COLORADO
Parks and Wildlife
Department of Natural Resources

Water Resources Section
6060 Broadway
Denver, CO 80216

November 1, 2024

Mr. Rob Viehl, Section Chief
Colorado Water Conservation Board
Stream and Lake Protection Section
1313 Sherman Street, 7th Floor
Denver, CO 80203

Subject: Instream Flow Recommendation for Beaver Dams Creek in Water Division 4, Ouray County to be presented at the January 2025 CWCB Meeting

Dear Mr. Viehl:

The information contained within and referred to in this letter forms the scientific and biological basis for an instream flow (ISF) recommendation on Beaver Dams Creek in Water Division 4. Field investigations relating to this ISF recommendation were conducted by Colorado Parks and Wildlife (CPW) and Colorado Water Conservation Board (CWCB) staff in 2022. Beaver Dams Creek is a first order stream that supports native Colorado River cutthroat trout. This ISF recommendation was first presented to interested parties at the ISF Workshop in January 2020. CPW and CWCB staff conducted outreach to the Ouray County Commissioners in 2024. It is CPW staff's opinion that the information contained in this letter is sufficient for the CWCB's staff to recommend an ISF appropriation to the Board on Beaver Dams Creek as it specifically addresses the findings required in Rule 5(i) of the Instream Flow Program Rules.

CPW participates in the ISF Program and develops ISF recommendations for the Board's consideration in an effort to address CPW's legislative directives "… that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors … and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" [§33-1-101 (1) C.R.S.], and "… that the natural, scenic, scientific, and outdoor recreation areas … be protected, preserved, enhanced and managed for the use, benefit, and enjoyment of the people of this state and (its) visitors … and that, to carry out such program and policy, there shall be a continuous operation of acquisition, development, and management of … lands, waters, and facilities." [§33-10-101 (1) C.R.S.].

In addition to these broad statutory guidelines, CPW's strategic planning document (CPW Strategic Plan, 2015) explains the agency's current goals to, "[c]onserve wildlife and habitat to ensure healthy sustainable populations and ecosystems" in order to, "protect and enhance water resources for fish and wildlife populations," by pursuing, "partnerships and agreements to enhance instream flows,

protect reservoir levels, and influence water management activities," and to, "[a]dvocate for water quality and quantities to conserve aquatic resources." In addition to the CPW Strategic Plan, the agency's fish and wildlife conservation activities are also informed by the State Wildlife Action Plan (2002, Revised 2015). The aforementioned documents direct CPW to advocate for the preservation of the state's fish and wildlife resources and natural environment, and therefore link CPW's mission to the goals and priorities of CWCB's Instream Flow and Natural Lake Level Program.

Recommended Segments & Land Status

CPW is proposing an ISF recommendation on Beaver Dams Creek from the headwaters (located at UTM 12S 229120.87 4241934.00) to the confluence with East Fork Dry Creek (located at UTM 12S 229778.94 4246758.01). The reach is approximately 3.3 miles in length. The proposed reach is mainly on public lands managed under the Uncompahgre National Forest. The ISF reach does pass through a small private land inholding for the last 0.5 mile reach above the confluence with East Fork Dry Creek.

Colorado Cutthroat Trout Conservation Goals

In 2001, CPW entered into a multi-state and multi-agency conservation agreement and strategy concerning Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*). Colorado's partners in this plan and agreement include the natural resource management agencies from Utah and Wyoming, a number of federal agencies including the USFS, USFWS, BLM and NPS, and the Ute Indian Tribe of the Uintah and Ouray Reservation. The purpose of the strategy is to provide a framework for the long-term conservation of the Colorado River cutthroat trout (CRCT), and to reduce or eliminate the threats that warrant its status as a sensitive species or species of concern by federal resource agencies. Essentially, the parties agreed that in order to prevent listing of the subspecies, and to reach desired recovery goals without hindering further development of our state resources, continued implementation of the conservation strategy was necessary.

The objectives of the strategy are to identify and characterize all CRCT core and conservation populations, secure and enhance conservation populations, restore populations, secure and enhance watershed conditions, public outreach, data sharing, and coordination. CPW believes that flow protection via establishing an ISF water right is a conservation action that will help "secure and enhance watershed conditions" and will support the core conservation populations of CRCT which are resident to Beaver Dams Creek and the East Fork Dry Creek basin. Information about the species and CPW's conservation strategy can be found here: CPW Cutthroat Trout Research. CPW believes that securing ISF water rights for core conservation populations of CRCT is a critical step in the overall preservation of these important native trout.

Natural Environment and Biological Summary

Beaver Dams Creek is a tributary of the Uncompahgre River which flows easterly off the Uncompahgre Plateau towards the town of Montrose. It is a first order headwaters stream which is snow-melt dominated and influenced by late-summer monsoonal periods. The mean basin elevation is 9,300 feet. Mean annual precipitation is 28 inches. The contributing basin is approximately 2.9 square miles in size and is densely forested containing mainly coniferous pine. The creek supports a healthy riparian environment.

Beaver Dams Creek has a high-gradient, confined channel with substrate that ranges from large cobble to gravel and sand. Fish habitat is complex with lots of wood and cover in the channel, as well as some side channel features. Cover habitat includes undercut banks, large woody debris, and step-pools.

There is ample overhead shading supporting suitable stream temperatures. The creek supports a diverse macroinvertebrate community. Multiple species of mayfly, dipetera, and caddisfly were observed in the field.

