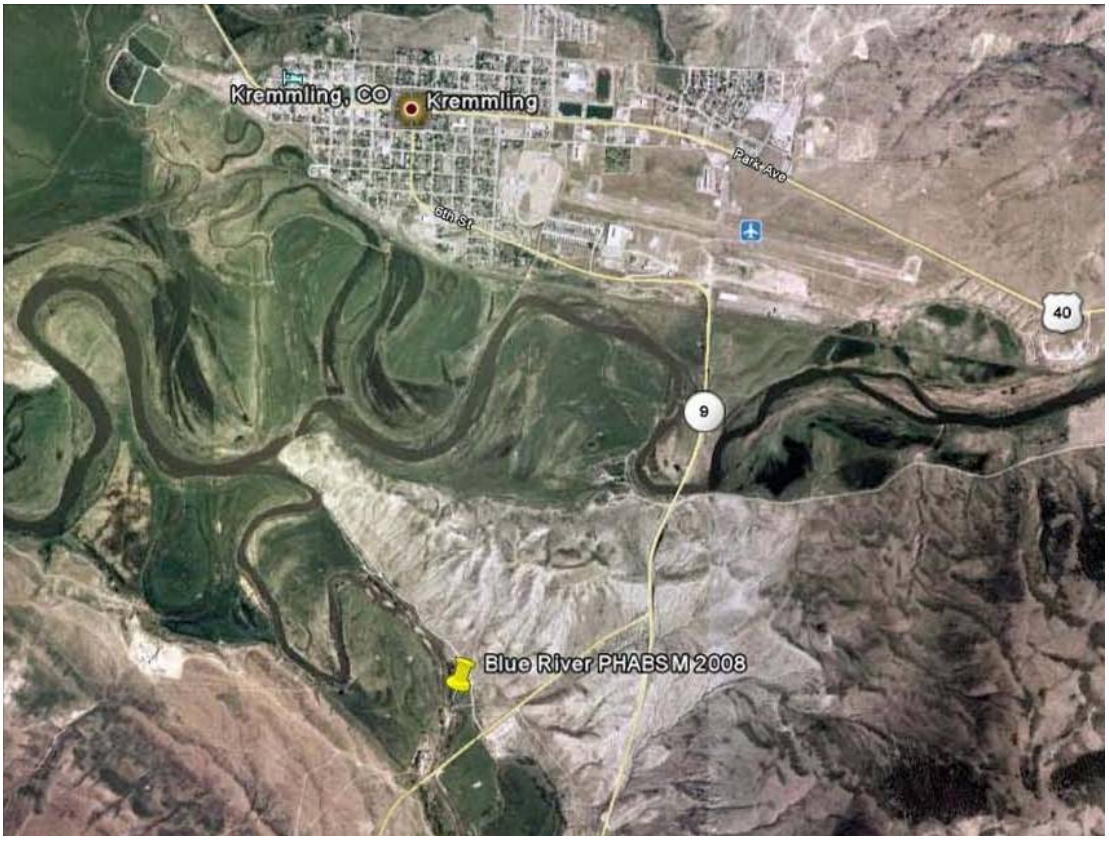
Aerial of transect sites on Reeder Creek and Troublesome Creek.

TRANSECT SITES 2008: REEDER AND TROUBLESOME CREEK

Photo 1. Reeder Creek at transect location near fishing access parking area off of County Road 33

Photo 2. Troublesome Creek at transect location immediately upstream of Highway 40.

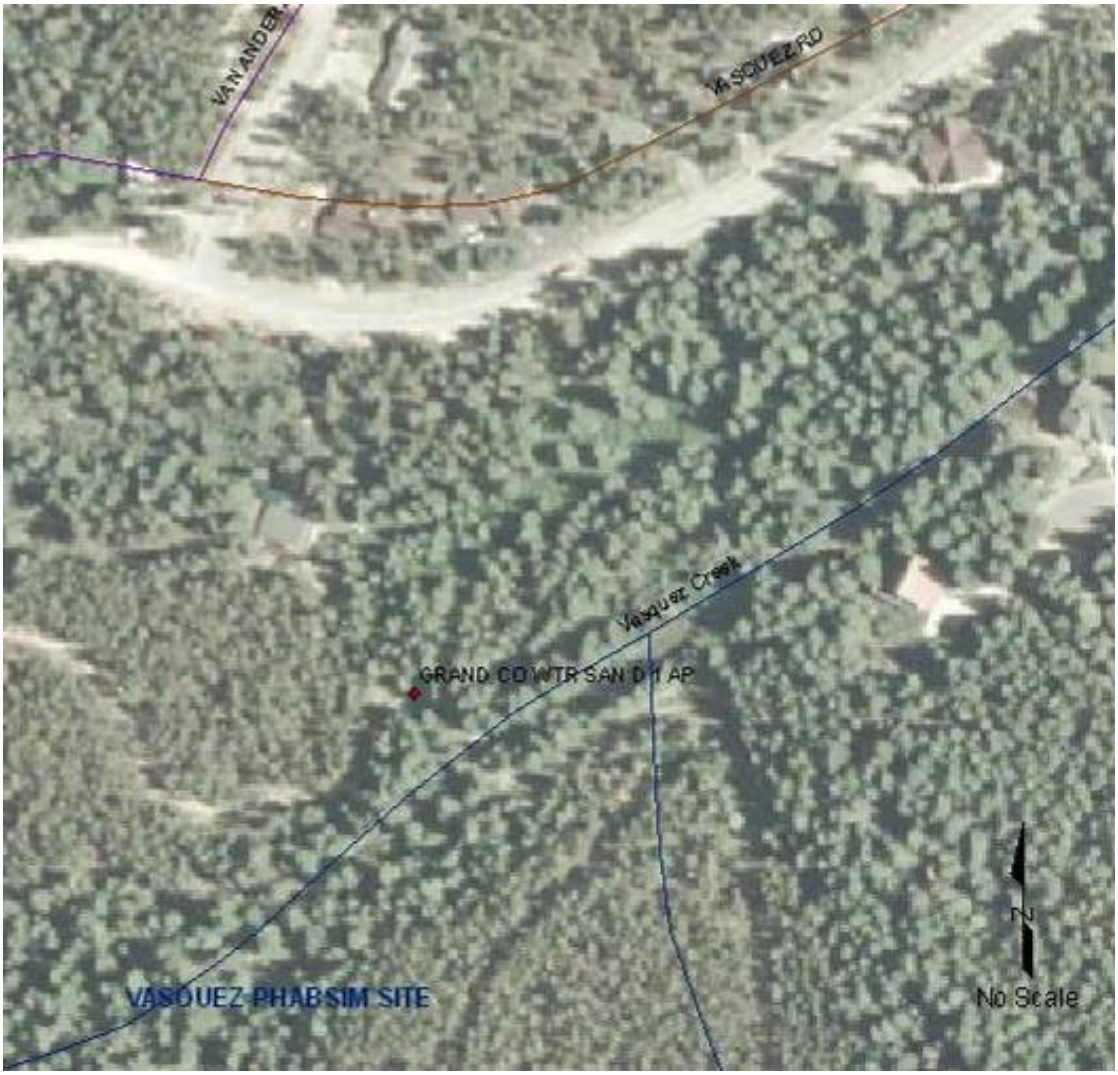
BLU E RIVER, BR PHABSIM SITE 2008



Aerial of Blue River 2008 PHABSIM Site downstream of Trough Road

Photo 1. Blue River at old Railroad crossing downstream of Trough Road, looking upstream.

