United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7210

In Reply Refer To:
7250 (CO-932)

Mr. Rob Viehl
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Dear Mr. Viehl:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its recommendation for an instream flow water right on Deep Creek, located in Water Division 6.

Location and Land Status. Deep Creek originates on the southwest flank of Hahn's Peak and flows into Steamboat Lake. This recommendation addresses the portion of Deep Creek that starts at the headwaters and extends downstream to the confluence with Steamboat Lake, a distance of approximately 2.5 miles. The BLM manages approximately 0.1 miles of this reach, the U.S. Forest Service manages 1.5 miles, Steamboat Lake State Park manages 0.65 miles, and 0.25 miles are in private ownership.

Biological Summary. Deep Creek is a cold water, high gradient stream. It begins in a narrow, densely forested valley, and then emerges into a wide meadow area that surrounds Steamboat Lake. Substrate is generally from small to medium in size, ranging from gravels to six-inch cobbles. A low quantity of pool habitat is a limiting factor for the fish population. The limited amount of pool habitat is augmented by deeper stream habitat that forms around root wads and beaver ponds close to Steamboat Lake.

Water quality is excellent for supporting cold water species. Fish surveys have documented a self-supporting population of what appear visually to be cutthroat trout-rainbow trout hybrids. Spot surveys have revealed abundant populations of stonefly, caddisfly, and mayfly.

Deep Creek supports a healthy riparian community comprised of spruce, willow, and alder. Bank stability appears to be good, except in areas of high livestock usage.

R2Cross Analysis. The BLM collected the following R2Cross data from Deep Creek:

Cross Section Date	Discharge Rate	Top Width	Winter Flow Recommendation (meets 2 of 3 hydraulic criteria)	Summer Flow Recommendation (meets 3 of 3 hydraulic criteria)
6/9/2020 #1	2.90 cfs	14.70 feet	1.35 cfs	3.36 cfs
6/9/2020 #2	2.29 cfs	9.44 feet	1.53 cfs	1.55 cfs
		Averages:	1.44 cfs	2.46 cfs

BLM's analysis of this data indicates that the following flows are needed to protect the natural environment to a reasonable degree.

> 2.50 cubic feet per second is recommended during the snowmelt runoff period and summer, from May 1 through July 31. This recommendation is driven by the average depth criteria. This flow rate will ensure that the riffle habitat can be fully utilized during the late spring, when fish are completing their spawning cycle and early summer, when fish are actively moving between pools.
>
> 0.95 cubic feet per second is recommended during late summer and fall from August 1 through September 30. This recommendation is driven by the average velocity and wetted perimeter criteria. This flow rate should provide adequate physical habitat for the fish population to complete important parts of its life cycle before cold temperatures arrive.
>
> 0.3 cubic feet per second is recommended during the cold weather period from October 1 through April 30. This recommendation is driven by naturally limited water availability. This flow rate should maintain full and sufficiently cool pools during fall, and it should prevent pools from completely icing during winter, allowing the fish population to successfully overwinter.

Water Availability. BLM recommends using a variety of data sources to confirm water availability, because BLM is not aware of any historical gage data on this creek. Use of Streamstats can provide an estimate of natural hydrology. One nearby gage may provide an estimate of the seasonality of flows, because it is located on a watershed with similar characteristics. USGS Gage 09240800, on South Fork Elk River near Clark, is located on a larger watershed but appears to be relatively unaffected by diversion and storage operations.

BLM is aware of only one water right that diverts directly from Deep Creek:

Button Ditch No. 1 – 1 cfs, 1991 priority

The official diversion record for Button Ditch shows no diversions since 2003.

The BLM is also aware of multiple springs located on National Forest System lands that are decreed for domestic use.

Relationship to Land Management Plans. BLM's management plan calls for actions to maintain and enhance habitat that supports fish species. Specifically, the BLM plan calls for making instream flow recommendations to the Colorado Water Conservation Board to meet minimum instream flow requirements to maintain fisheries. Finally, the plan calls for maintaining and improving the function of riparian areas to achieve advanced ecological stage for the riparian community, and it also calls for protecting riparian and wetland systems from activities that could degrade those habitats. Establishing an instream flow water right would assist in meeting these objectives.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2021. BLM thanks both Colorado Parks and Wildlife and the Colorado Water Conservation Board for their cooperation in this effort.

If you have any questions regarding our instream flow recommendation, please contact Roy Smith at 303-239-3940.

Sincerely,

ALAN BITTNER

Digitally signed by ALAN BITTNER
Date: 2022.01.06 16:37:15 -07'00'

Alan Bittner
Deputy State Director, Resources

Cc: Bruce Sillitoe, Little Snake Field Office
Eric Scherff, Little Snake Field Office
Elijah Waters, Northwest District Manager

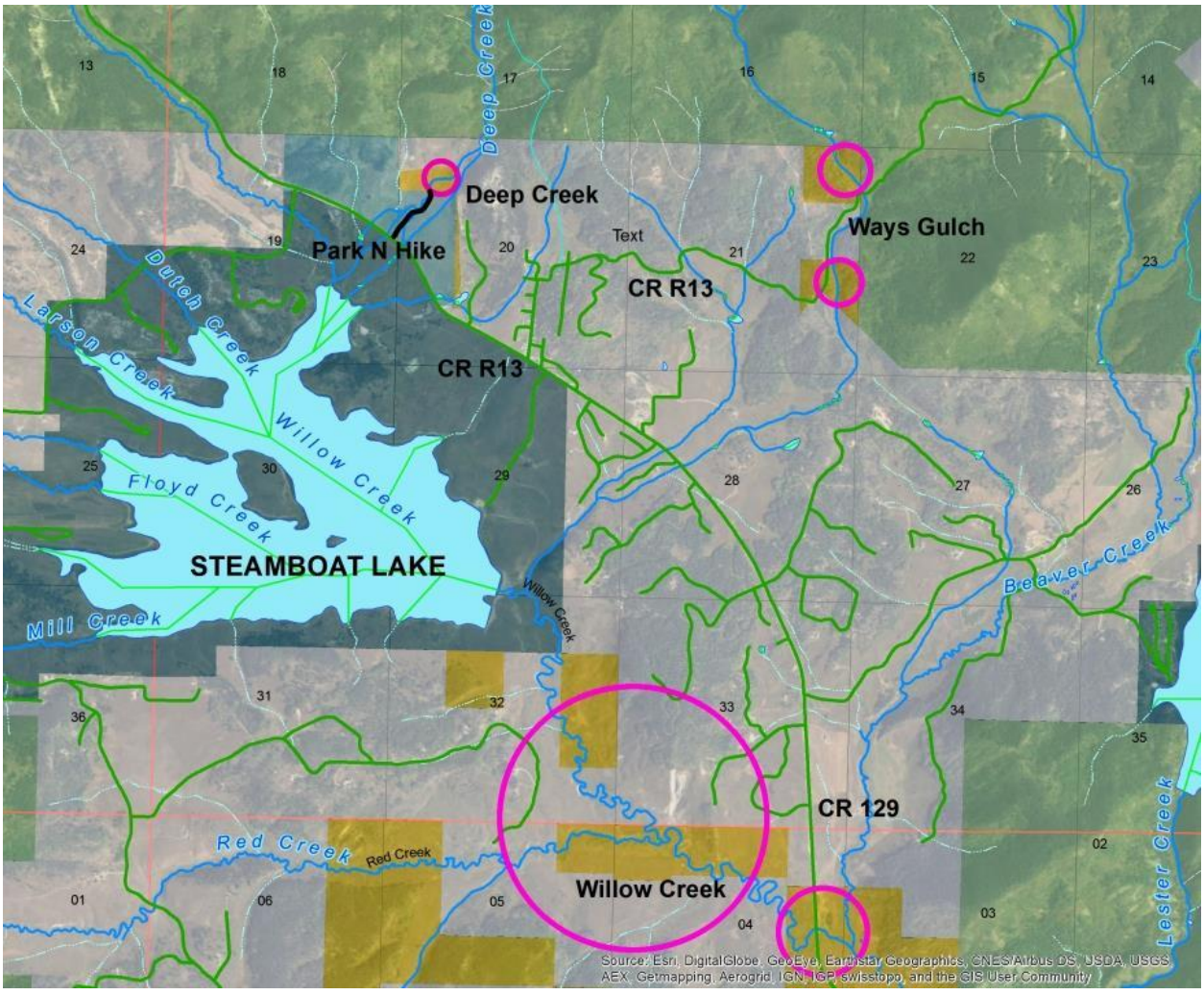
Little Snake Field Office

Stream Sampling July 2016

Deep Creek - Water Code: 21349

Introduction:

Deep Creek, located North of Clark, Colorado, near Steamboat Lake State Park on BLM lands managed by the Little Snake Field Office was sampled on July 20, 2016. Deep Creek is tributary to Steamboat Lake. Sampling was conducted to determine fishery status, species composition, and obtain a two-pass removal population estimate. One shocker was used to sample a 360 foot reach of stream. What appeared visually to be a mix of Rainbow Trout and Cutthroat Trout (RXN's) were the only species seen or collected (see photos). Personnel present included: Tom Fresques, Shawn Wiser, Kristen Doyle, and Nate Higginson, BLM, and Brian Hodge, Trout Unlimited.



Deep Creek - representative habitat

RXN hybrid – this fish appears more Cutthroat - note the distribution and fewer spots

RXN hybrid – this one appears more Rainbow - note number and distribution of spots

Discussion:

Deep Creek at the sample site supports a small population of what appeared to be rainbow x cutthroat trout hybrids. A total of 9 fish were collected and all appeared healthy. Age-class diversity was limited as only two were noted. Based on the sampling the population estimate for the stream at the site is **6 fish (≥140mm) + or – 2 fish at the 95% confidence interval, and 88 fish (≥140mm) + or – 22 fish per stream mile at the 95% confidence interval.**

Riparian vegetation was extremely dense and was comprised primarily of willow, with some alder, cow parsnip, monkshood, timothy, and larkspur. The stream was very well shaded and covered and was difficult to access. Stream habitats were comprised of a mix of riffles, small runs and small pools. Quality pool habitat was limited and is likely a limiting factor in this stream reach. Substrate was comprised of gravel with some cobble and rock. Root wads provided some habitat as well. Beaver ponds habitat was noted below the BLM reach on State Property.

This stream is small and has limited flow, but otherwise provides good habitat. Limited flow and lack of larger pool/holding habitat are likely the primary limiting factors on this stream. Water temperature at the time of sampling was 59.4°F and does not appear to be a limiting factor although a temperature probe would better inform temperature ranges and seasonal variations.