Beaver Dams Creek supports a self-sustaining population of Colorado River cutthroat trout of the Gunnison Basin lineage. The population is considered a core conservation population indicating high genetic purity of the cutthroat trout and limited introgression with non-native trout species. CRCT are state species of special concern and considered federally sensitive species (State Wildlife Action Plan, 2015). Length-frequency data indicates multiple age classes surveyed by CPW in 2017 (see attached), which reinforces that the cutthroat trout in Beaver Dams Creek are a self-sustaining population. CPW staff observed fish during 2022 field work.

R2Cross Background

Initial biological instream flow recommendations were developed using the R2Cross methodology (Espegren, 1996[1]). R2Cross uses field data that has been collected in a riffle habitat type. Riffles are often the limiting habitat features in streams during low flow events, so maintaining specific hydraulic conditions across riffle habitat types will also maintain aquatic habitat in pools and runs for most life stages of fish and macroinvertebrates (Nehring, 1979[2]). The R2Cross model uses field data, including a survey of cross-sectional channel geometry, a longitudinal slope of the water surface, and a flow measurement, as input to a single transect hydraulic model. R2Cross uses Ferguson's Variable-Power Equation (Ferguson, 2007[3]) to model a stage-discharge relationship and compute corresponding hydraulic parameters of average depth, average velocity, and percent wetted perimeter over modeled stages. Maintaining these three hydraulic parameters at specified levels should ensure conditions that allow movement of fish longitudinally across riffles and adequate depths, velocities, and oxygenation for production of macroinvertebrates and development of trout eggs. Baseflow recommendations are typically developed based on the flows that meet two of three hydraulic criteria and summer flow recommendations are based on hydraulic criteria that meet three of three hydraulic criteria (as described in Nehring 1979 and Espergren 1996).

In 2022, CPW and CWCB staff collected two cross-section data sets on Beaver Dams Creek near the USFS boundary. The preliminary results of the R2Cross analysis are summarized below.

	Bankfull Top Width	Date Measured	Flow Measured	Flow Meeting Two Criteria	Flow Meeting Three Criteria
1	7.89 ft	5/25/2022	1.88 cfs	0.39 cfs	2.1 cfs
2	10.08 ft	5/25/2022	1.88 cfs	0.59 cfs	3.5 cfs
Recommended Flow Rates:				**0.49 cfs**	**2.8 cfs**

[1]Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

[2]Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

[3] Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

The initial biological flow recommendation during the baseflow period is 0.5 cfs. This rate is protective during the overwintering period as it maintains at least 50 percent wetted perimeter and average depth of at least 0.2 feet. The initial biological flow recommendation in the summer is 2.80 cfs, which will maintain these hydaulic parameters as well as velocity of 1 foot per second (fps) in both surveyed critical riffles.

In order to make a preliminary determination whether water is available for the R2Cross-based flow recommendations and to determine the appropriate seasonal transition dates, CPW examined basic hydrologic data and water rights information for Beaver Dams Creek. Beaver Dams Creek does not have any gage data, and because it is high-elevation and undeveloped, CWCB staff relied upon regression equations for monthly flow estimates to determine the seasonality of the flow recommendations. CPW is not aware of any active water rights within the reach.

Water Availability-Refined Flow Recommendations

CPW's analysis indicates that the following flows are needed to protect the natural environment to a reasonable degree. Based on the hydrology from CSUFlow18 (Eurich et al., 2021[4]), there appears to be water availablity limitations during the late-summer through winter. Therefore, CPW's adjusted flow recommendation are the following:

- Early Spring Flow Recommendation (March 1 through March 31): **0.5 cfs**
    - Earlier spring snowmelt may be a reality in a changing climate. This flow recommendation will support adequate depth and wetted perimeter to support fish as they begin to transition from overwintering resting habitat into more metabolic activity.
- Spring High Flow Recommendation (April 1 through April 30): **2.6 cfs**
    - Maintains adequate wetted perimeter and depth, as well as higher velocities, that will support fish as they transition into more metabolic activity as ice cover decreases and flows start to rise during the beginning of snowmelt runoff.
- Summer Flow Recommendation (May 1 through June 30): **2.8 cfs**
    - Maintains adequate depth, velocity, and wetted perimeter during spring runoff through its recession. This flow rate will allow oxygenation and productivity of macroinvertebrates in riffles. This will support fish when they are active feeding and spawning. This higher flow rate will support beneficial spawning conditions for cutthroat trout who spawn during this period.
- July Flow Recommendation (July 1 through July 31): **1.7 cfs**
    - This flow recommendation will maintain adequate depth and wetted perimeter that supports rearing habitats enabling feeding and growth of cutthroat trout. Longer days and warmer water temperature facilitate growth, but this flow rate also provides refuge habitats as flows drop and stream flow temperatures may be high.
- Late Summer Flow Recommendation (August 1 through August 31): **0.6 cfs**

[4] Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

    - This flow recommendation will maintain adequate depth and wetted perimeter to provide sufficient habitat in riffles, runs, and pools, allowing fish movement between habitat types.
- Fall and Baseflow Period Flow Recommendation (September 1 through February 28): **0.3 cfs**
    - This flow rate has been reduced due to water availability constraints but will maintain adequate wetted perimeter in the channel to provide sufficient holding habitats in pools and glides. This will support fish during the fall when they are transitioning to resting habitat in preparation for overwintering conditions.

The purpose of this letter is to formally transmit this ISF recommendation to CWCB for their Board's consideration. Based on CPW's opinion that there is a flow-dependent natural environment in Beaver Dams Creek that can be preserved to a reasonable degree with an ISF water right in the recommended rates. Please refer to attachments which include; R2Cross field forms, R2Cross output, fish survey information, and photographs at each cross section location.

CPW personnel will be available at the January 2025 CWCB meeting to answer any questions that the Board might have regarding these flow recommendations. We appreciate your consideration.