VASQUEZ CREEK, F-VC PHABSIM SITE 2007



Aerial of PHABSIM Site on Vasquez Creek approximately 1 mile southwest of Hwy 40

VASQUEZ CREEK, F-VC PHABSIM SITE 2007

Photo 1. Transect 6 on Vasquez- highly vegetated banks, fast moving narrow channel (24Jun07)

Photo 2. Midriver looking downstream on Vasquez Creek (30Jul07)

ST LOUIS CREEK, F-StL PHABSIM SITE 2007

Aerial of PHABSIM Site on St. Louis Creek approximately 2.5 miles southwest of Fraser

ST LOUIS CREEK, F-StL PHABSIM SITE 2007

Photo 1. Midriver looking downstream on St. Louis (22Jun07)

Photo 2. Transect 7 on St. Louis- highly vegetated banks, plentiful willows.

FRASER RIVER AT SANITATION DISTRICT WASTE WATER TREATEMENT PLANT (SDWWTP), F6 PHABSIM SITE 2007

Aerial of Fraser River at SDWWTP PHABSIM Site just north of Fraser.

FRASER RIVER AT SANITATION DISTRICT WASTE WATER TREATEMENT PLANT (SDWWTP), F6 PHABSIM SITE 2007

Photo 1. Looking upstream on Fraser near WWTP (30Jul07)

Photo 2. Transect 10 on Fraser near WWTP. Grassy banks and low valley. (30Jul07)

FRASER RIVER AT GRANBY RANCH, F9 PHABSIM SITE 2007

Aerial of Fraser River at Granby Ranch PHABSIM Site just east of Granby.

FRASER RIVER AT GRANBY RANCH, F9 PHABSIM SITE 2007

Photo 1. Looking downstream on Fraser near Granby (31Jul07)

Photo 2. Looking upstream on Fraser near Granby (25Oct07)

COLORADO RIVER MILLER RANCH, CR3 PHABSIM SITE 2007

Aerial of Miller Ranch PHABSIM location

COLORADO RIVER MILLER RANCH, CR3 PHABSIM SITE 2007

Photo 1. Looking downstream towards survey area (18Jun07)

Photo 2. Transect 1 from right bank to left bank (18Jun07)

COLORADO RIVER ABOVE KB DITCH, CR5 PHABSIM SITE 2007

Aerial of Colorado River above KB Ditch PHABSIM site

COLORADO RIVER ABOVE KB DITCH, CR5 PHABSIM SITE 2007

Photo 1. Confluence of Colorado River with Reeder Creek (04Jul07)

Photo 2. Looking upstream on Colorado River (04Jul07)

COLORADO RIVER BELOW KB DITCH, CR6 PHABSIM SITE 2007

Aerial of Colorado River below KB Ditch PHABSIM site

COLORADO RIVER BELOW KB DITCH, CR6 PHABSIM SITE 2007

Photo 1. Looking upstream towards bridge (03Jul07)

Photo 2. Looking right bank towards left bank at transect 5. (03Jul07)

BLUE RIVER NEAR BLUE VALLEY RANCH, BR PHABSIM SITE 2007

Aerial of Blue River PHABSIM on Blue Valley Ranch downstream of County Road off of Hwy 9 approximately 6.5 miles south of Kremmling

BLUE RIVER NEAR BLUE VALLEY RANCH, BR PHABSIM SITE 2007

Photo 1. Blue River looking upstream

Photo 2. At transect 7 towards steep confining wall.

WILLIAMS FORK, WR PHABSIM SITE 2007

Aerial of PHABSIM Site on Williams Fork approximately ½ mile west of Parshall near confluence with Colorado River.

WILLIAMS FORK, WR PHABSIM SITE 2007

Photo 1. Looking upstream on Williams Fork (31Jul07)

Photo 2. Looking downstream on Williams Fork (26Oct07)

MUDDY CREEK CAMPGROUND, MC PHABSIM SITE 2007

Aerial at Campground on Muddy Creek approximately 2 miles north of Kremmling

MUDDY CREEK CAMPGROUND, MC PHABSIM SITE 2007

Photo 1. Looking downstream on Muddy Creek (23Jun07)

Photo 2. Looking downstream on Muddy Creek (23Jun07)

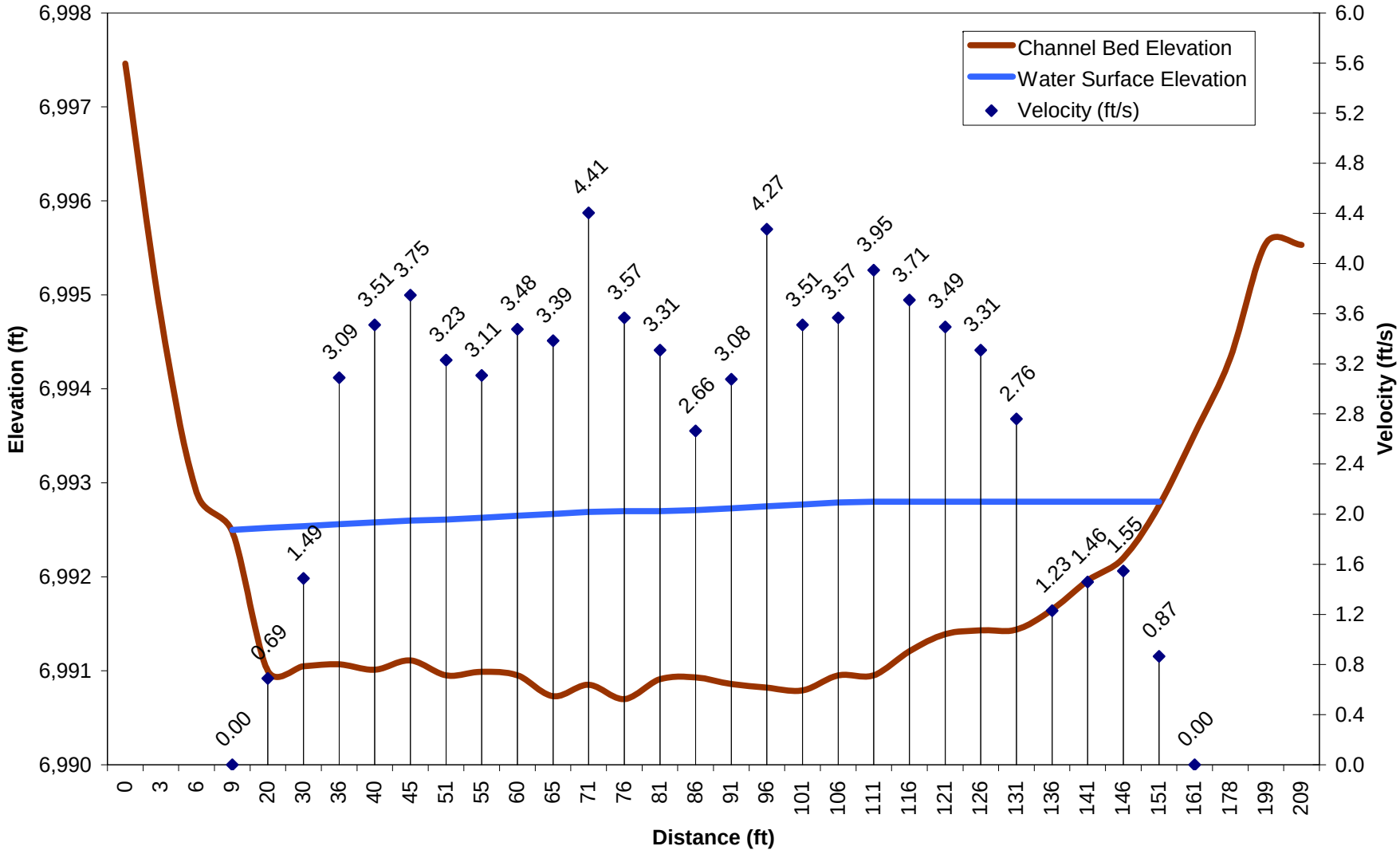
COLORADO RIVER CROSS SECTION SURVEY AT THE PUMP HOUSE BOAT RAMP 2007

On October 31, 2007 a cross section and discharge measurement survey was performed on the Colorado River in a riffle section located just downstream of the Pump House Boat Launch. (39º 59'11"N, 106º 30' 46" W).