Recommendations:

- Investigate fish distribution up on Forest
- Look for barriers to fish movement
- Consider placement of a temperature probe

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

C. DIVISION OF

LOCATION INFORMATION

STREAM NAME: Deep Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: At State Loud Board – BLM boundary						
DATE: 6-9-20	OBSERVERS: R. Smith, A. Hiff					
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 20	TOWNSHIP: 10 (N)/S	RANGE: 85 E(W)	PM: 6th	
COUNTY: Routt	WATERSHED: Elk River	WATER DIVISION: 6	DOW WATER CODE: 21349			
MAP(S): USGS:			Zone 13N	335842		
USFS:				4520171		

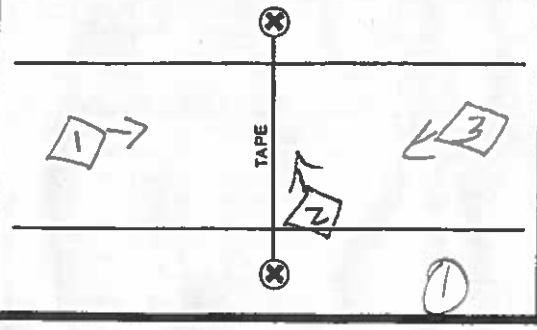
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES / NO)	METER TYPE: M-M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" cobble	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(X) Tape @ Stake LB	0.0	surveyed
(X) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	6.90 / 6.90
(2) WS Upstream	6.0	6.75
(3) WS Downstream	11.0	7.20
SLOPE	0.45 / 17.0 = 0.026	

SKETCH



LEGEND:
Stake (X)
Station (1)
Photo (1)
Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/(NO)	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:
mayfly, stonefly, caddisfly - abundant

COMMENTS

Water Quality Data Readings:

Temp.	Conductivity	pH	Salinity
7.5°C	154	7.0	0.11 ppt

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Keen Creek | CROSS-SECTION NO.: | DATE: 6-10-20 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: Noon

Features (Stake (S) Grassline (G) Waterline (W) Rock (R))	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.9		5.36								
	3.5		5.76								
G	5.0		6.05								
	7.1		6.30								
	7.9		6.78								
W	8.2		6.90	0.0				0.0			
	9.0		6.95	0.05				0.16			
	9.5		6.95	0.05				0.55			
	10.0		6.95	0.05				0.43			
	10.5		7.05	0.15				0.83			
	11.0		7.0	0.10				0.58			
	11.5		7.0	0.10				0.87			
	12.0		7.0	0.10				0.46			
	12.5		7.05	0.15				0.58			
	13.0		7.0	0.10				0.68			
	13.5		7.0	0.10				0.48			
	14.0		7.05	0.15				0.83			
	14.5		7.05	0.15				0.42			
	15.0		7.15	0.25				1.47			
	15.5		7.20	0.30				1.17			
	16.0		7.20	0.30				1.95			
	16.3		7.20	0.30				1.71			
	16.6		7.20	0.30				2.16			
	16.9		7.20	0.30				1.75			
	17.2		7.35	0.45				2.11			
	17.5		7.3	0.40				1.96			
	17.8		7.25	0.35				1.91			
	18.1		7.3	0.40				2.63			
	18.4		7.2	0.30				0.83			
	18.7		7.25	0.35				1.96			
	19.0		7.15	0.25				1.41			
W	19.3		6.90	0.0				0.0			
G	19.7		6.05								
	19.9		5.60								
	20.8		5.40								
LS	24.0		5.34								
TOTALS:											

End of Measurement | Time: | Gage Reading: _____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Deep Creek						CROSS-SECTION NO.: 2	
CROSS-SECTION LOCATION: Approx. 0.4 miles downstream from bridge crossing							
DATE: 6-9-20	OBSERVERS: R. Smith, A. Huff						
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 20	TOWNSHIP: 10 (N)/S	RANGE: 85 E/(W)	PM: 6		
COUNTY: Routt	WATERSHED: Elk River	WATER DIVISION: 6	DOW WATER CODE: 21349				
MAP(S): USGS:	Zone 13N 4520130 mN						
USFS:	335303 mE						

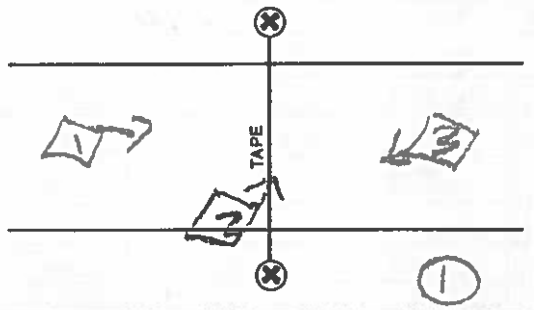
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO	METER TYPE: M-M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel to 6-inch cobble	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	6.30/6.30
② WS Upstream	19.5	6.10
③ WS Downstream	19.0	6.61
SLOPE	0.45/38.5 = 0.012	

SKETCH



LEGEND:
- Stake ⊗
- Station ①
- Photo ◇
- Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/(NO)	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: (YES)/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

mayfly, caddisfly, stonefly

COMMENTS

Temp = 7.5°C
Cond = 154
pH = 7.0
Salinity = 0.11

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Deep Creek | CROSS-SECTION NO.: | DATE: 6-9-20 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 12:50 pm

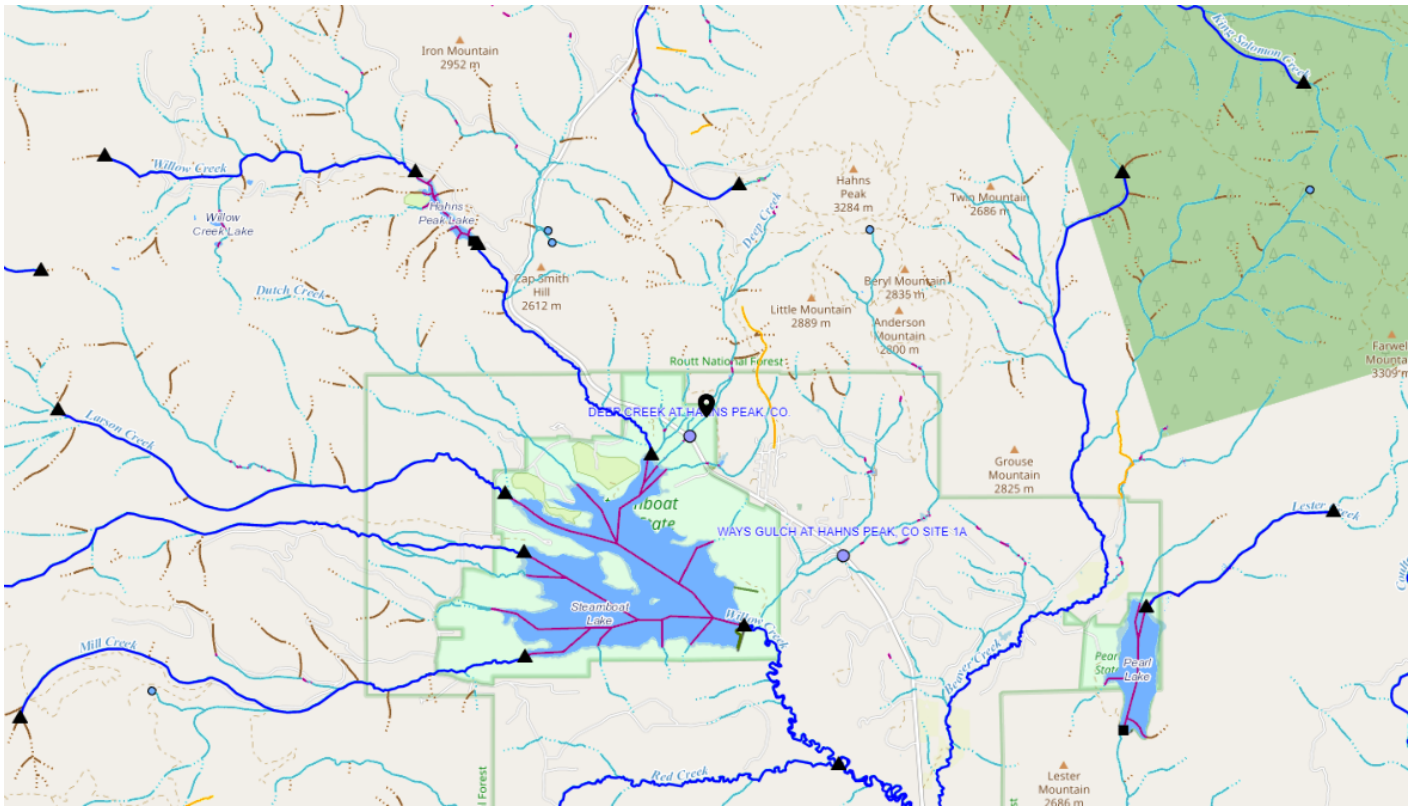
Features (Stake (S), Grassline (G), Waterline (W), Rock (R))	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec): At Point	Velocity (ft/sec): Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.7		5.08								
	3.0		5.18								
G	4.7		5.95								
	5.4		6.17								
W	5.9		6.30	0.0				0.0			
	6.2		6.45	0.15				0.51			
	6.5		6.45	0.15				0.67			
	6.8		6.45	0.15				0.67			
	7.1		6.45	0.15				0.83			
	7.4		6.45	0.15				0.90			
	7.7		6.45	0.15				0.58			
	8.0		6.50	0.20				1.07			
	8.3		6.50	0.20				0.04			
	8.6		6.50	0.20				1.27			
	8.9		6.60	0.30				1.60			
	9.2		6.60	0.30				1.54			
	9.5		6.60	0.30				1.80			
	9.8		6.60	0.30				2.39			
	10.1		6.65	0.35				1.84			
	10.4		6.70	0.40				1.62			
	10.7		6.75	0.45				1.45			
	11.0		6.70	0.40				1.15			
	11.3		6.70	0.40				1.02			
	11.6		6.75	0.45				0.85			
	11.9		6.70	0.40				0.83			
	12.2		6.65	0.35				1.18			
	12.5		6.50	0.20				0.86			
	12.8		6.40	0.10				0.93			
	13.1		6.90	0.20				0.62			
	13.4		6.45	0.15				0.0			
W	13.9		6.30	0.0				0.0			
G	14.3		6.00								
	15.2		5.52								
	16.7		5.40								
LS	18.0		5.22								
TOTALS:											

End of Measurement | Time: | Gage Reading: _____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

R2Cross RESULTS

Stream Name: Deep Creek
Stream Locations: x
Fieldwork Date: 06/09/2020
Cross-section: R. Smith, A. Huff
Observers: 1
Coordinate System: UTM Zone 13
X (easting): 335342
Y (northing): 4520171
Date Processed: 08/13/2021
Slope: 0.026
Computation method: Manning's n
R2Cross data filename: Deep Creek 6-9-2020 #1.xlsx
R2Cross version: 1.1.19