Sincerely,

Katie Birch
CPW Instream Flow Program Coordinator
Attachments (as stated)

Length Weight Frequency Data

Water **44521** **Beaver Dams Creek** Date **8/10/2017**

Station **GU4126**

Drainage **Gunnison River** UtmX **229042** UtmY **4244555** Elevation **2728 m**

Length **74 m** Width Area

Surveyors **Gardunio, Palmer, Temple**

Gear **BPEF LR-24** Effort Metric **PASS** Protocol **TWO-PASS REMOVAL**

Total catch

Species	Count	Length (mm)	Weight (gm)	Status	Mark	Tag ID	Habitat
CRN	1	95		1			
CRN	1	142		1	W		
CRN	1	90		1			
CRN	1	140		1	W		
CRN	1	166		1			
CRN	1	125		1			
CRN	1	149		1			
CRN	1	135		1	W		
CRN	1	149		1	W		
CRN	1	97		1			
CRN	1	82		1			
CRN	1	80		1			
CRN	1	108		1	W		
CRN	1	141		1	W		
CRN	1	125		1	W		
CRN	1	135		1	W		
CRN	1	90		1			

Length Weight Frequency Data

Water **44521** **Beaver Dams Creek** Date **8/10/2017**

Station **GU4126**

Species	Count	Length (mm)	Weight (gm)	Status	Mark	Tag ID	Habitat
CRN	1	84		1			
CRN	1	113		1			
CRN	1	82		1			
CRN	1	129		1	W		
CRN	1	104		1	W		
CRN	1	95		1			
CRN	1	70		1			
CRN	1	85		1			
CRN	1	26		1			
CRN	1	115		2			
CRN	1	100		2			
CRN	1	50		2			
CRN	1	78		2			
CRN	1	60		2			

Notes: New location after finding no fish at GU2321. Two pass depletion. W in mark column idicates fish with visable white tipped dorsal fin. Pass one (P1) was 951 seconds and pass two (P2) 798 seconds making the total effort 29.15 min.

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Beaver Dams Creek					CROSS-SECTION NO.: 1-22
CROSS-SECTION LOCATION: Belw trib confluences UTM 753660 4293990					
DATE: 5/25/22	OBSERVERS: Birch McDowell Fields-Sommers				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:		
MAP(S): USGS:					
USFS:					

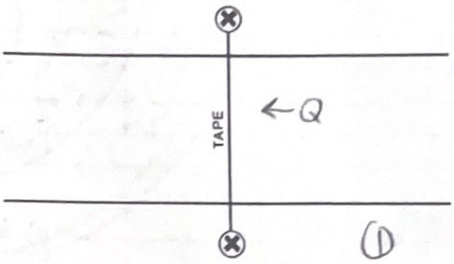
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE: FT2 by Fields-Sommers 100' d/s			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: Large cobble to gravel	PHOTOGRAPHS TAKEN: YES/NO	NUMBER OF PHOTOGRAPHS:		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	X
⊗ Tape @ Stake RB	0.0	X
① WS @ Tape LB/RB	0.0	6.49 / 6.52
② WS Upstream		6.22
③ WS Downstream		6.85
SLOPE	2.46%	

SKETCH



total length = 25.6

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: Diptera, flathead Mayfly, Giant waks strider

COMMENTS

Lots of wood under wtr banks. Large drops. Lots of overhead cover. Mainly conifer, Blue spruce, horsetail

1.88cfs 6.42% uncertainty
0.2ft Δ in stage 4°F Δ wtemp

Sunny 60°F air temp 42°F wtemp, very light downstm wind

low 50°Fs in shade

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO.:	DATE:	SHEET ___ OF ___

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

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)		Area (ft^2)	Discharge (cfs)
								At Point	Mean in Vertical		
S	0.00		5.04								
	1.3		5.62								
	5.0		5.69								
Bankfull	6.2		5.90								
W	7.3		6.542								
	7.6		6.75	.25							
	7.9		6.85	.36							
	8.2		6.71	.20							
	8.5		7.01	.50							
	8.8		6.99	.48							
	9.1		6.99	.48							
	9.4		6.97	.46							
	9.7		6.99	.48							
	10.0		6.83	.32							
	10.3		6.84	.37							
	10.6		6.93	.42							
	10.9		6.94	.44							
	11.2		6.95	.46							
	11.5		6.80	.32							
	11.8		6.89	.45							
	12.1		6.85	.37							
	12.4		6.80	.33							
W	12.5		6.49								
	13.3		6.15								
	13.6		6.03								
B	14.2		5.96								
	15.5		5.69								
S	22.0		5.49								
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: Beaver Dams Creek					CROSS-SECTION NO.: 2-22
CROSS-SECTION LOCATION: Below trib confluences UTM 753684 4244030					
DATE: 5/25/22	OBSERVERS: Birch McDonell Fields-Sommers				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:		
MAP(S):	USGS:				
	USFS:				

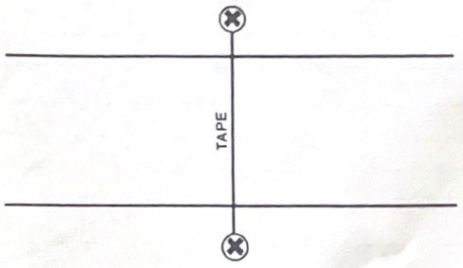
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE: FT2 by Fields-Sommers			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: Small boulders & Medium Cobble	PHOTOGRAPHS TAKEN: YES/NO	NUMBER OF PHOTOGRAPHS:		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	
⊗ Tape @ Stake RB	0.0	~
① WS @ Tape LB/RB	0.0	6.75 / 6.90
② WS Upstream	Δ 20.4	6.50
③ WS Downstream		7.04
SLOPE	2.6%	

SKETCH



LEGEND:
- Stake ⊗
- 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: 2+ Sp. Mayfly, Diptera, caddisfly, fish

COMMENTS

Plethora of woody debri; braided channels up & downstream, Pools, Drops, Fish; macro habitat variety.