Brian Bertoline and Alaina Briggs performed the work. A robotic total station was used to measure the elevations. A base control point was established with assumed coordinates 50,000 N, 60,000 E and 7,000 ft Elevation. An Aquacalc 5000 with a Price AA current meter and wading rod were used to perform the discharge measurement. The weather was overcast with scattered rain in the morning, temperatures ranged from 40º F to 55º F.

The results of the survey and velocity measurements are depicted in the figure below.
The total discharge was 535 cfs.

Colorado River: Cross Section at Pump House



AQUACALC DATA
Colorado River at Pump House Boat Launch

AquaCalc 5000 (tm) by JBS Instruments
Firmware Version AQNUSH8b (c)1995-2000

GAGE ID#	0	METER CONST. C2	0.0178
DATE	10/31/2007	METER CONST. C3	2.2048
TRANSECT	4	METER CONST. C4	0.0178
USER ID#	0	METER CONST. C5	0
SH BEGIN	0	MEASUREMENT TIME	20
SH END	0	MEAS. SYSTEM	SAE
GH BEGIN	0	PERCENT SLOPE	0
GH END	0	TOTAL VERTICALS	28
EST. DISCHARGE	0	TOTAL STATIONS	28
EST. Q (ADJ)	535	TOTAL WIDTH	140
METER ID#	0	TOTAL AREA	170
AQUACALC ID#	0	TOTAL DISCHARGE	535
SOUNDING WT.	0	PCT DIFFERENCE	0
START MEAS. AT	LEW	MEAN VELOCITY	3.15
METER TYPE	Price AA 1:1 ST2	WETTED PERIMETER	140.11
METER CONST. C1	2.2048	HYDRAULIC RADIUS	1.21
		MANNING FACTOR	0

OB	DIST	DEPTH	ICE	REVS	TIME	COS:VF	LOC	COEF	CLOCK	VEL	AREA	FLOW(Q)	Safety Factor
1	0	0.0	0	0	0.0	1	6	1	0:03	0	0.0	0.0	
2	5	0.7	0	7	23.0	1	6	1	0:03	0.689	3.5	2.4	0.5
3	10	1.2	0	14	21.0	1	6	1	0:07	1.488	6.0	8.9	1.8
4	15	1.0	0	28	20.1	1	6	1	0:08	3.089	5.0	15.5	3.1
5	20	1.1	0	32	20.2	1	6	1	0:09	3.51	5.5	19.3	3.9
6	25	1.3	0	34	20.1	1	6	1	0:10	3.747	6.5	24.4	4.9
7	30	1.4	0	30	20.6	1	6	1	0:11	3.229	7.0	22.6	4.5
8	35	1.4	0	29	20.7	1	6	1	0:12	3.107	7.0	21.8	4.3
9	40	1.1	0	32	20.4	1	6	1	0:15	3.476	5.5	19.1	3.8
10	45	1.6	0	31	20.3	1	6	1	0:15	3.385	8.0	27.1	5.4
11	50	1.3	0	40	20.1	1	6	1	0:17	4.405	6.5	28.6	5.7
12	55	1.6	0	33	20.5	1	6	1	0:19	3.567	8.0	28.5	5.7
13	60	1.8	0	30	20.1	1	6	1	0:20	3.308	9.0	29.8	6.0
14	65	1.6	0	24	20.0	1	6	1	0:21	2.664	8.0	21.3	4.3
15	70	1.9	0	29	20.9	1	6	1	0:22	3.077	9.5	29.2	5.8
16	75	1.5	0	39	20.2	1	6	1	0:23	4.274	7.5	32.1	6.4
17	80	1.7	0	32	20.2	1	6	1	0:24	3.51	8.5	29.8	6.0
18	85	1.7	0	33	20.5	1	6	1	0:25	3.567	8.5	30.3	6.1
19	90	1.8	0	36	20.2	1	6	1	0:27	3.947	9.0	35.5	7.1
20	95	1.6	0	34	20.3	1	6	1	0:28	3.71	8.0	29.7	5.9
21	100	1.4	0	32	20.3	1	6	1	0:29	3.493	7.0	24.5	4.9
22	105	1.4	0	30	20.1	1	6	1	0:30	3.308	7.0	23.2	4.6
23	110	0.9	0	25	20.1	1	6	1	0:32	2.76	4.5	12.4	2.5
24	115	0.9	0	11	20.0	1	6	1	0:33	1.23	4.5	5.5	1.1
25	120	0.8	0	14	21.4	1	6	1	0:34	1.46	4.0	5.8	1.2
26	125	0.6	0	14	20.2	1	6	1	0:35	1.546	3.0	4.6	0.9
27	130	0.4	0	8	20.8	1	6	1	0:35	0.866	3.0	2.6	0.3
28	140	0.0	0	0	0.0	1	6	1	0:00	0	0.0	0.0	
											TOTAL =	**534.6**	

Grand County Stream Management Plan
Project Number: 5362-001-00

Colorado River at Pump House Cross Section

Note: instrument was set up with an assumed elevation of 7,000 ft

Water Surface Slope Calculation					
Upstream Elev (ft).	Downstream Elev. (ft)	Distance (ft)	WS Slope (ft/ft)	WS Slope (ft/mile)	WS Slope (%)
6993.46	6991.06	448	0.00536	28.29	0.54%

Cross Section Information					
Station	Channel Bed Elevation (ft)	Water Surface Elevation (ft)	Description	Velocity Measurement Num.	Velocity (ft/s)
0	6997.46		Top of Bank		
3	6994.78		Ground		
6	6992.90		Toe of Bank		
9	6992.48	6992.5	Left Edge of Water, velocity measurement #1	1	0.00
20.1	6991.00	6992.52	Velocity Measurement #2, Sand, coarse gravel, fine cobble	2	0.69
30.1	6991.05	6992.54	Velocity Measurement #3, Coarse cobble and boulders	3	1.49
35.7	6991.07	6992.56	Velocity Measurement #4, Coarse cobble and boulders, algae/vegetation	4	3.09
40.2	6991.01	6992.58	Velocity Measurement #5, Coarse cobble and boulders, algae/vegetation	5	3.51
45.2	6991.11	6992.6	Velocity Measurement #6, Coarse cobble and boulders, algae/vegetation	6	3.75
50.6	6990.95	6992.61	Velocity Measurement #7, Coarse cobble and boulders, algae/vegetation	7	3.23
55.2	6990.99	6992.63	Velocity Measurement #8, Coarse cobble and boulders, algae/vegetation	8	3.11
60.2	6990.95	6992.65	Velocity Measurement #9, Coarse cobble and boulders, algae/vegetation	9	3.48
65.3	6990.73	6992.67	Velocity Measurement #10, Coarse cobble and boulders, algae/vegetation	10	3.39
70.6	6990.85	6992.69	Velocity Measurement #11, Coarse cobble and boulders, algae/vegetation	11	4.41
75.7	6990.70	6992.7	Velocity Measurement #12, Coarse cobble and boulders, algae/vegetation	12	3.57
80.5	6990.91	6992.7	Velocity Measurement #13, Coarse cobble and boulders, algae/vegetation	13	3.31
85.8	6990.93	6992.71	Velocity Measurement #14, Coarse cobble and boulders, algae/vegetation	14	2.66
91.1	6990.86	6992.73	Velocity Measurement #15, Coarse cobble and boulders, algae/vegetation	15	3.08
95.9	6990.82	6992.75	Velocity Measurement #16, Coarse cobble and boulders, algae/vegetation	16	4.27
100.9	6990.79	6992.77	Velocity Measurement #17, Coarse cobble and boulders, algae/vegetation	17	3.51
106.2	6990.95	6992.79	Velocity Measurement #18, Coarse cobble and boulders, algae/vegetation	18	3.57
110.9	6990.95	6992.8	Velocity Measurement #19, Coarse cobble and boulders, algae/vegetation	19	3.95
116.1	6991.21	6992.8	Velocity Measurement #20, Coarse cobble and boulders, algae/vegetation	20	3.71
121.2	6991.39	6992.8	Velocity Measurement #21, Coarse cobble and boulders, algae/vegetation	21	3.49
126.2	6991.43	6992.8	Velocity Measurement #22, Coarse cobble and boulders, algae/vegetation	22	3.31
131.1	6991.44	6992.8	Velocity Measurement #23, Coarse cobble and boulders, brown algae/vegetation	23	2.76
136.2	6991.65	6992.8	Velocity Measurement #24, Coarse cobble and boulders, brown algae/vegetation	24	1.23
141.3	6991.96	6992.8	Velocity Measurement #25, Coarse cobble and boulders, brown algae/vegetation	25	1.46
146.1	6992.20	6992.8	Velocity Measurement #26, Coarse cobble and boulders, brown algae/vegetation	26	1.55
151.4	6992.76	6992.8	Right Edge of Water	27	0.87
161.3	6993.52		Ground	28	0.00
177.9	6994.33		Ground		
198.9	6995.55		Ground		
208.7	6995.53		Ground		
231.3	6996.43		Ground		
252.0	6996.88		Ground		