LOCATION



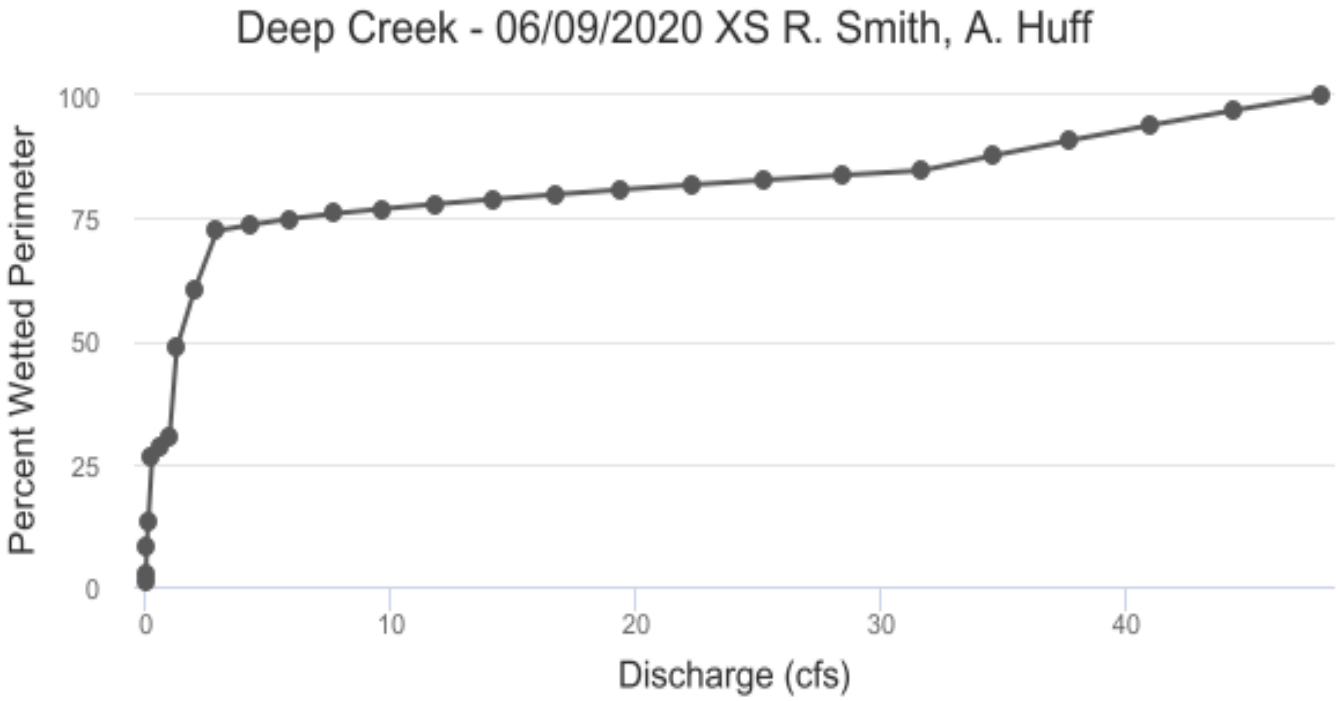
ANALYSIS RESULTS

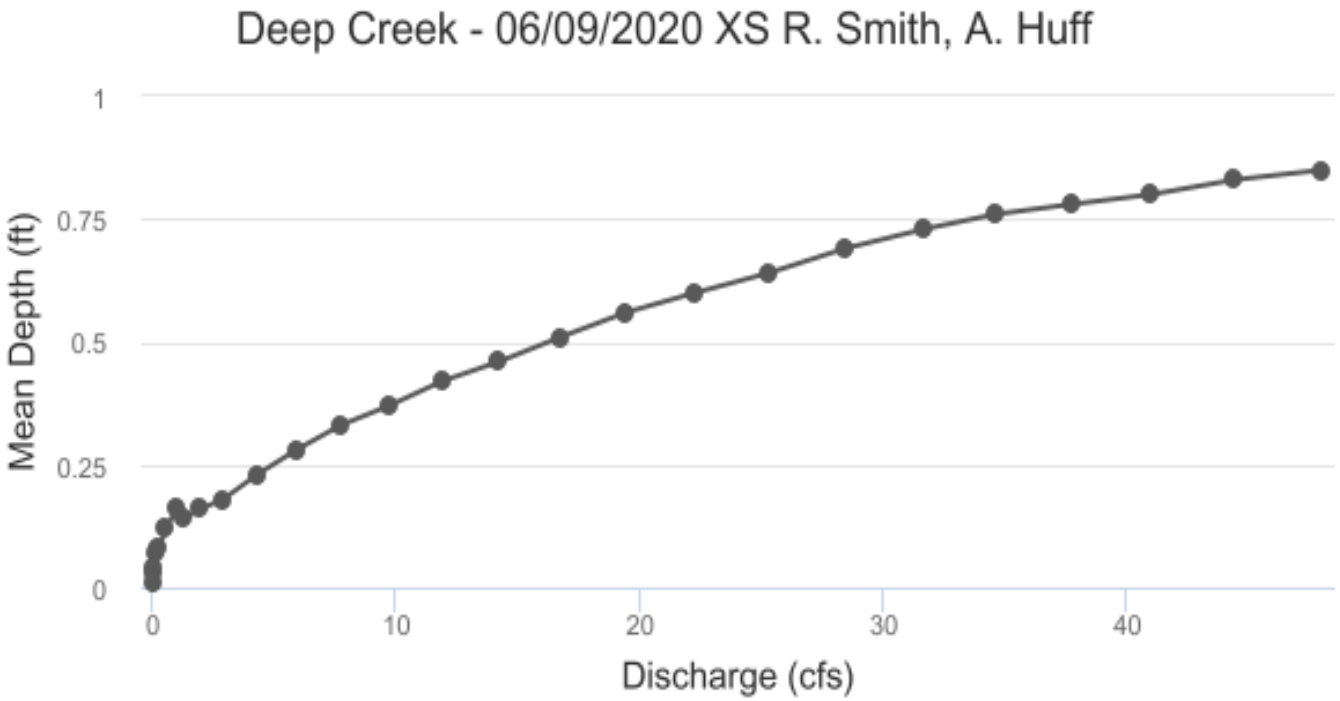
Habitat Criteria Results

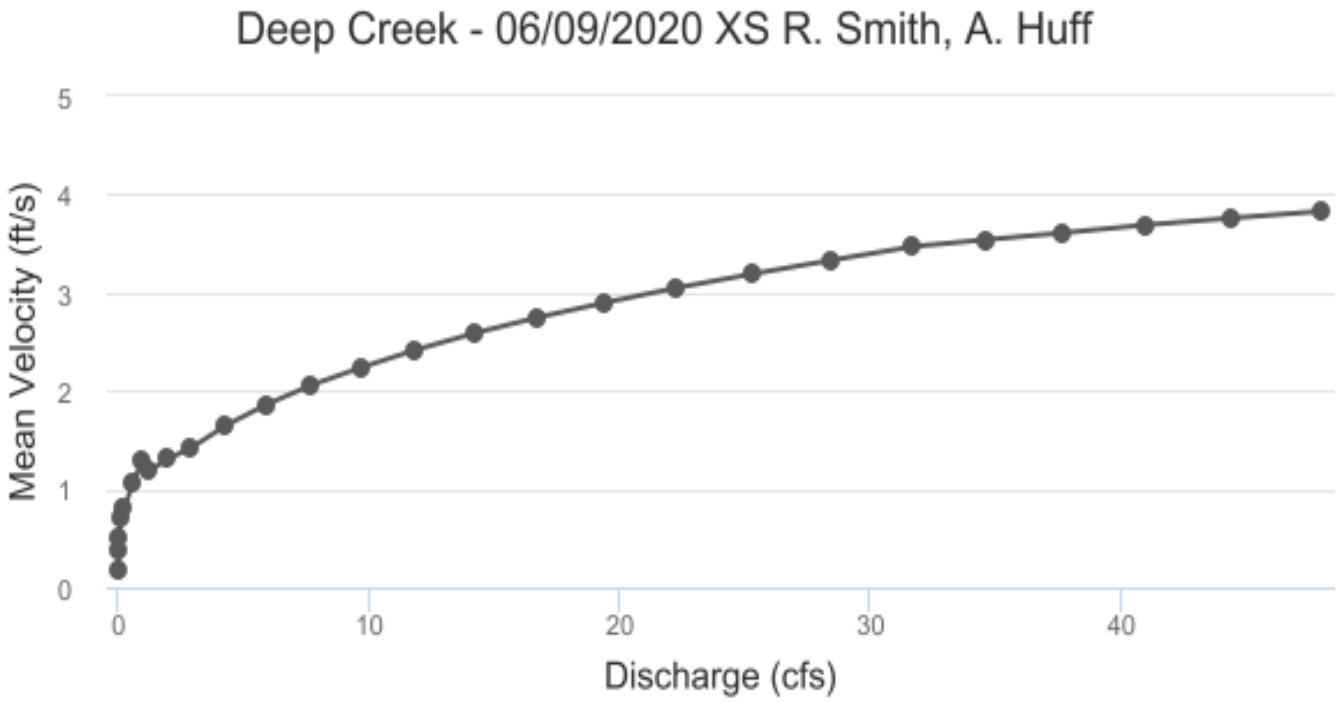
Bankfull top width (ft) = 14.7

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	3.36
Percent Wetted Perimeter (%)	50.0	1.35
Mean Velocity (ft/s) **	1.0	0.48

**Values highlighted in yellow indicate that the discharge is less than 40% of measured Q or greater than 250% of measured Q.