Sunny, breezy, light, downstream

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO:	DATE:	SHEET ___ OF ___

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

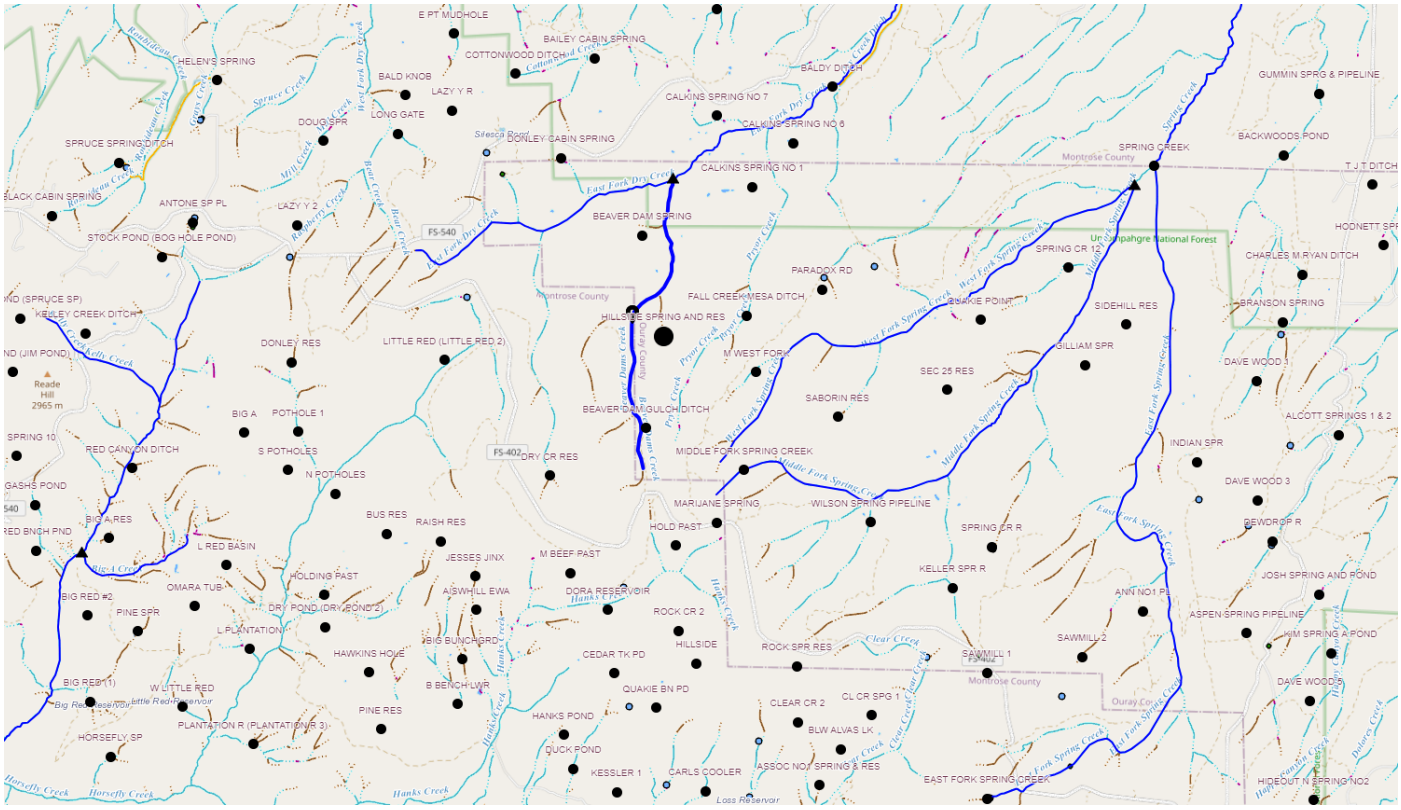
Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
S	0	0	5.33								
BF	0.7		6.29								
WS	1.3		6.75								
	1.7		6.98		0.31						
	2.1		6.99		0.31						
	2.5		6.95		0.27						
	2.9		7.17		0.49						
	3.3		7.15		0.48						
	3.7		7.12		0.43						
	4.1		7.16		0.41						
	4.5		7.08		0.38						
	4.9		6.91		0.25						
R	5.4		6.8		0.16						
	5.8		6.97		0.35						
	6.2		6.95		0.30						
	6.6		7.00		0.35						
	7.0		7.00		0.41						
	7.4		7.14		0.48						
	7.8		7.06		0.39						
	8.2		6.95		0.25						
	8.6		6.94		0.05						
WS	9		6.80								
	10		6.67								
BF	10.9		6.23								
S	11.8		4.42								
TOTALS:											

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

R2Cross RESULTS

Stream Name: Beaver Dams Creek
Stream Locations: Below trib confluences
Fieldwork Date: 05/25/2022
Cross-section: 1
Observers: Birch Fields-Sommers McDowell
Coordinate System: UTM Zone 12
X (easting): 753660
Y (northing): 4243940
Date Processed: 06/17/2024
Slope: 0.0246
Discharge: Entered Value: 1.88 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: R2Cross_Beaver Dams Creek-1_05-25-2022-Q=1.88.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 7.89