Four photos were taken at the cross section shown on the following pages:
1. From the left bank looking at the right bank
2. From the center of the channel looking upstream
3. From the center of the channel looking downstream
4. From the right bank looking at the left bank

Photo 1. From the left bank looking towards the right bank

Photo 2. From the center of the channel looking upstream

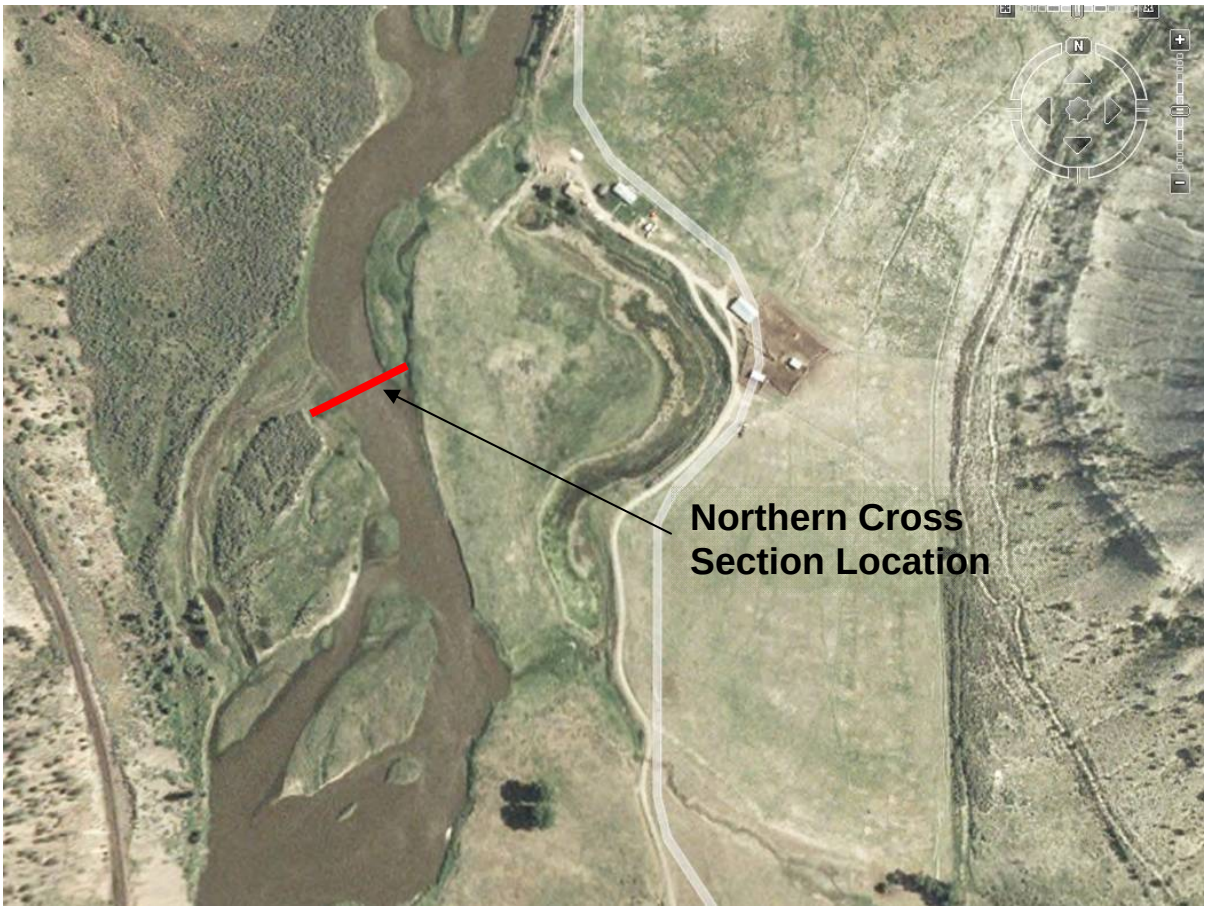
Photo 3. From the center of the channel looking downstream

Photo 4. From the right bank looking towards the left bank

COLORADO RIVER CROSS SECTION SURVEY AT NORTHERN PROPERTIES 2007

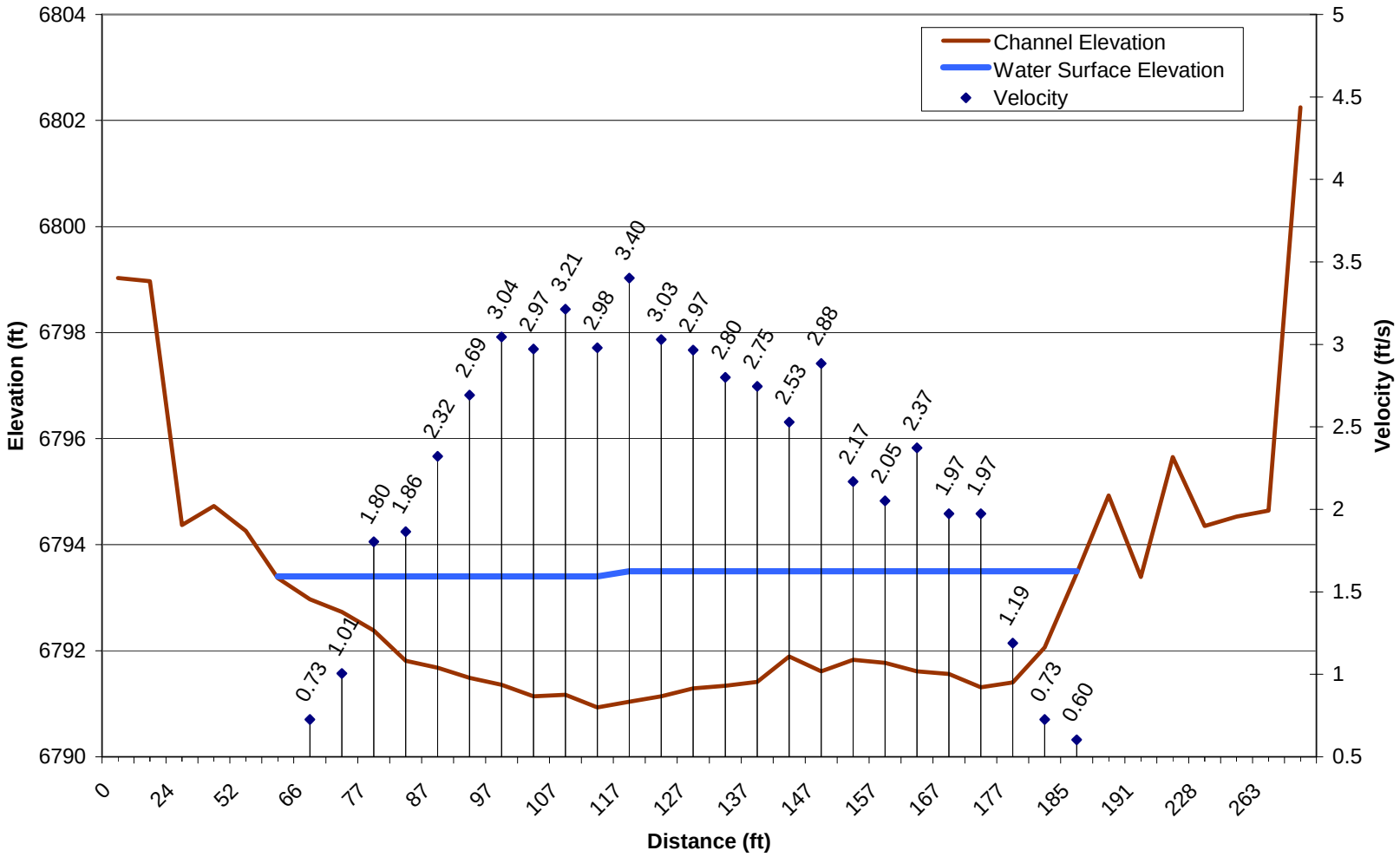
On October 31, 2007 a cross section and discharge measurement survey was performed on the Colorado River in a riffle section located within the Northern Properties.
(39º 58' 11" N, 106º 31' 04" W).