Deep Creek - 06/09/2020 XS R. Smith, A. Huff
Mean Depth (ft)
1
0.75
0.5
0.25
0
0
10
20
30
40
Discharge (cfs)


Deep Creek - 06/09/2020 XS R. Smith, A. Huff
Mean Velocity (ft/s)
5
4
3
2
1
0
0
10
20
30
40
Discharge (cfs)

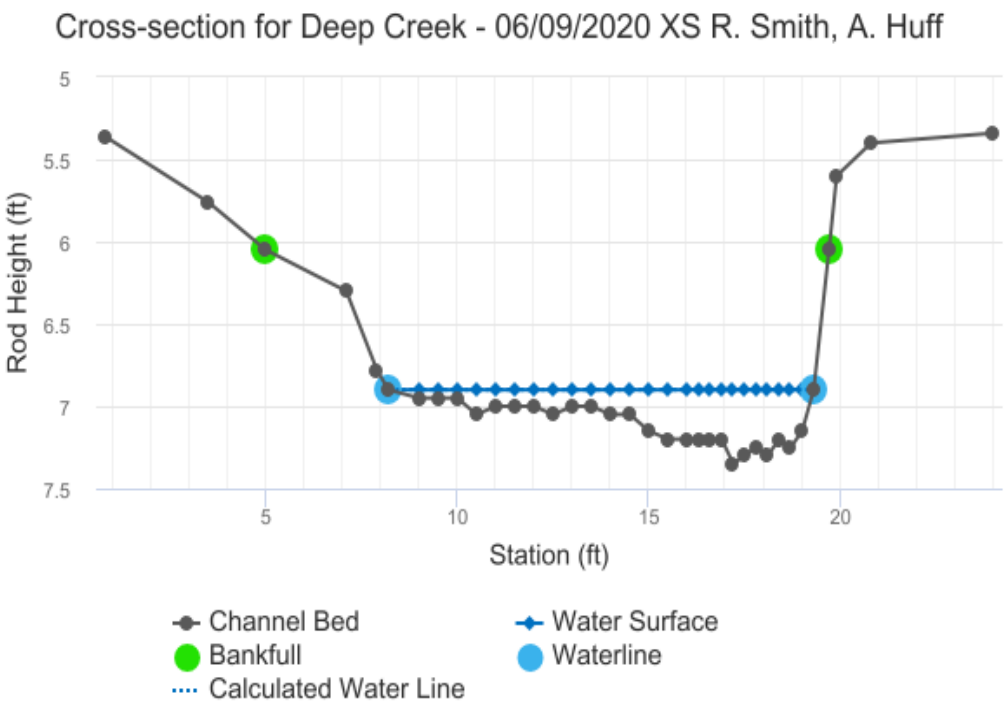
STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (SQ ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	6.05	14.7	0.85	1.3	12.54	15.62	100.00%	0.8	3.83	48.03
	6.1	14.26	0.83	1.25	11.82	15.14	96.94%	0.78	3.76	44.42
	6.15	13.81	0.8	1.2	11.12	14.66	93.88%	0.76	3.69	40.98
	6.2	13.37	0.78	1.15	10.44	14.18	90.81%	0.74	3.61	37.71
	6.25	12.93	0.76	1.1	9.78	13.71	87.75%	0.71	3.54	34.62
	6.3	12.48	0.73	1.05	9.15	13.23	84.69%	0.69	3.47	31.7
	6.35	12.38	0.69	1.0	8.52	13.08	83.72%	0.65	3.33	28.41
	6.4	12.27	0.64	0.95	7.91	12.92	82.74%	0.61	3.19	25.27
	6.45	12.16	0.6	0.9	7.3	12.77	81.76%	0.57	3.05	22.27
	6.5	12.05	0.56	0.85	6.69	12.62	80.79%	0.53	2.9	19.43
	6.55	11.95	0.51	0.8	6.09	12.47	79.81%	0.49	2.75	16.75
	6.6	11.84	0.46	0.75	5.5	12.31	78.84%	0.45	2.59	14.23
	6.65	11.73	0.42	0.7	4.91	12.16	77.86%	0.4	2.42	11.88
	6.7	11.63	0.37	0.65	4.32	12.01	76.88%	0.36	2.24	9.7
	6.75	11.52	0.33	0.6	3.75	11.86	75.91%	0.32	2.06	7.7
	6.8	11.4	0.28	0.55	3.17	11.69	74.84%	0.27	1.86	5.89
	6.85	11.25	0.23	0.5	2.61	11.5	73.62%	0.23	1.65	4.29
Waterline	6.9	11.1	0.18	0.45	2.05	11.31	72.40%	0.18	1.42	2.9
	6.95	9.24	0.16	0.4	1.51	9.43	60.37%	0.16	1.31	1.98
	7.0	7.43	0.14	0.35	1.06	7.6	48.63%	0.14	1.19	1.26
	7.05	4.62	0.16	0.3	0.75	4.75	30.43%	0.16	1.29	0.96
	7.1	4.31	0.12	0.25	0.52	4.42	28.30%	0.12	1.07	0.56
	7.15	4.0	0.08	0.2	0.32	4.09	26.17%	0.08	0.8	0.25
	7.2	1.95	0.07	0.15	0.13	2.03	12.97%	0.06	0.71	0.09
	7.25	1.25	0.04	0.1	0.05	1.29	8.29%	0.04	0.51	0.03

	7.3	0.4	0.03	0.05	0.01	0.42	2.66%	0.02	0.37	0.0
	7.33	0.12	0.01	0.01	0.0	0.12	0.80%	0.01	0.17	0.0

MODEL SUMMARY

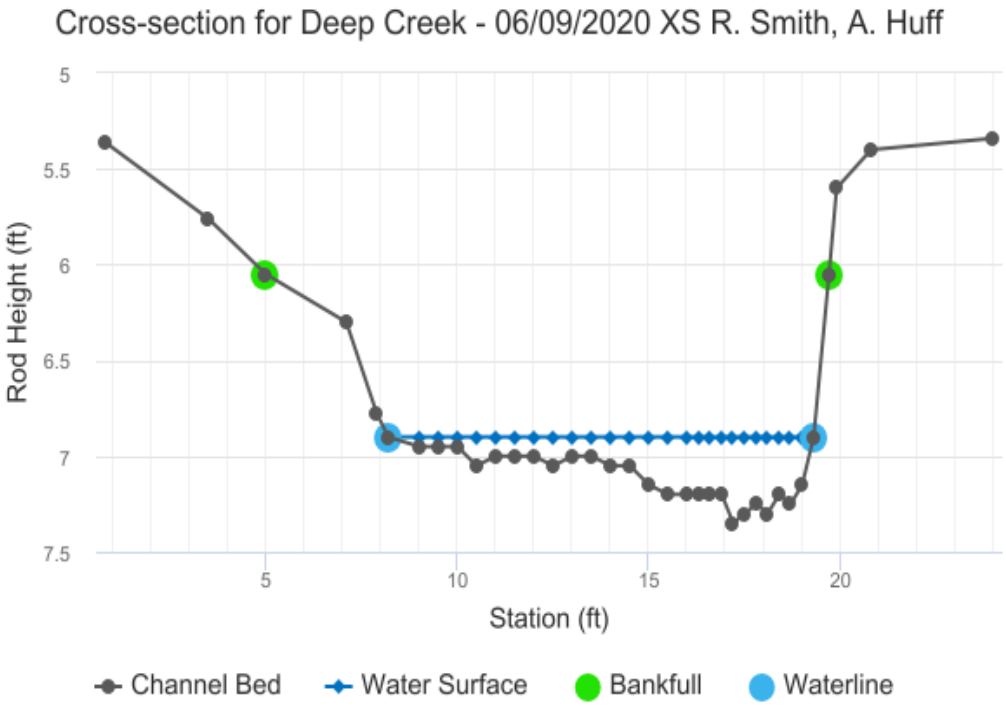
Measured Flow (Qm) =	2.9
Calculated Flow (Qc) =	2.9
(Qm-Qc)/Qm * 100 =	-0.00%
Measured Waterline (WLm) =	6.9
Calculated Waterline (WLc) =	6.9
(WLm-WLc)/WLm * 100 =	0.00%
Max Measured Depth (Dm) =	0.45
Max Calculated Depth (Dc) =	0.45
(Dm-Dc)/Dm * 100 =	-0.00%
Mean Velocity =	1.42
Manning's n =	0.054
0.4 * Qm =	1.16
2.5 * Qm =	7.26



FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0.8	5.36		
	3.5	5.76		
Bankfull	5	6.05		
	7.1	6.3		
	7.9	6.78		
Waterline	8.2	6.9	0	0
	9	6.95	0.05	0.16
	9.5	6.95	0.05	0.55
	10	6.95	0.05	0.43
	10.5	7.05	0.15	0.83
	11	7	0.1	0.58
	11.5	7	0.1	0.87
	12	7	0.1	0.46
	12.5	7.05	0.15	0.58
	13	7	0.1	0.68
	13.5	7	0.1	0.48
	14	7.05	0.15	0.83
	14.5	7.05	0.15	0.42
	15	7.15	0.25	1.47
	15.5	7.2	0.3	1.17
	16	7.2	0.3	1.95
	16.3	7.2	0.3	1.71
	16.6	7.2	0.3	2.16
	16.9	7.2	0.3	1.75
	17.2	7.35	0.45	2.11
	17.5	7.3	0.4	1.96
	17.8	7.25	0.35	1.91
	18.1	7.3	0.4	2.63
	18.4	7.2	0.3	0.83
	18.7	7.25	0.35	1.96

	19	7.15	0.25	1.41
Waterline	19.3	6.9	0	0
Bankfull	19.7	6.05		
	19.9	5.6		
	20.8	5.4		
	24	5.34		



COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (SQ ft)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.8	0.05	0.03	0.01	0.18
0.5	0.05	0.03	0.01	0.47
0.5	0.05	0.03	0.01	0.37
0.51	0.15	0.07	0.06	2.14
0.5	0.1	0.05	0.03	1
0.5	0.1	0.05	0.04	1.5
0.5	0.1	0.05	0.02	0.79
0.5	0.15	0.07	0.04	1.5
0.5	0.1	0.05	0.03	1.17
0.5	0.1	0.05	0.02	0.83
0.5	0.15	0.07	0.06	2.14
0.5	0.15	0.07	0.03	1.08
0.51	0.25	0.12	0.18	6.33
0.5	0.3	0.15	0.18	6.04
0.5	0.3	0.12	0.23	8.06
0.3	0.3	0.09	0.15	5.3
0.3	0.3	0.09	0.19	6.69
0.3	0.3	0.09	0.16	5.42
0.34	0.45	0.14	0.28	9.81
0.3	0.4	0.12	0.24	8.1
0.3	0.35	0.1	0.2	6.91
0.3	0.4	0.12	0.32	10.87
0.32	0.3	0.09	0.07	2.57
0.3	0.35	0.1	0.21	7.09

0.32	0.25	0.08	0.11	3.64
0.39	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