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.39
Percent Wetted Perimeter (%)	50.0	0.07
Mean Velocity (ft/s)	1.0	2.1

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)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	5.96	7.89	0.68	1.05	5.38	8.72	100.0	0.62	0.08	2.16	11.65
	6.0	7.53	0.68	1.01	5.11	8.35	95.67	0.61	0.08	2.14	10.95
	6.05	7.1	0.67	0.96	4.75	7.9	90.61	0.6	0.08	2.09	9.91
	6.1	6.89	0.64	0.91	4.4	7.67	87.9	0.57	0.08	1.96	8.63
	6.15	6.68	0.61	0.86	4.06	7.43	85.19	0.55	0.08	1.84	7.45
	6.2	6.47	0.58	0.81	3.73	7.2	82.55	0.52	0.09	1.71	6.37
	6.25	6.26	0.54	0.76	3.41	6.97	79.91	0.49	0.09	1.58	5.39
	6.3	6.06	0.51	0.71	3.1	6.74	77.28	0.46	0.1	1.45	4.51
	6.35	5.85	0.48	0.66	2.81	6.51	74.65	0.43	0.1	1.32	3.72
	6.4	5.64	0.45	0.61	2.52	6.28	72.01	0.4	0.11	1.2	3.01
	6.45	5.44	0.41	0.56	2.24	6.05	69.38	0.37	0.11	1.07	2.4
Waterline	6.5	5.24	0.38	0.51	1.97	5.83	66.84	0.34	0.12	0.94	1.86
	6.55	5.15	0.33	0.46	1.71	5.69	65.19	0.3	0.13	0.8	1.37
	6.6	5.07	0.29	0.41	1.46	5.55	63.64	0.26	0.15	0.65	0.95
	6.65	4.99	0.24	0.36	1.21	5.42	62.1	0.22	0.17	0.51	0.62
	6.7	4.9	0.2	0.31	0.96	5.28	60.55	0.18	0.2	0.38	0.37
	6.75	4.71	0.15	0.26	0.72	5.01	57.48	0.14	0.24	0.27	0.19
	6.8	4.4	0.11	0.21	0.49	4.62	52.98	0.11	0.3	0.17	0.08
	6.85	3.23	0.09	0.16	0.29	3.38	38.77	0.09	0.36	0.13	0.04
	6.9	2.32	0.07	0.11	0.16	2.41	27.6	0.07	0.45	0.08	0.01
	6.95	1.5	0.04	0.06	0.05	1.54	17.62	0.04	0.75	0.03	0.0
	7.0	0.24	0.01	0.01	0.0	0.25	2.83	0.01	2.81	0.0	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	1.88	(cfs)
Calculated Flow (Qc) =	1.87	(cfs)
(Qm-Qc)/Qm * 100 =	0.51%	
Measured Waterline (WLm) =	6.5	(ft)
Calculated Waterline (WLc) =	6.5	(ft)
(WLm-WLc)/WLm * 100 =	0.15%	
Max Measured Depth (Dm) =	0.5	(ft)
Max Calculated Depth (Dc) =	0.51	(ft)
(Dm-Dc)/Dm * 100 =	-2.92%	
Mean Velocity =	0.95	(ft/s)
Manning's n =	0.12	
0.4 * Qm =	0.75	(cfs)
2.5 * Qm =	4.7	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	5.04		
	1.3	5.62		
	5	5.69		
Bankfull	6.2	5.9		
Waterline	7.3	6.52	0	
	7.6	6.75	0.25	
	7.9	6.85	0.36	
	8.2	6.71	0.2	
	8.5	7.01	0.5	
	8.8	6.99	0.48	
	9.1	6.99	0.48	
	9.4	6.97	0.46	
	9.7	6.99	0.48	
	10	6.83	0.32	
	10.3	6.84	0.37	
	10.6	6.93	0.42	
	10.9	6.94	0.44	
	11.2	6.95	0.46	
	11.5	6.8	0.32	
	11.8	6.89	0.45	
	12.1	6.85	0.37	
	12.4	6.8	0.33	
Waterline	12.5	6.49	0	
	13.3	6.15		
	13.6	6.03		
Bankfull	14.2	5.96		
	15.5	5.69		
	22	5.49		

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	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
0.38	0.25	0.08	0.07	3.8
0.32	0.36	0.11	0.1	5.47
0.33	0.2	0.06	0.06	3.04
0.42	0.5	0.15	0.14	7.6
0.3	0.48	0.14	0.14	7.29
0.3	0.48	0.14	0.14	7.29
0.3	0.46	0.14	0.13	6.99
0.3	0.48	0.14	0.14	7.29
0.34	0.32	0.1	0.09	4.86
0.3	0.37	0.11	0.11	5.62
0.31	0.42	0.13	0.12	6.38
0.3	0.44	0.13	0.13	6.69
0.3	0.46	0.14	0.13	6.99
0.34	0.32	0.1	0.09	4.86
0.31	0.45	0.14	0.13	6.84
0.3	0.37	0.11	0.11	5.62
0.3	0.33	0.07	0.06	3.34
0.33	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