Brian Bertoline and Alaina Briggs performed the work. A robotic total station was used to measure the elevations. A base control point was established with assumed coordinates 40,000 N, 50,000 E and 6,800 ft elevation. An Aquacalc 5000 with a Price AA current meter and wading rod were used to perform the discharge measurement. The weather was overcast with scattered rain in the morning, temperatures ranged from 40º F to 55º F.



The results of the survey and velocity measurements are depicted in the figure below.
The total discharge was 509 cfs.

Colorado River: Cross Section at Northern Properties



AQUACALC DATA

AquaCalc 5000 (tm) by JBS Instruments
Firmware Version AQNUSH8b (c)1995-2000

GAGE ID#	0	METER CONST. C2	0.0178
DATE	10/31/2007	METER CONST. C3	2.2048
TRANSECT	5	METER CONST. C4	0.0178
USER ID#	0	METER CONST. C5	0
SH BEGIN	0	MEASUREMENT TIME	20
SH END	0	MEAS. SYSTEM	SAE
GH BEGIN	0	PERCENT SLOPE	0
GH END	0	TOTAL VERTICALS	27
EST. DISCHARGE	0	TOTAL STATIONS	27
EST. Q (ADJ)	509	TOTAL WIDTH	123
METER ID#	0	TOTAL AREA	200
AQUACALC ID#	0	TOTAL DISCHARGE	509
SOUNDING WT.	0	PCT DIFFERENCE	0
START MEAS. AT	LEW	MEAN VELOCITY	2.55
METER TYPE	Price AA 1:1 ST2	WETTED PERIMETER	123.17
METER CONST. C1	2.2048	HYDRAULIC RADIUS	1.62
		MANNING FACTOR	0

OB	DIST (ft)	DEPTH (ft)	ICE	REVS	TIME (s)	COS:VF	LOC	COEF	CLOCK	VEL (ft/s)	AREA (ft^2)	Q (ft^3/s))	Safety Factor
1	0	0.0	0	0	0.0	1	6	1	0:18	0.00	0.0	0.00	0.0
2	5	0.5	0	7	21.8	1	6	1	0:18	0.73	2.5	1.82	0.4
3	10	0.5	0	9	20.1	1	6	1	0:19	1.01	2.5	2.51	0.5
4	15	1.0	0	17	21.0	1	6	1	0:20	1.80	5.0	9.02	1.8
5	20	1.4	0	17	20.3	1	6	1	0:21	1.86	7.0	13.05	2.6
6	25	1.7	0	21	20.1	1	6	1	0:22	2.32	8.5	19.73	3.9
7	30	1.9	0	25	20.6	1	6	1	0:23	2.69	9.5	25.58	5.1
8	35	2.1	0	28	20.4	1	6	1	0:24	3.04	10.5	31.96	6.4
9	40	2.1	0	28	20.9	1	6	1	0:25	2.97	10.5	31.21	6.2
10	45	2.2	0	30	20.7	1	6	1	0:26	3.21	11.0	35.34	7.1
11	50	2.2	0	27	20.1	1	6	1	0:27	2.98	11.0	32.77	6.6
12	55	2.3	0	31	20.2	1	6	1	0:28	3.40	11.5	39.11	7.8
13	60	2.3	0	28	20.5	1	6	1	0:29	3.03	11.5	34.83	7.0
14	65	2.1	0	27	20.2	1	6	1	0:31	2.97	10.5	31.13	6.2
15	70	2.1	0	26	20.6	1	6	1	0:32	2.80	10.5	29.40	5.9
16	75	2.0	0	25	20.2	1	6	1	0:33	2.75	10.0	27.46	5.5
17	80	1.8	0	23	20.2	1	6	1	0:34	2.53	9.0	22.75	4.6
18	85	1.6	0	26	20.0	1	6	1	0:35	2.88	8.0	23.07	4.6
19	90	1.9	0	20	20.5	1	6	1	0:36	2.17	9.5	20.61	4.1
20	95	1.5	0	19	20.6	1	6	1	0:36	2.05	7.5	15.38	3.1
21	100	1.6	0	22	20.6	1	6	1	0:37	2.37	8.0	18.98	3.8
22	105	1.8	0	18	20.3	1	6	1	0:38	1.97	9.0	17.76	3.6
23	110	1.8	0	18	20.3	1	6	1	0:39	1.97	9.0	17.76	3.6
24	115	1.1	0	11	20.7	1	6	1	0:40	1.19	5.0	5.89	1.3
25	119	0.7	0	7	21.8	1	6	1	0:41	0.73	2.1	1.53	0.5
26	121	0.3	0	6	22.6	1	6	1	0:41	0.60	0.6	0.36	0.2
27	123	0.0	0	0	0.0	1	6	1	0:00	0.00	0.0	0.00	0.0
											TOTAL =	**509.0**	

Grand County Stream Management Plan
Project Number: 5362-001-00

Colorado River at Northern Properties Cross Section

Note: instrument was set up with an assumed elevation of 6,800 ft

Water Surface Slope Calculation					
Upstream Elev (ft).	Downstream Elev. (ft)	Distance (ft)	WS Slope (ft/ft)	WS Slope (ft/mile)	WS Slope (%)
6993.46	6991.06	447.9	0.00536	28.29	0.54%