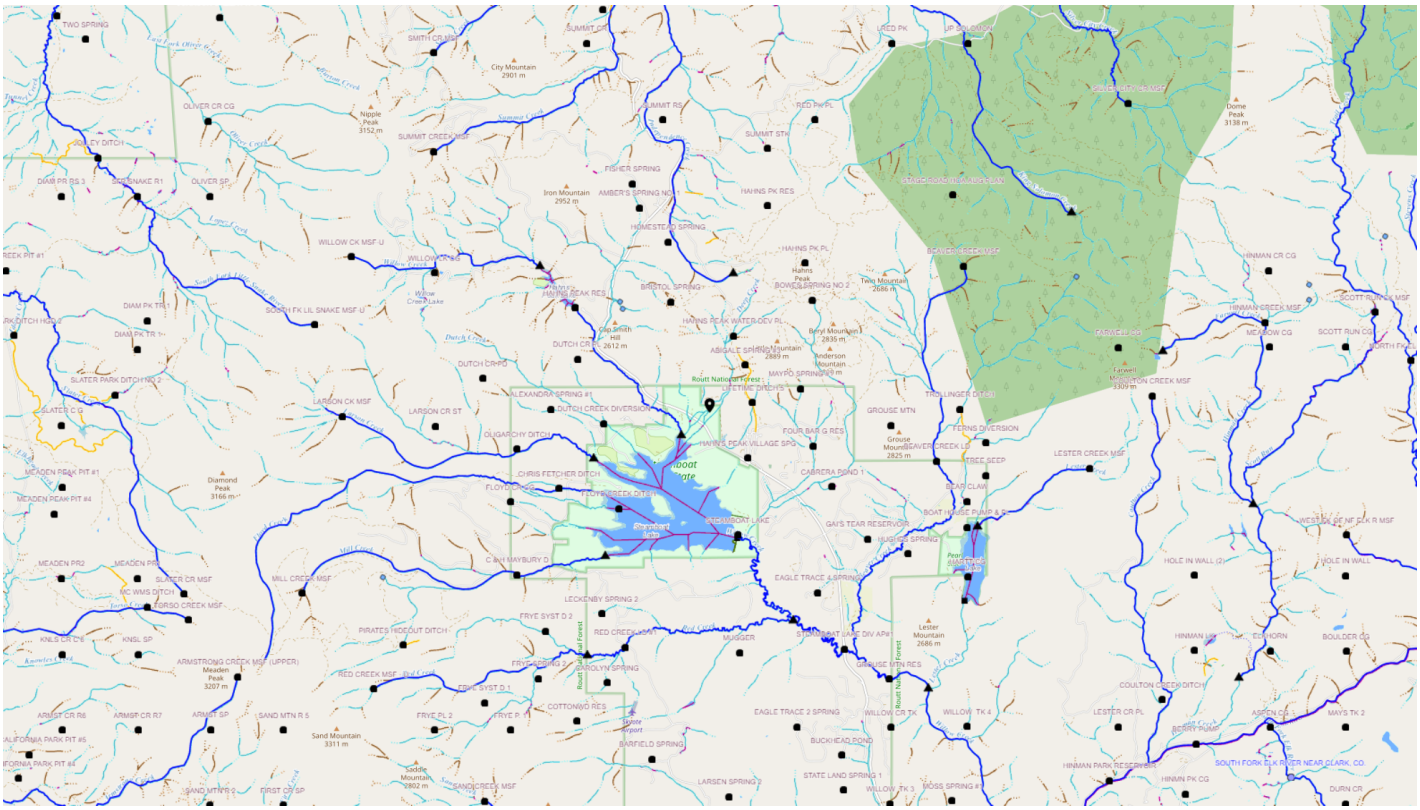
DISCLAIMER

"The Colorado Water Conservation Board makes no representations about the use of the software contained in the R2Cross platform for any purpose besides that for which it was designed. To the maximum extent permitted by applicable law, all information, modeling results, and software are provided “as is” without warranty or condition of any kind, including all implied warranties or conditions of merchantability, or fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this program for a specific application. In no event shall the Colorado Water Conservation Board or any state agency, official or employee be liable for any direct, indirect, punitive, incidental, special, consequential damages or any damages whatsoever including, without limitation, damages for loss of use, data, profits, or savings arising from the implementation, reliance on, or use of or inability to use the R2Cross platform.

R2Cross RESULTS

Stream Name: Deep Cr
Stream Locations: x
Fieldwork Date: 06/09/2020
Cross-section: 2
Observers: R. Smith, A. Huff
Coordinate System: UTM Zone 13
X (easting): 335303
Y (northing): 4520130
Date Processed: 11/01/2021
Slope: 0.012
Computation method: Manning's n
R2Cross data filename: Deep Creek 6-9-20 #2.xlsx
R2Cross version: 1.3.2