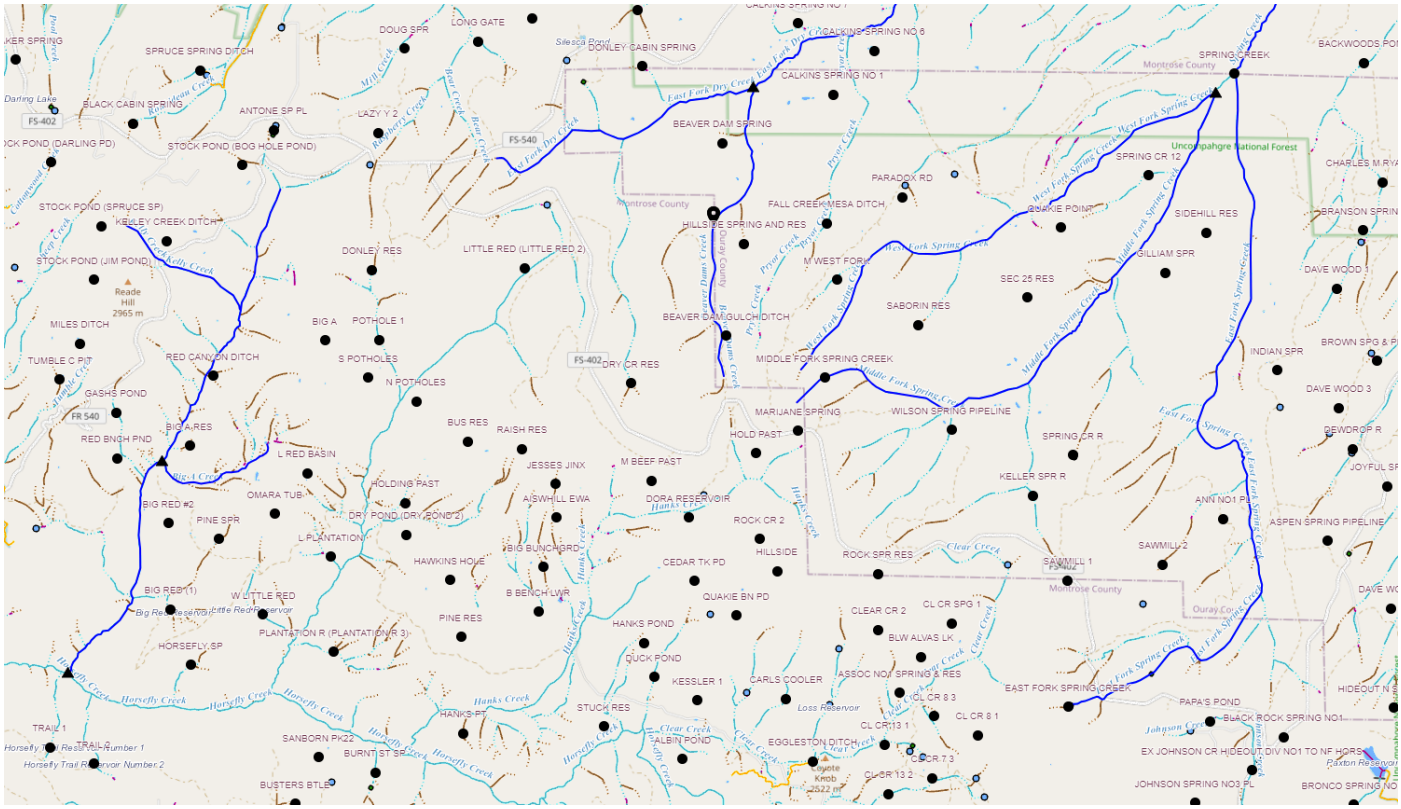
DISCLAIMER

"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: Beaver Dams Creek
Stream Locations: Below trib confluences
Fieldwork Date: 05/25/2022
Cross-section: 2
Observers: Birch Fields-Sommers McDowell
Coordinate System: UTM Zone 12
X (easting): 753684
Y (northing): 4244030
Date Processed: 06/17/2024
Slope: 0.0265
Discharge: Entered Value: 1.88 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: R2Cross_Beaver Dams Creek-2_05-25-2022-Q=1.88.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 10.08

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.59
Percent Wetted Perimeter (%)	50.0	0.07
Mean Velocity (ft/s)	1.0	3.5

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)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	6.29	10.08	0.62	0.88	6.22	10.62	100.0	0.59	0.09	1.92	11.92
	6.31	10.0	0.6	0.86	6.0	10.53	99.19	0.57	0.09	1.84	11.06
	6.33	9.93	0.58	0.84	5.78	10.44	98.38	0.55	0.09	1.77	10.24
	6.36	9.86	0.56	0.81	5.56	10.36	97.56	0.54	0.09	1.7	9.46
	6.38	9.78	0.55	0.79	5.35	10.27	96.75	0.52	0.1	1.63	8.71
	6.4	9.71	0.53	0.77	5.13	10.19	95.94	0.5	0.1	1.56	7.99
	6.42	9.64	0.51	0.75	4.92	10.1	95.13	0.49	0.1	1.49	7.31
	6.44	9.56	0.49	0.73	4.71	10.01	94.31	0.47	0.1	1.41	6.66
	6.47	9.49	0.47	0.7	4.5	9.93	93.5	0.45	0.11	1.34	6.04
	6.49	9.41	0.46	0.68	4.29	9.84	92.69	0.44	0.11	1.27	5.46
	6.51	9.34	0.44	0.66	4.09	9.75	91.88	0.42	0.11	1.2	4.91
	6.53	9.27	0.42	0.64	3.88	9.67	91.06	0.4	0.12	1.13	4.39
	6.55	9.19	0.4	0.62	3.68	9.58	90.25	0.38	0.12	1.06	3.9
	6.58	9.12	0.38	0.59	3.48	9.5	89.44	0.37	0.12	0.99	3.45
	6.6	9.05	0.36	0.57	3.28	9.41	88.63	0.35	0.13	0.92	3.02
	6.62	8.97	0.34	0.55	3.08	9.32	87.81	0.33	0.14	0.85	2.63
	6.64	8.9	0.32	0.53	2.88	9.24	87.0	0.31	0.14	0.79	2.27
	6.66	8.82	0.3	0.51	2.69	9.15	86.19	0.29	0.15	0.72	1.94
	6.69	8.66	0.29	0.48	2.49	8.98	84.55	0.28	0.15	0.67	1.66
Waterline	6.69	8.61	0.28	0.48	2.45	8.93	84.09	0.27	0.16	0.65	1.6
	6.71	8.46	0.27	0.46	2.31	8.77	82.6	0.26	0.16	0.61	1.42
	6.73	8.26	0.26	0.44	2.12	8.56	80.65	0.25	0.17	0.56	1.19
	6.75	8.07	0.24	0.42	1.94	8.36	78.7	0.23	0.18	0.51	1.0
	6.77	7.86	0.22	0.4	1.77	8.14	76.68	0.22	0.19	0.46	0.82
	6.8	7.65	0.21	0.37	1.6	7.93	74.65	0.2	0.2	0.42	0.66