Cross Section Information					
Station	Channel Bed Elevation (ft)	Water Surface Elevation (ft)	Description	Velocity Measurement Num.	Velocity (ft/s)
0	6799.03		Ground		
12	6798.97		Top of Bank		
24	6794.37		Toe of Bank		
35	6794.73		ground		
52	6794.26		ground		
61	6793.37	6793.4	Left Edge of Water, velocity measurement #1	1	
66	6792.97	6793.4	Velocity measurement #2, sand, fine to coarse gravel, and fine cobble, algae/ vegetation	2	0.73
72	6792.73	6793.4	Velocity measurement #3, sand, fine to coarse gravel, and fine cobble, algae/ vegetation	3	1.01
77	6792.38	6793.4	Velocity measurement #4, sand, fine to coarse gravel, and fine cobble, algae/ vegetation	4	1.80
81	6791.81	6793.4	Velocity measurement #5, sand, fine to coarse gravel, and fine cobble, algae/ vegetation	5	1.86
87	6791.68	6793.4	Velocity measurement #6, coarse gravel and fine cobble, algae/ vegetation	6	2.32
92	6791.49	6793.4	Velocity measurement #7, fine to coarse cobble, algae/ vegetation	7	2.69
97	6791.36	6793.4	Velocity measurement #8, fine to coarse cobble, algae/ vegetation	8	3.04
102	6791.14	6793.4	Velocity measurement #9, fine to coarse cobble	9	2.97
107	6791.17	6793.4	Velocity measurement #10, fine to coarse cobble, algae/ vegetation	10	3.21
111	6790.93	6793.4	Velocity measurement #11, fine to coarse cobble, algae/ vegetation	11	2.98
117	6791.04	6793.5	Velocity measurement #12, fine to coarse cobble, algae/ vegetation	12	3.40
122	6791.14	6793.5	Velocity measurement #13, coarse cobble to boulder, algae/ vegetation	13	3.03
127	6791.29	6793.5	Velocity measurement #14, coarse cobble to boulder, algae/ vegetation	14	2.97
132	6791.34	6793.5	Velocity measurement #15, coarse cobble to boulder, algae/ vegetation	15	2.80
137	6791.41	6793.5	Velocity measurement #16, coarse cobble to boulder, algae/ vegetation	16	2.75
142	6791.89	6793.5	Velocity measurement #17, fine to coarse cobble, algae/ vegetation	17	2.53
147	6791.61	6793.5	Velocity measurement #18, fine to coarse cobble, algae/ vegetation	18	2.88
152	6791.83	6793.5	Velocity measurement #19, fine to coarse cobble, algae/ vegetation	19	2.17
157	6791.77	6793.5	Velocity measurement #20, fine to coarse cobble, algae/ vegetation	20	2.05
162	6791.61	6793.5	Velocity measurement #21, fine to coarse cobble, algae/ vegetation	21	2.37
167	6791.56	6793.5	Velocity measurement #22, fine to coarse cobble, algae/ vegetation	22	1.97
172	6791.31	6793.5	Velocity measurement #23, fine to coarse cobble, algae/ vegetation	23	1.97
177	6791.40	6793.5	Velocity measurement #24, fine to coarse cobble, algae/ vegetation	24	1.19
181	6792.06	6793.5	Velocity measurement #25, fine to coarse cobble, algae/ vegetation	25	0.73
185	6793.46	6793.5	Right Edge of Water, velocity measurement #26	26	0.60
185	6794.93		Point on bank	27	0.00
191	6793.39		Ground		
206	6795.65		Top of bank		
228	6794.35		Ground		
245	6794.53		Ground		
263	6794.64		Toe of bank		
280	6802.25		Top of outer bank		

Four photos were taken at the cross section shown on the following pages:
1. From the left bank looking at the right bank
2. From the center of the channel looking upstream
3. From the center of the channel looking downstream
4. From the right bank looking at the left bank

Photo 1. From the left bank looking towards the right bank

Photo 2. From the center of the channel looking upstream

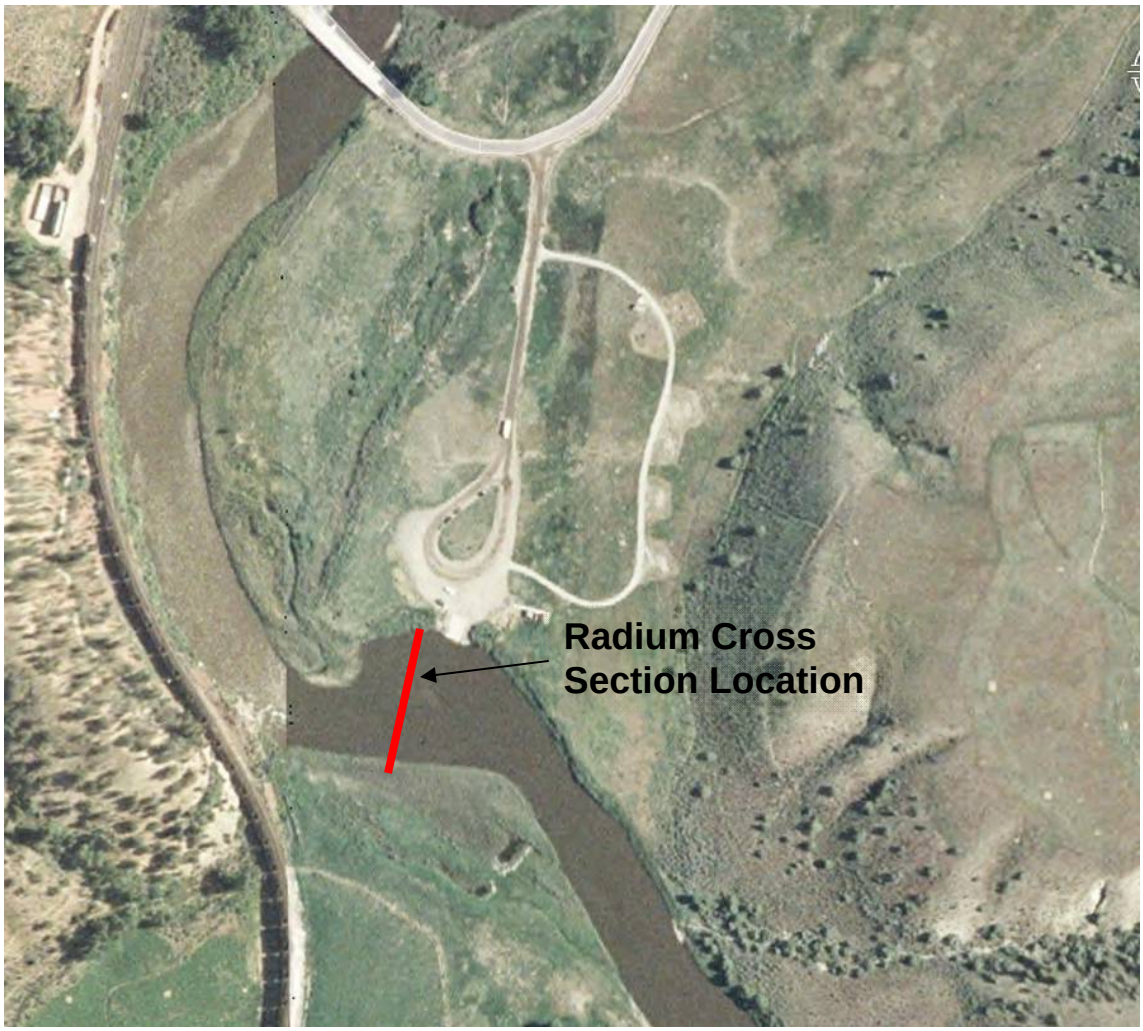
Photo 3. From the center of the channel looking downstream