LOCATION



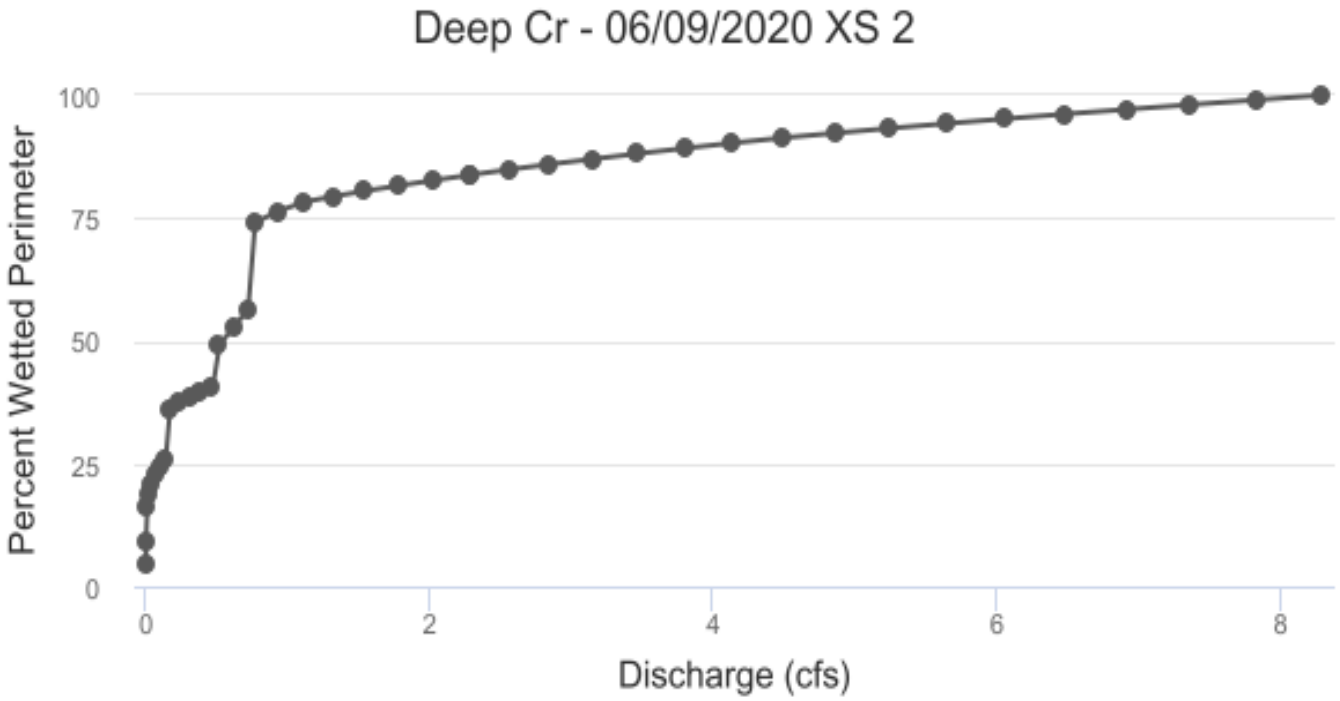
ANALYSIS RESULTS

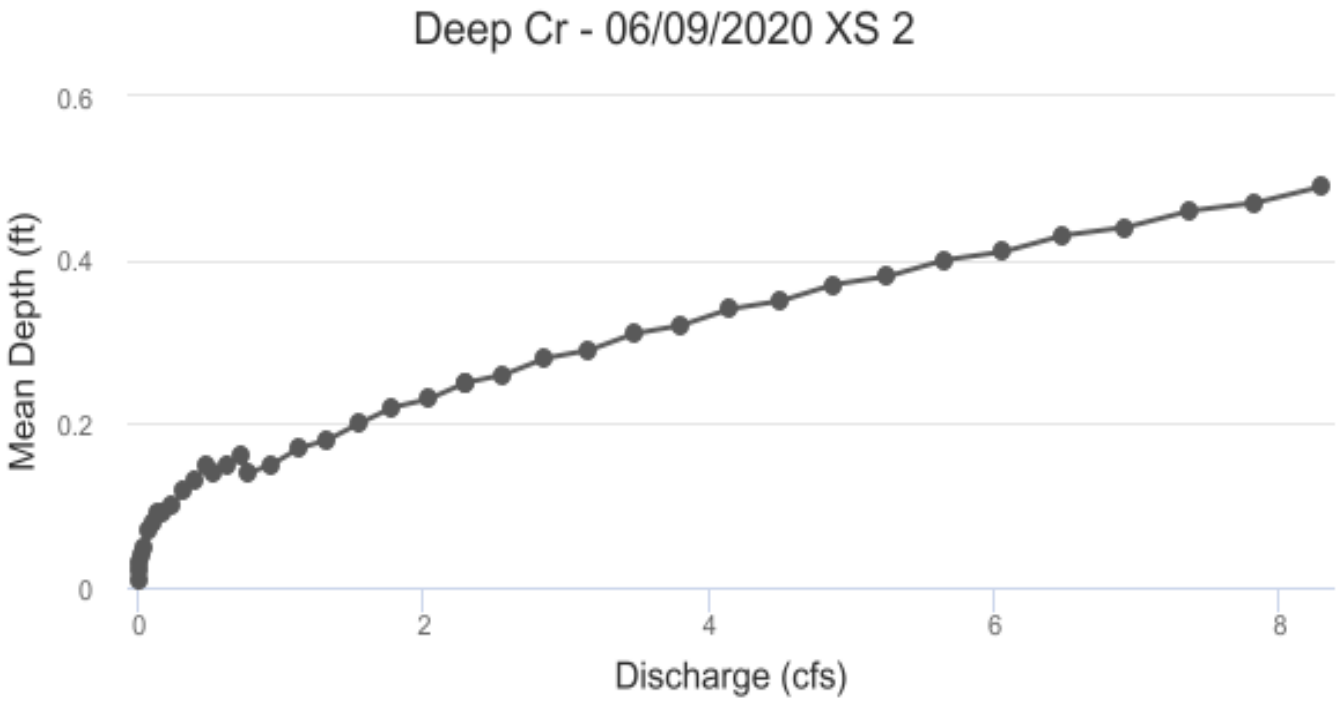
Habitat Criteria Results

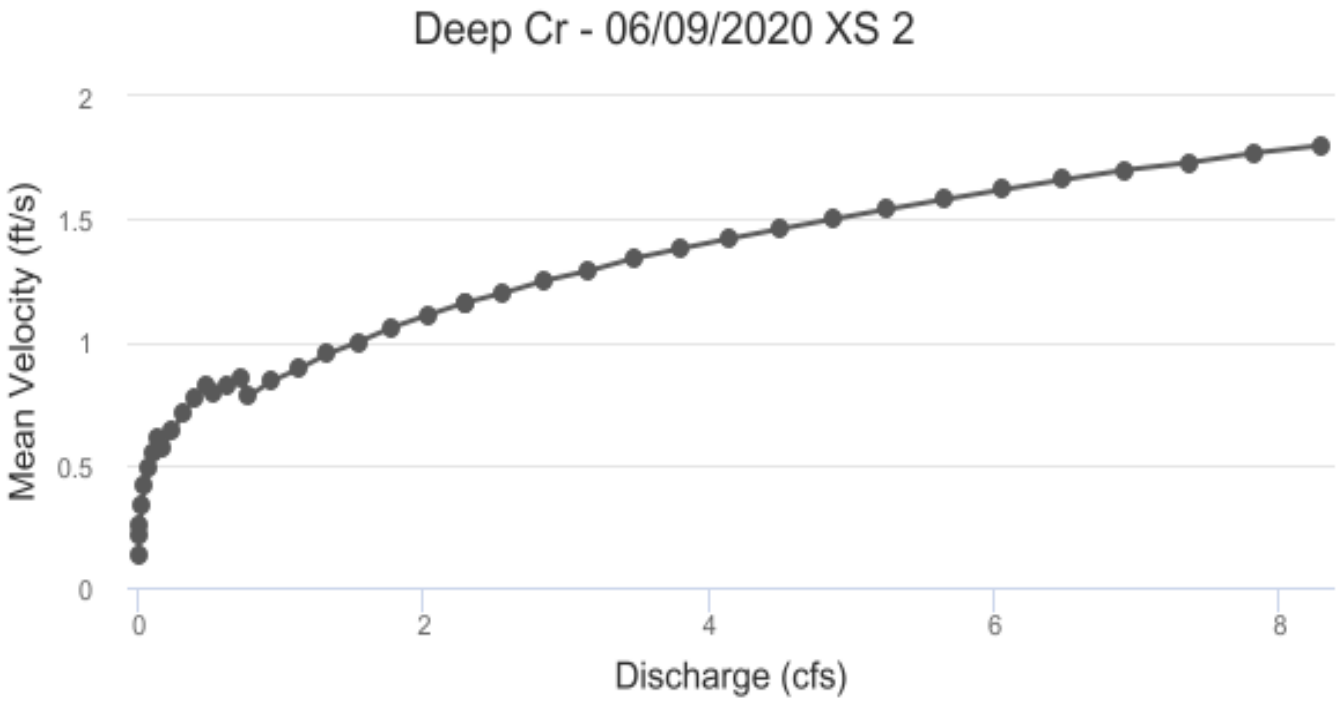
Bankfull top width (ft) = 9.44

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.546
Percent Wetted Perimeter (%) **	50.0	0.539
Mean Velocity (ft/s)	1.0	1.53

**Values highlighted in yellow indicate that the discharge is less than 40% of measured Q or greater than 250% of measured Q.




Deep Cr - 06/09/2020 XS 2
Mean Depth (ft)
0.6
0.4
0.2
0
0
2
4
6
8
Discharge (cfs)


Deep Cr - 06/09/2020 XS 2
Mean Velocity (ft/s)
2
1.5
1
0.5
0
0
2
4
6
8
Discharge (cfs)

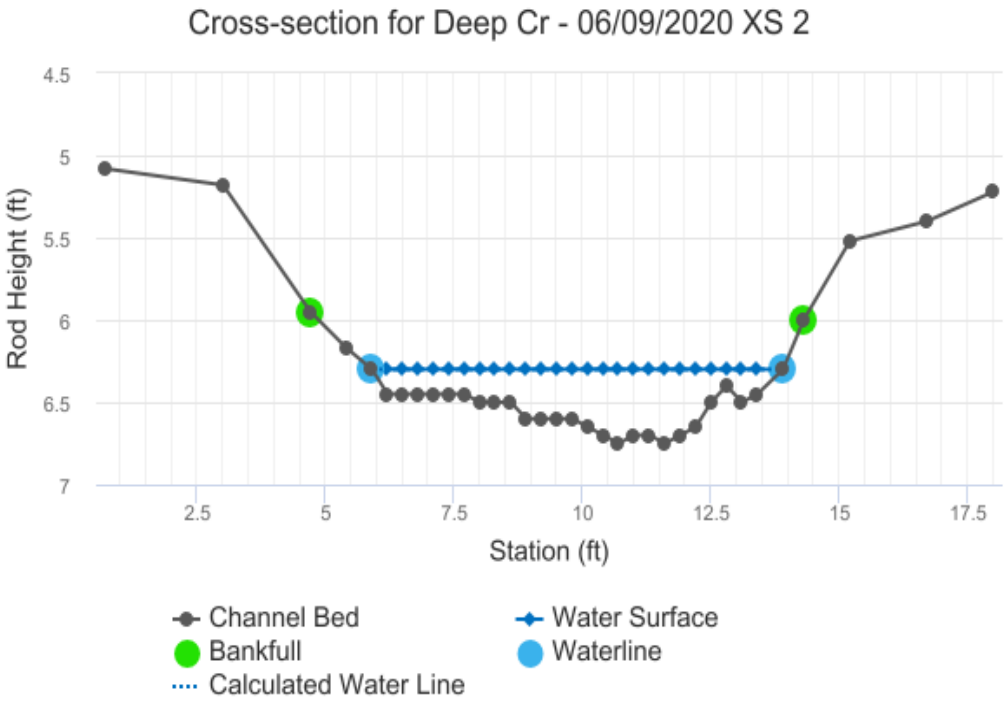
STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (SQ ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	6.0	9.44	0.49	0.75	4.6	9.76	100.00%	0.47	1.8	8.3
	6.02	9.36	0.47	0.73	4.43	9.67	99.04%	0.46	1.77	7.83
	6.04	9.27	0.46	0.71	4.25	9.57	98.08%	0.44	1.73	7.37
	6.06	9.19	0.44	0.69	4.08	9.48	97.12%	0.43	1.7	6.92
	6.08	9.1	0.43	0.68	3.91	9.39	96.16%	0.42	1.66	6.48
	6.09	9.02	0.41	0.66	3.74	9.29	95.20%	0.4	1.62	6.06
	6.11	8.93	0.4	0.64	3.57	9.2	94.24%	0.39	1.58	5.65
	6.13	8.85	0.38	0.62	3.4	9.11	93.28%	0.37	1.54	5.25
	6.15	8.76	0.37	0.6	3.24	9.01	92.31%	0.36	1.5	4.87
	6.17	8.68	0.35	0.58	3.07	8.92	91.35%	0.34	1.46	4.5
	6.19	8.58	0.34	0.56	2.91	8.81	90.28%	0.33	1.42	4.14
	6.21	8.49	0.32	0.54	2.75	8.71	89.20%	0.32	1.38	3.8
	6.22	8.39	0.31	0.53	2.59	8.6	88.11%	0.3	1.34	3.47
	6.24	8.29	0.29	0.51	2.44	8.5	87.03%	0.29	1.29	3.16
	6.26	8.19	0.28	0.49	2.28	8.39	85.95%	0.27	1.25	2.85
	6.28	8.1	0.26	0.47	2.13	8.28	84.86%	0.26	1.2	2.56
	6.3	8.0	0.25	0.45	1.98	8.18	83.78%	0.24	1.16	2.29
Waterline	6.3	8.0	0.25	0.45	1.98	8.18	83.78%	0.24	1.16	2.29
	6.32	7.9	0.23	0.43	1.83	8.07	82.68%	0.23	1.11	2.03
	6.34	7.8	0.22	0.41	1.68	7.96	81.58%	0.21	1.06	1.78
	6.36	7.7	0.2	0.39	1.54	7.86	80.48%	0.2	1.0	1.54
	6.38	7.6	0.18	0.38	1.39	7.75	79.39%	0.18	0.95	1.32
	6.39	7.5	0.17	0.36	1.25	7.64	78.29%	0.16	0.89	1.12
	6.41	7.33	0.15	0.34	1.11	7.46	76.38%	0.15	0.84	0.93
	6.43	7.11	0.14	0.32	0.98	7.23	74.07%	0.14	0.78	0.77

	6.45	5.4	0.16	0.3	0.85	5.51	56.39%	0.15	0.85	0.72
	6.47	5.06	0.15	0.28	0.75	5.16	52.84%	0.15	0.82	0.62
	6.49	4.72	0.14	0.26	0.66	4.81	49.29%	0.14	0.79	0.52
	6.51	3.87	0.15	0.24	0.58	3.95	40.43%	0.15	0.82	0.47
	6.53	3.77	0.13	0.23	0.5	3.85	39.39%	0.13	0.77	0.39
	6.54	3.68	0.12	0.21	0.43	3.74	38.36%	0.12	0.71	0.31
	6.56	3.59	0.1	0.19	0.37	3.64	37.32%	0.1	0.64	0.24
	6.58	3.49	0.09	0.17	0.3	3.54	36.28%	0.08	0.57	0.17
	6.6	2.5	0.09	0.15	0.23	2.54	26.03%	0.09	0.61	0.14
	6.62	2.35	0.08	0.13	0.19	2.38	24.43%	0.08	0.55	0.1
	6.64	2.2	0.07	0.11	0.15	2.23	22.83%	0.07	0.49	0.07
	6.66	2.02	0.05	0.09	0.11	2.05	20.99%	0.05	0.42	0.04
	6.67	1.8	0.04	0.08	0.07	1.82	18.65%	0.04	0.34	0.02
	6.69	1.58	0.03	0.06	0.04	1.59	16.31%	0.02	0.25	0.01
	6.71	0.9	0.02	0.04	0.02	0.91	9.35%	0.02	0.21	0.0
	6.73	0.45	0.01	0.02	0.0	0.46	4.67%	0.01	0.13	0.0