	6.82	7.41	0.19	0.35	1.43	7.67	72.21	0.19	0.21	0.37	0.53
	6.84	7.15	0.18	0.33	1.27	7.4	69.67	0.17	0.23	0.33	0.42
	6.86	6.9	0.16	0.31	1.12	7.13	67.14	0.16	0.25	0.29	0.32
	6.88	6.65	0.15	0.29	0.97	6.86	64.6	0.14	0.27	0.25	0.24
	6.91	6.39	0.13	0.26	0.82	6.59	62.06	0.12	0.3	0.2	0.17
	6.93	6.18	0.11	0.24	0.69	6.36	59.88	0.11	0.33	0.16	0.11
	6.95	5.61	0.1	0.22	0.55	5.76	54.29	0.1	0.37	0.14	0.08
	6.97	4.55	0.1	0.2	0.44	4.68	44.13	0.09	0.37	0.13	0.06
	6.99	3.61	0.1	0.18	0.35	3.73	35.09	0.09	0.37	0.13	0.05
	7.02	2.94	0.1	0.15	0.28	3.04	28.67	0.09	0.38	0.13	0.04
	7.04	2.71	0.08	0.13	0.22	2.79	26.3	0.08	0.43	0.1	0.02
	7.06	2.48	0.07	0.11	0.16	2.54	23.93	0.06	0.51	0.08	0.01
	7.08	2.21	0.05	0.09	0.11	2.26	21.24	0.05	0.64	0.05	0.01
	7.1	1.88	0.04	0.07	0.07	1.92	18.07	0.03	0.86	0.03	0.0
	7.13	1.42	0.02	0.04	0.03	1.44	13.58	0.02	1.36	0.01	0.0
	7.15	0.65	0.01	0.02	0.01	0.65	6.17	0.01	2.47	0.0	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	1.88	(cfs)
Calculated Flow (Qc) =	1.75	(cfs)
(Qm-Qc)/Qm * 100 =	7.14%	
Measured Waterline (WLm) =	6.78	(ft)
Calculated Waterline (WLc) =	6.69	(ft)
(WLm-WLc)/WLm * 100 =	1.24%	
Max Measured Depth (Dm) =	0.49	(ft)
Max Calculated Depth (Dc) =	0.48	(ft)
(Dm-Dc)/Dm * 100 =	2.29%	
Mean Velocity =	0.71	(ft/s)
Manning's n =	0.143	
0.4 * Qm =	0.75	(cfs)
2.5 * Qm =	4.7	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	5.33		
Bankfull	0.7	6.29		
Waterline	1.3	6.75	0	
	1.7	6.98	0.31	
	2.1	6.99	0.31	
	2.5	6.95	0.27	
	2.9	7.17	0.49	
	3.3	7.15	0.48	
	3.7	7.12	0.43	
	4.1	7.16	0.41	
	4.5	7.08	0.38	
	4.9	6.91	0.25	
	5.4	6.8	0.16	
	5.8	6.97	0.35	
	6.2	6.95	0.3	
	6.6	7	0.35	
	7	7	0.41	
	7.4	7.14	0.48	
	7.8	7.06	0.39	
	8.2	6.95	0.25	
	8.6	6.94	0.05	
Waterline	9	6.8	0	
	10	6.67		
Bankfull	10.9	6.23		
	11.8	4.42		

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.46	0.31	0.12	0.1	5.06
0.4	0.31	0.12	0.1	5.06
0.4	0.27	0.11	0.08	4.41
0.46	0.49	0.2	0.15	8.01
0.4	0.48	0.19	0.15	7.84
0.4	0.43	0.17	0.13	7.03
0.4	0.41	0.16	0.13	6.7
0.41	0.38	0.15	0.12	6.21
0.43	0.25	0.11	0.09	4.59
0.51	0.16	0.07	0.06	2.94
0.43	0.35	0.14	0.11	5.72
0.4	0.3	0.12	0.09	4.9
0.4	0.35	0.14	0.11	5.72
0.4	0.41	0.16	0.13	6.7
0.42	0.48	0.19	0.15	7.84
0.41	0.39	0.16	0.12	6.37
0.41	0.25	0.1	0.08	4.08
0.4	0.05	0.02	0.02	0.82
0.42	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

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General Site Field Visit Data Report *(Filters: Name begins with Beaver Dams Creek;)*

Type		Div	Name	CWCB Case Number	Segment ID	Visit Date	Location Description	Watershed Name
Stream		4	Beaver Dams Creek		21/4/A-001	5/25/2022	Beaver Dams Creek above the confluence with East Fork Dry Creek	Uncompahgre

Remarks	Date	Remark	
	25/05/22 14:54	Assisted CPW in collecting R2Cross and assesing the local environment.	
GPS Log	No GPS Log records for this visit.		
Photo Log	No Photo Log records for this visit.		