Photo 4. From the right bank looking towards the left bank

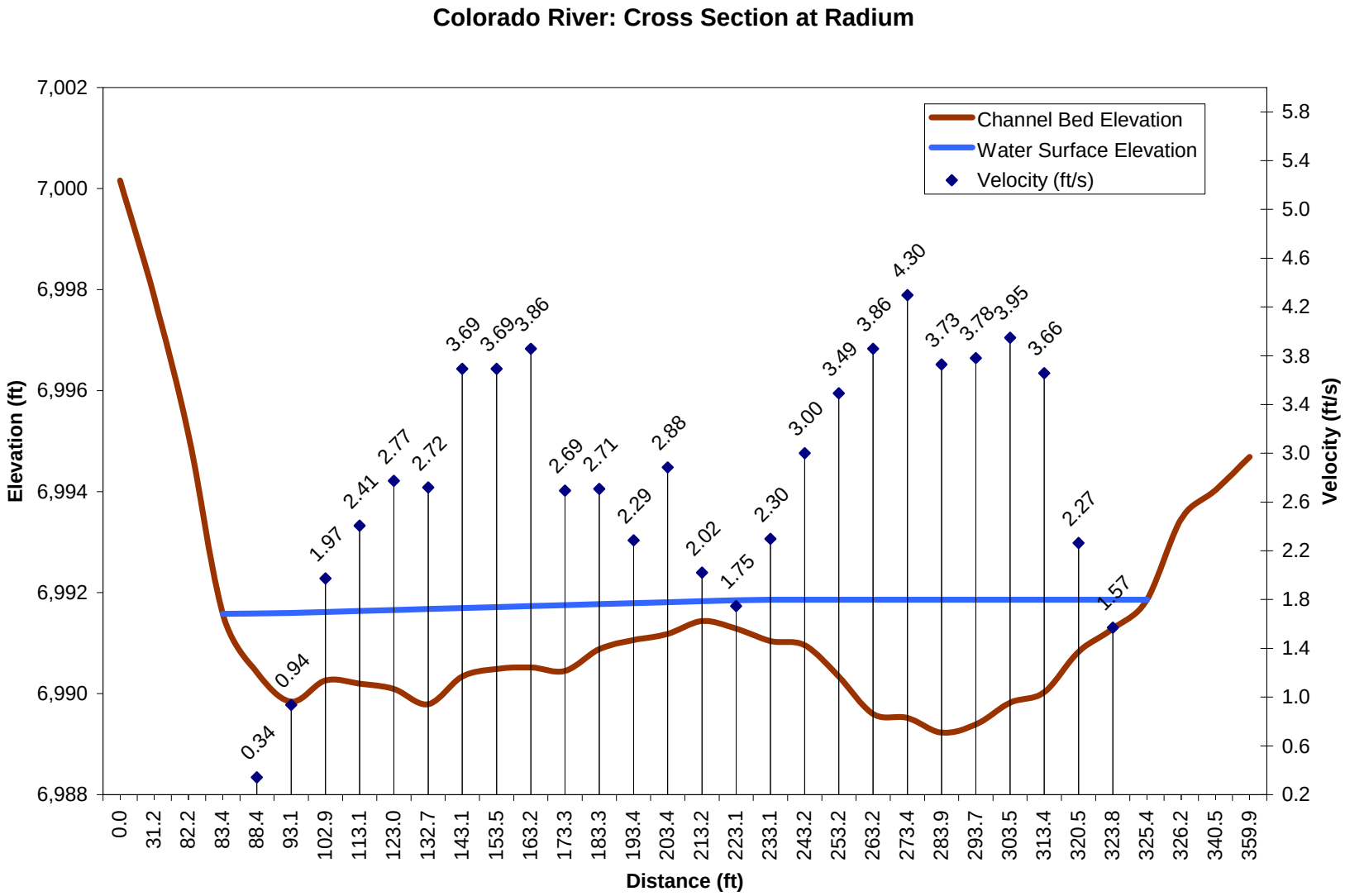
COLORADO RIVER CROSS SECTION SURVEY AT RADIUM BOAT LAUNCH 2007

On October 10, 2007 a cross section and discharge measurement survey was performed on the Colorado River on the upstream side of the boat launch at Radium (39º 56'55"N, 106º33'25" W).

Brian Bertoline and Alaina Briggs performed the work. A robotic total station was used to measure the elevations. A base control point was establisted with assumed coordinates 20,000 N, 50,000 E and 7,000 ft Elevation. An Aquacalc 5000 with a Price AA current meter and wading rod were used to perform the discharge measurement. The weather was clear and cool (40 – 60 degrees throughout the day) with no wind.



The results of the survey and velocity measurements are depicted in the figure below.
The total discharge was 958 cfs.


Colorado River: Cross Section at Radium
Channel Bed Elevation
Water Surface Elevation
Velocity (ft/s)
Elevation (ft)
Velocity (ft/s)
Distance (ft)
7,002
7,000
6,998
6,996
6,994
6,992
6,990
6,988
5.8
5.4
5.0
4.6
4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
0.6
0.2
0.34
0.94
1.97
2.41
2.77
2.72
3.69
3.69
3.86
2.69
2.71
2.29
2.88
2.02
1.75
2.30
3.00
3.49
3.86
4.30
3.73
3.78
3.95
3.66
2.27
1.57
0.0
31.2
82.2
83.4
88.4
93.1
102.9
113.1
123.0
132.7
143.1
153.5
163.2
173.3
183.3
193.4
203.4
213.2
223.1
233.1
243.2
253.2
263.2
273.4
283.9
293.7
303.5
313.4
320.5
323.8
325.4
326.2
340.5
359.9

AQUACALC DATA

AquaCalc 5000 (tm) by JBS Instruments
Firmware Version AQNUSH8b (c)1995-2000

GAGE ID#	0	METER CONST. C2	0.0178
DATE	8/10/2007	METER CONST. C3	2.2048
TRANSECT	1	METER CONST. C4	0.0178
USER ID#	0	METER CONST. C5	0
SH BEGIN	0	MEASUREMENT TIME	20
SH END	0	MEAS. SYSTEM	SAE
GH BEGIN	0	PERCENT SLOPE	0
GH END	0	TOTAL VERTICALS	28
EST. DISCHARGE	0	TOTAL STATIONS	28
EST. Q (ADJ)	943	TOTAL WIDTH	241
METER ID#	0	TOTAL AREA	298
AQUACALC ID#	0	TOTAL DISCHARGE	943
SOUNDING WT.	0	PCT DIFFERENCE	0
START MEAS. AT	LEW	MEAN VELOCITY	3.16
METER TYPE	Price AA 1:1 ST2	WETTED PERIMETER	241.58
METER CONST. C1	2.2048	HYDRAULIC RADIUS	1.23
		MANNING FACTOR	0

OB	DIST (ft)	DEPTH (ft)	ICE	REVS	TIME (s)	COS:VF	LOC	COEF	CLOCK	VEL (ft/s)	AREA (ft^2)	Q (ft^3/s))	Safety Factor
1	0	0.0	0	0	0	1	6	1	0:02	0.00	0.0	0.0	
2	3	1.1	0	3	20.3	1	6	1	0:02	0.34	6.6	2.3	0.4
3	12	1.8	0	9	21.6	1	6	1	0:04	0.94	15.3	14.3	1.7
4	20	1.2	0	18	20.3	1	6	1	0:11	1.97	10.8	21.3	2.4
5	30	1.1	0	22	20.3	1	6	1	0:17	2.41	11.0	26.5	2.6
6	40	1.3	0	26	20.8	1	6	1	0:18	2.77	13.0	36.1	3.6
7	50	1.2	0	25	20.4	1	6	1	0:20	2.72	12.0	14.4	3.3
8	60	1.2	0	34	20.4	1	6	1	0:22	3.69	12.0	44.3	4.4
9	70	1.0	0	34	20.4	1	6	1	0:23	3.69	10.0	36.9	3.7
10	80	1.0	0	35	20.1	1	6	1	0:24	3.86	10.0	38.6	3.9
11	90	1.2	0	25	20.6	1	6	1	0:25	2.69	12.0	32.3	3.2
12	100	0.9	0	25	20.5	1	6	1	0:26	2.71	9.0	24.4	2.4
13	110	0.6	0	21	20.4	1	6	1	0:27	2.29	6.0	13.7	1.4
14	120	0.6	0	26	20.0	1	6	1	0:29	2.88	6.0	17.3	1.7
15	130	0.5	0	19	20.9	1	6	1	0:30	2.02	5.0	10.1	1.0
16	140	0.5	0	16	20.4	1	6	1	0:31	1.75	5.0	8.7	0.9
17	150	0.8	0	21	20.3	1	6	1	0:31	2.30	8.0	18.4	1.8
18	160	0.6	0	28	20.7	1	6	1	0:32	3.00	6.0	18.0	1.8
19	170	1.5	0	32	20.3	1	6	1	0:33	3.49	15.0	52.4	5.2
20	180	2.2	0	35	20.1	1	6	1	0:35	3.86	22.0	84.9	8.5
21	190	2.4	0	39	20.1	1	6	1	0:37	4.30	24.0	103.1	10.3
22	200	2.7	0	34	20.2	1	6	1	0:38	3.73	27.0	100.7	10.1
23	210	2.6	0	35	20.5	1	6	1	0:39	3.78	26.0	98.3	9.8
24	220	2.0	0	36	20.2	1	6	1	0:41	3.95	20.0	78.9	7.9
25	230	1.7	0	34	20.6	1	6	1	0:42	3.66	14.5	53.0	6.2
26	237	0.7	0	21	20.6	1	6	1	0:43	2.27	3.5	7.9	1.6
27	240	0.3	0	15	21.3	1	6	1	0:43	1.57	0.6	0.9	0.5
28	241	0.0	0	0	0	1	6	1	0:00	0.00	0.0	0.0	
											TOTAL =	**957.8**	