MODEL SUMMARY

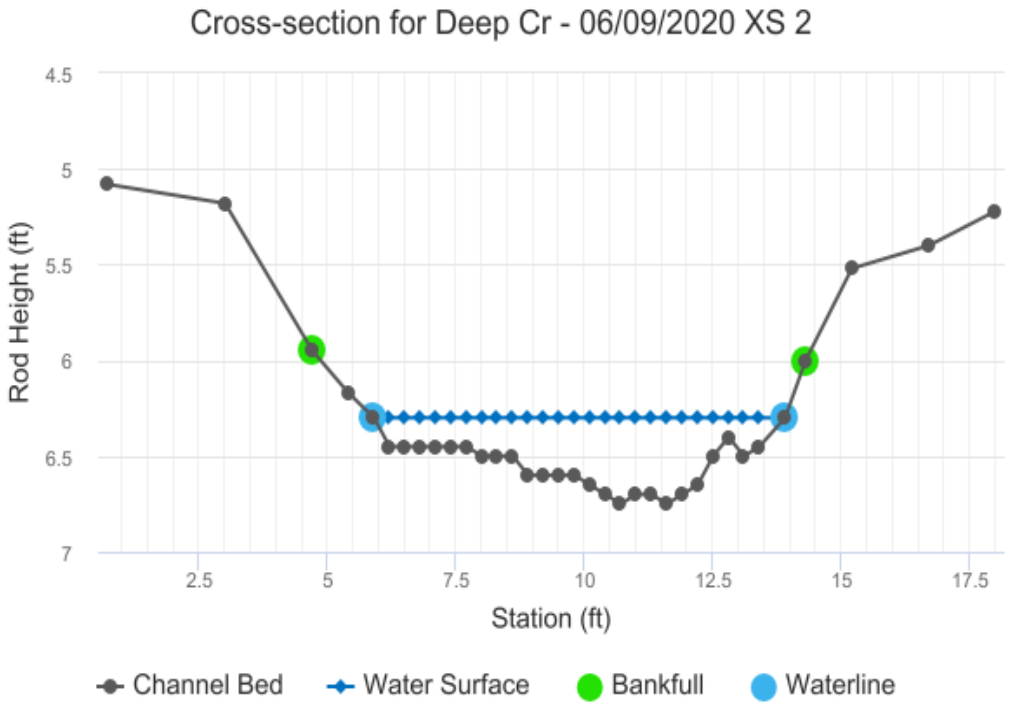
Measured Flow (Qm) =	2.29
Calculated Flow (Qc) =	2.29
(Qm-Qc)/Qm * 100 =	0.00%
Measured Waterline (WLm) =	6.3
Calculated Waterline (WLc) =	6.3
(WLm-WLc)/WLm * 100 =	-0.00%
Max Measured Depth (Dm) =	0.45
Max Calculated Depth (Dc) =	0.45
(Dm-Dc)/Dm * 100 =	0.00%
Mean Velocity =	1.16
Manning's n =	0.055
0.4 * Qm =	0.92
2.5 * Qm =	5.72



FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0.7	5.08		
	3	5.18		
Bankfull	4.7	5.95		
	5.4	6.17		
Waterline	5.9	6.3	0	0
	6.2	6.45	0.15	0.51
	6.5	6.45	0.15	0.67
	6.8	6.45	0.15	0.67
	7.1	6.45	0.15	0.83
	7.4	6.45	0.15	0.9
	7.7	6.45	0.15	0.58
	8	6.5	0.2	1.07
	8.3	6.5	0.2	0.04
	8.6	6.5	0.2	1.27
	8.9	6.6	0.3	1.6
	9.2	6.6	0.3	1.54
	9.5	6.6	0.3	1.8
	9.8	6.6	0.3	2.39
	10.1	6.65	0.35	1.84
	10.4	6.7	0.4	1.62
	10.7	6.75	0.45	1.45
	11	6.7	0.4	1.15
	11.3	6.7	0.4	1.02
	11.6	6.75	0.45	0.85
	11.9	6.7	0.4	0.83
	12.2	6.65	0.35	1.18
	12.5	6.5	0.2	0.86
	12.8	6.4	0.1	0.93
	13.1	6.5	0.2	0.62
	13.4	6.45	0.15	0

Waterline	13.9	6.3	0	0
Bankfull	14.3	6		
	15.2	5.52		
	16.7	5.4		
	18	5.22		


Cross-section for Deep Cr - 06/09/2020 XS 2
Rod Height (ft)
4.5
5
5.5
6
6.5
7
2.5
5
7.5
10
12.5
15
17.5
Station (ft)
Channel Bed
Water Surface
Bankfull
Waterline

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (SQ ft)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.34	0.15	0.04	0.02	1
0.3	0.15	0.04	0.03	1.32
0.3	0.15	0.04	0.03	1.32
0.3	0.15	0.04	0.04	1.63
0.3	0.15	0.04	0.04	1.77
0.3	0.15	0.04	0.03	1.14
0.3	0.2	0.06	0.06	2.81
0.3	0.2	0.06	0	0.1
0.3	0.2	0.06	0.08	3.33
0.32	0.3	0.09	0.14	6.29
0.3	0.3	0.09	0.14	6.06
0.3	0.3	0.09	0.16	7.08
0.3	0.3	0.09	0.22	9.4
0.3	0.35	0.1	0.19	8.44
0.3	0.4	0.12	0.19	8.49
0.3	0.45	0.14	0.2	8.55
0.3	0.4	0.12	0.14	6.03
0.3	0.4	0.12	0.12	5.35
0.3	0.45	0.14	0.11	5.01
0.3	0.4	0.12	0.1	4.35
0.3	0.35	0.1	0.12	5.41
0.34	0.2	0.06	0.05	2.25
0.32	0.1	0.03	0.03	1.22
0.32	0.2	0.06	0.04	1.63
0.3	0.15	0.06	0	0

0.52	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

DISCLAIMER

"The Colorado Water Conservation Board makes no representations about the use of the software contained in the R2Cross platform for any purpose besides that for which it was designed. To the maximum extent permitted by applicable law, all information, modeling results, and software are provided “as is” without warranty or condition of any kind, including all implied warranties or conditions of merchantability, or fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this program for a specific application. In no event shall the Colorado Water Conservation Board or any state agency, official or employee be liable for any direct, indirect, punitive, incidental, special, consequential damages or any damages whatsoever including, without limitation, damages for loss of use, data, profits, or savings arising from the implementation, reliance on, or use of or inability to use the R2Cross platform.

Discharge Measurment Field Visit Data Report *(Filters: Name begins with Deep; Division = 6;)*

Div	Name	CWCB Case Number	Segment ID	Meas. Date	UTM	Location	Flow Amount (cfs)	Meas #	Rating	Station ID
6	Deep Creek		22/6/A-001	10/20/2021	UTMx: 335576 UTMy: 4520253	Deep Creek above Steamboat Lake upstream of CPW wooden bridge.	0.08	1	fair	

Discharge Measurement Summary

Site name	DeepabvsbLake
Site number	DEEPNRSTMBOAT
Operator(s)	Lfs
File name	DeepabvsbLake_20211020-134252.ft
Comment	

Start time	10/20/2021 1:19 PM
End time	10/20/2021 1:40 PM
Start location latitude	40.818
Start location longitude	-106.950
Calculations engine	FlowTracker2

Sensor type	Top Setting
Handheld serial number	FT2H2104006
Probe serial number	FT2P2103011
Probe firmware	1.30
Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
17	40	0.0850

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
4.800	1.2855	4.915

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
13	0.268	0.0661

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
46.551	0.400	0.0977

Discharge Uncertainty		
Category	**ISO**	**IVE**
Accuracy	1.0%	1.0%
Depth	0.5%	9.5%
Velocity	0.9%	7.1%
Width	0.2%	0.2%
Method	2.3%	
# Stations	3.0%	
Overall	**4.0%**	**11.9%**

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

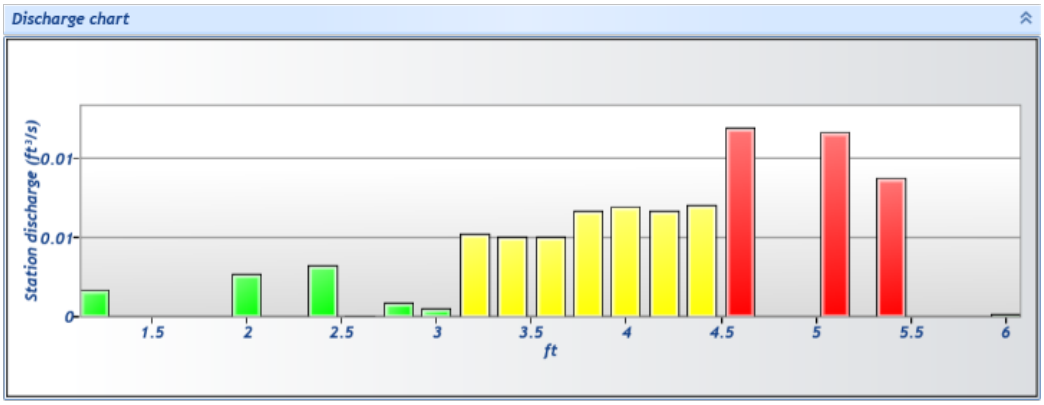
Summary overview

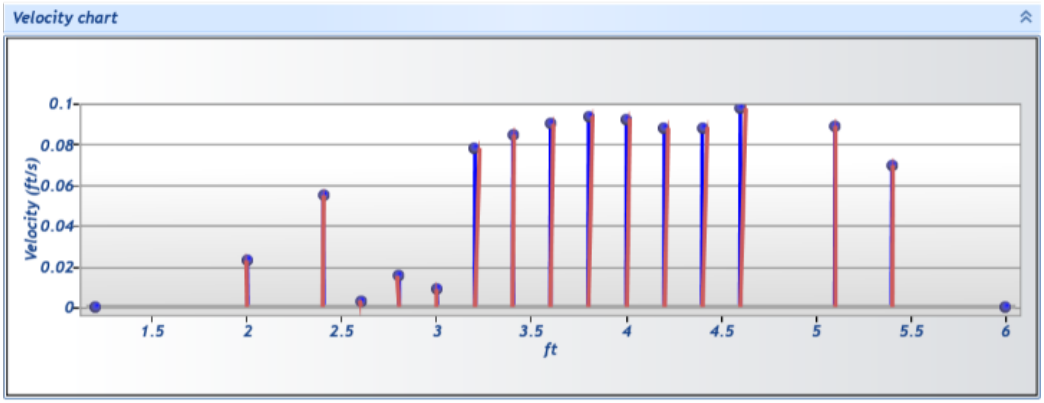
No changes were made to this file
Quality control warnings