Water Surface Slope Calculation						
Upstream Elev (ft).	Downstream Elev. (ft)		Distance (ft)	WS Slope (ft/ft)	WS Slope (ft/mile)	WS Slope (%)
6992.22	6991.31		558.48	0.00163	8.60	0.16%

Cross Section Information					
Station	Channel Bed Elevation (ft)	Water Surface Elevation (ft)	Description	Velocity Measurement Num.	Velocity (ft/s)
0.0	7000.16		Edge of road		0
31.2	6997.86		Ground		0
82.2	6995.13		Top of bank		0
83.4	6991.58	6991.58	Left Edge of Water		0
88.4	6990.42	6991.59	Velocity Measurement #2, Silt, Algae / Vegetation	2	0.34
93.1	6989.84	6991.60	Velocity Measurement #3, Sand, Algae / Vegetation	3	0.94
102.9	6990.26	6991.62	Velocity Measurement #4, Coarse gravel / fine cobble, no veg	4	1.97
113.1	6990.20	6991.64	Velocity Measurement #5, Coarse gravel / fine cobble, no veg	5	2.41
123.0	6990.09	6991.66	Velocity Measurement #6, Coarse gravel / fine cobble, no veg	6	2.77
132.7	6989.79	6991.68	Velocity Measurement #7, Coarse gravel / fine cobble, no veg	7	2.72
143.1	6990.34	6991.70	Velocity Measurement #8, Coarse gravel / fine cobble, no veg	8	3.69
153.5	6990.49	6991.72	Velocity Measurement #9, Coarse gravel / fine cobble, no veg	9	3.69
163.2	6990.52	6991.73	Velocity Measurement #10, Coarse gravel / fine cobble, no veg	10	3.86
173.3	6990.45	6991.75	Velocity Measurement #11, Coarse gravel / fine cobble, no veg	11	2.69
183.3	6990.88	6991.77	Velocity Measurement #12, Coarse gravel / fine cobble, no veg	12	2.71
193.4	6991.06	6991.79	Velocity Measurement #13, Coarse gravel / fine cobble, no veg	13	2.29
203.4	6991.18	6991.81	Velocity Measurement #14, Coarse gravel / fine cobble, Algae / vegetation	14	2.88
213.2	6991.44	6991.83	Velocity Measurement #15, Coarse gravel / fine cobble, Algae / vegetation	15	2.02
223.1	6991.29	6991.85	Velocity Measurement #16, Coarse gravel / fine cobble, Algae / vegetation	16	1.75
233.1	6991.04	6991.86	Velocity Measurement #17, Coarse gravel / fine cobble, Algae / vegetation	17	2.30
243.2	6990.96	6991.86	Velocity Measurement #18, Coarse gravel / fine cobble, Algae / vegetation	18	3.00
253.2	6990.34	6991.86	Velocity Measurement #19, Coarse gravel / fine cobble, Algae / vegetation	19	3.49
263.2	6989.60	6991.86	Velocity Measurement #20, Coarse gravel / fine cobble, Algae / vegetation	20	3.86
273.4	6989.52	6991.86	Velocity Measurement #21, Coarse gravel / fine cobble, Algae / vegetation	21	4.30
283.9	6989.23	6991.86	Velocity Measurement #22, Coarse gravel / fine cobble, Algae / vegetation	22	3.73
293.7	6989.39	6991.86	Velocity Measurement #23, Coarse gravel / fine cobble, Algae / vegetation	23	3.78
303.5	6989.82	6991.86	Velocity Measurement #24, Coarse gravel / fine cobble, Algae / vegetation	24	3.95
313.4	6990.03	6991.86	Velocity Measurement #25, Coarse gravel / fine cobble, Algae / vegetation	25	3.66
320.5	6990.83	6991.86	Velocity Measurement #26, Coarse gravel / fine cobble, Algae / vegetation	26	2.27
323.8	6991.29	6991.86	Velocity Measurement #27, Coarse gravel / fine cobble, Algae / vegetation	27	1.57
325.4	6991.86	6991.86	Right Edge of Water		0
326.2	6993.46		Top of bank		0
340.5	6994.03		Ground		0
359.9	6994.69		Ground		0

Four photos were taken at the cross section shown on the following pages:

1. From the left bank looking at the right bank
2. From the center of the channel looking upstream
3. From the center of the channel looking downstream
4. From the right bank looking at the left bank

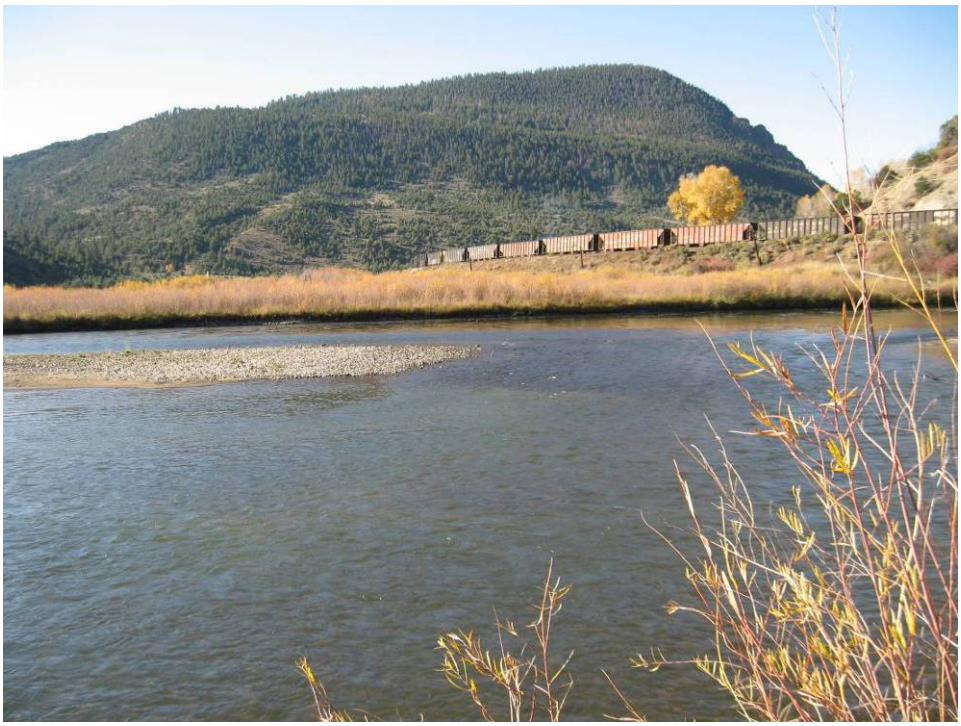


Photo 1. From the left bank looking towards the right bank

Photo 2. From the center of the channel looking upstream

Photo 3. From the center of the channel looking downstream

Photo 4. From the right bank looking towards the left bank