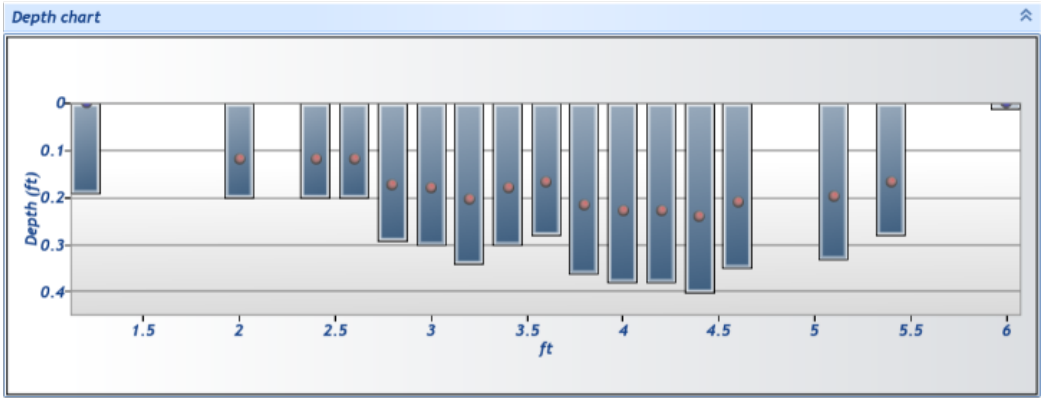
Discharge Measurement Summary

Site name	DeepabvsbLake
Site number	DEEPNRSTMBOAT
Operator(s)	Lfs
File name	DeepabvsbLake_20211020-134252.ft
Comment	

Station Warning Settings		
Station discharge OK	Station discharge < 5.00%	
Station discharge caution	5.00% >= Station discharge < 10.00%	
Station discharge warning	Station discharge >= 10.00%	







Discharge Measurement Summary

Site name	DeepabvsbLake
Site number	DEEPNRSTMBOAT
Operator(s)	Lfs
File name	DeepabvsbLake_20211020-134252.ft
Comment	

Measurement results

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft²)	Flow (ft³/s)	%Q	
0	1:19 PM	1.200	None	0.190	0.0000	0.000	0	0.0000	1.0000	0.0229	0.0760	0.0017	2.05	✓
1	1:19 PM	2.000	0.6	0.200	0.6000	0.120	80	0.0229	1.0000	0.0229	0.1200	0.0028	3.24	✓
2	1:21 PM	2.400	0.6	0.200	0.6000	0.120	80	0.0548	1.0000	0.0548	0.0600	0.0033	3.87	✓
3	1:23 PM	2.600	0.6	0.200	0.6000	0.120	80	0.0030	1.0000	0.0030	0.0400	0.0001	0.14	✓
4	1:25 PM	2.800	0.6	0.290	0.6000	0.174	80	0.0153	1.0000	0.0153	0.0580	0.0009	1.04	✓
5	1:26 PM	3.000	0.6	0.300	0.6000	0.180	80	0.0087	1.0000	0.0087	0.0600	0.0005	0.62	✓
6	1:27 PM	3.200	0.6	0.340	0.6000	0.204	80	0.0781	1.0000	0.0781	0.0680	0.0053	6.25	✓
7	1:29 PM	3.400	0.6	0.300	0.6000	0.180	80	0.0847	1.0000	0.0847	0.0600	0.0051	5.98	✓
8	1:30 PM	3.600	0.6	0.280	0.6000	0.168	80	0.0900	1.0000	0.0900	0.0560	0.0050	5.93	✓
9	1:31 PM	3.800	0.6	0.360	0.6000	0.216	80	0.0938	1.0000	0.0938	0.0720	0.0068	7.95	✓
10	1:33 PM	4.000	0.6	0.380	0.6000	0.228	80	0.0925	1.0000	0.0925	0.0760	0.0070	8.27	✓
11	1:34 PM	4.200	0.6	0.380	0.6000	0.228	80	0.0880	1.0000	0.0880	0.0760	0.0067	7.87	✓
12	1:35 PM	4.400	0.6	0.400	0.6000	0.240	80	0.0884	1.0000	0.0884	0.0800	0.0071	8.32	✓
13	1:36 PM	4.600	0.6	0.350	0.6000	0.210	80	0.0977	1.0000	0.0977	0.1225	0.0120	14.09	✓
14	1:40 PM	5.100	0.6	0.330	0.6000	0.198	80	0.0890	1.0000	0.0890	0.1320	0.0118	13.83	✓
15	1:38 PM	5.400	0.6	0.280	0.6000	0.168	80	0.0696	1.0000	0.0696	0.1260	0.0088	10.32	✓
16	1:39 PM	6.000	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0696	0.0030	0.0002	0.25	✓

Discharge Measurement Summary

Site name	DeepabvsbLake
Site number	DEEPNRSTMBOAT
Operator(s)	Lfs
File name	DeepabvsbLake_20211020-134252.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	1:19 PM	2.000	0.6	0.200	0.6000	0.120	Boundary Interference
2	1:21 PM	2.400	0.6	0.200	0.6000	0.120	Boundary Interference
3	1:23 PM	2.600	0.6	0.200	0.6000	0.120	Boundary Interference,Large SNR Variation
4	1:25 PM	2.800	0.6	0.290	0.6000	0.174	Boundary Interference
5	1:26 PM	3.000	0.6	0.300	0.6000	0.180	SNR Threshold Variation
7	1:29 PM	3.400	0.6	0.300	0.6000	0.180	Boundary Interference
13	1:36 PM	4.600	0.6	0.350	0.6000	0.210	High Stn % Discharge
14	1:40 PM	5.100	0.6	0.330	0.6000	0.198	High Stn % Discharge
15	1:38 PM	5.400	0.6	0.280	0.6000	0.168	High Stn % Discharge

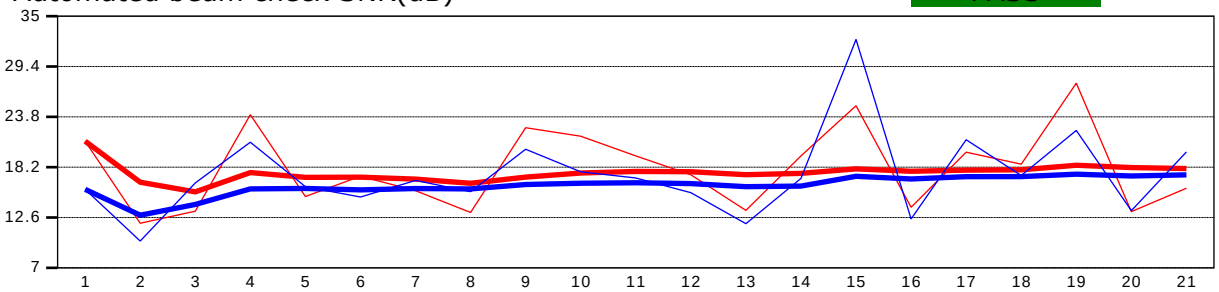
Discharge Measurement Summary

Site name	DeepabvsbLake
Site number	DEEPNRSTMBOAT
Operator(s)	Lfs
File name	DeepabvsbLake_20211020-134252.ft
Comment	

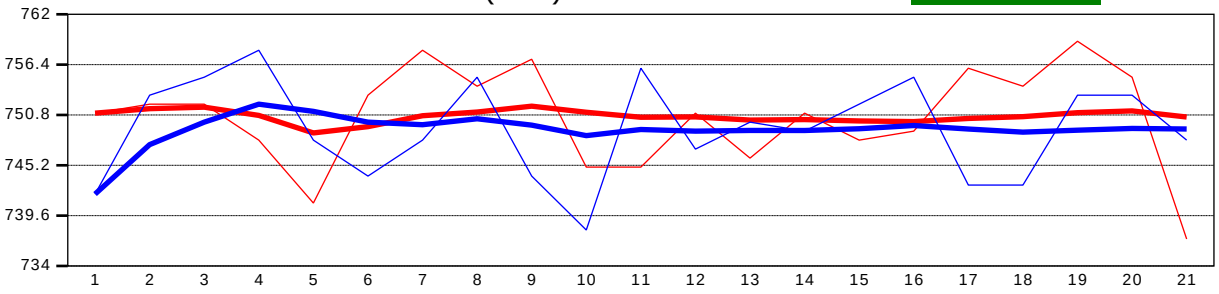
Beam 1	
Beam 2	

Automated beam check Start time 10/20/2021 1:18:55 PM

Automated beam check SNR(dB) PASS



Automated beam check Noise level(cnts) PASS



Automated beam check Quality control warnings

No quality control warnings

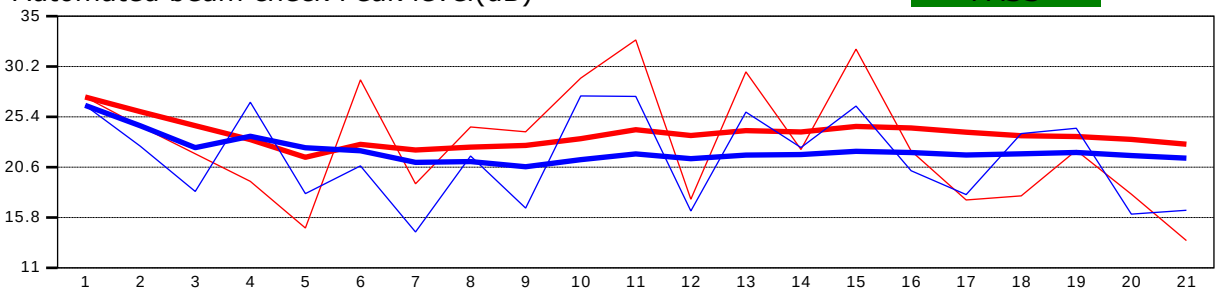
Discharge Measurement Summary

Site name	DeepabvsbLake
Site number	DEEPNRSTMBOAT
Operator(s)	Lfs
File name	DeepabvsbLake_20211020-134252.ft
Comment	

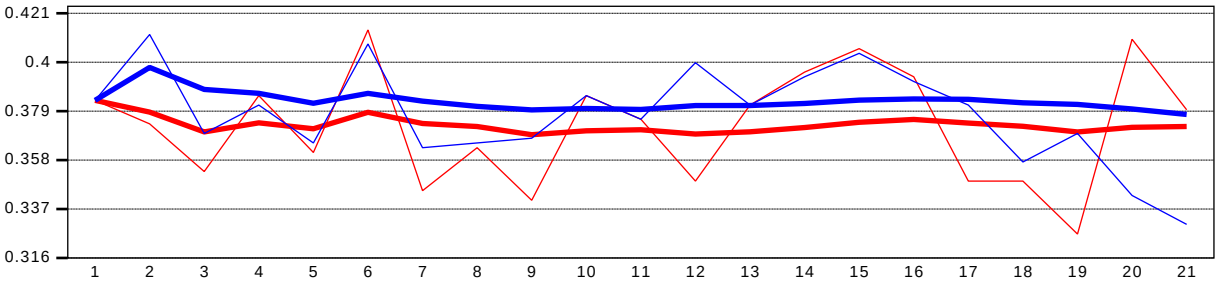
Beam 1	
Beam 2	

Automated beam check Start time 10/20/2021 1:18:55 PM

Automated beam check Peak level(dB) PASS



Automated beam check Peak position(ft) PASS



Automated beam check Quality control warnings

No quality control warnings