Discharge Measurement Summary

Site name	BeaverCr
Site number	5252022
Operator(s)	Lfs
File name	BeaverCr_20220525-130841.ft
Comment	

Start time	5/25/2022 12:43 PM
End time	5/25/2022 1:07 PM
Start location latitude	38.308
Start location longitude	-108.099
Calculations engine	FlowTracker2

Sensor type	Top Setting
Handheld serial number	FT2H2113010
Probe serial number	FT2P2114008
Probe firmware	1.30
Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
20	40	1.880

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
3.900	2.105	4.128

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
42.056	0.540	0.893

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
40.222	0.650	1.930

Discharge Uncertainty		
Category	**ISO**	**IVE**
Accuracy	1.0%	1.0%
Depth	0.5%	5.6%
Velocity	0.9%	3.1%
Width	0.2%	0.1%
Method	2.3%	
# Stations	2.5%	
Overall	**3.7%**	**6.5%**

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

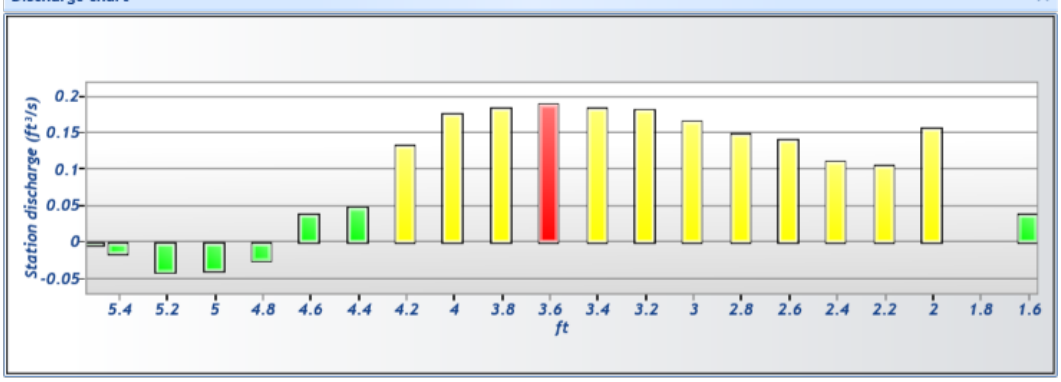
No changes were made to this file
Quality control warnings

Discharge Measurement Summary

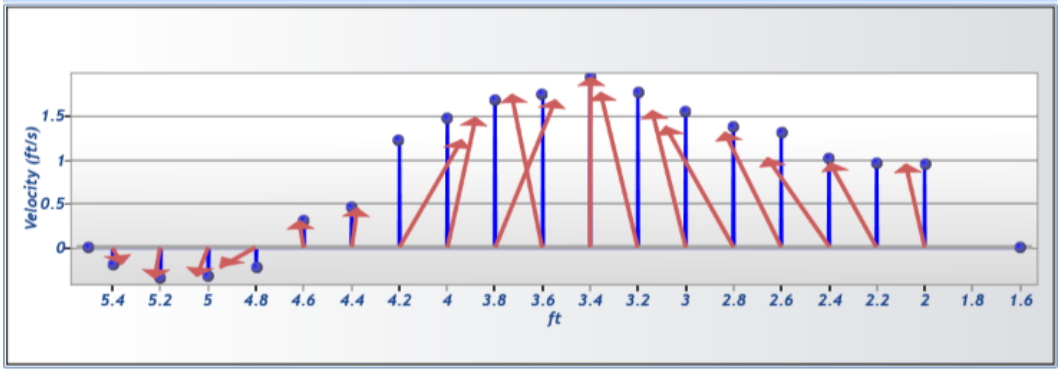
Site name	BeaverCr
Site number	5252022
Operator(s)	Lfs
File name	BeaverCr_20220525-130841.ft
Comment	

Station Warning Settings	
Station discharge OK	Station discharge < 5.000%
Station discharge caution	5.000% >= Station discharge < 10.000%
Station discharge warning	Station discharge >= 10.000%

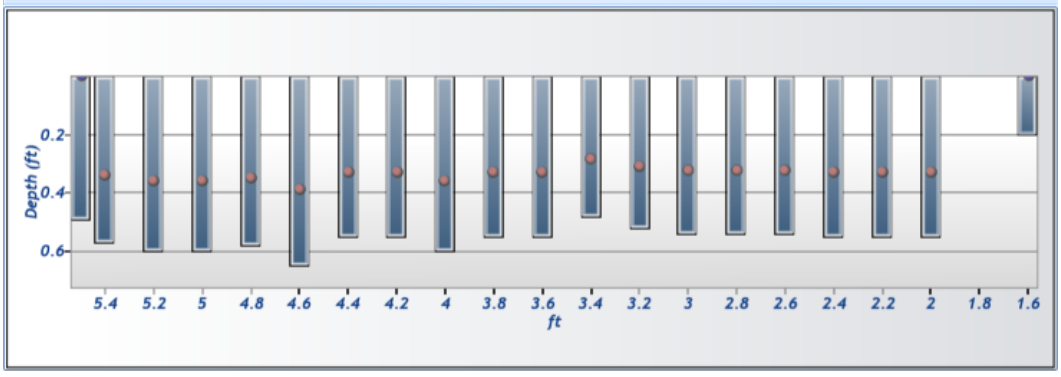
Discharge chart



Velocity chart



Depth chart



Discharge Measurement Summary

Site name	BeaverCr
Site number	5252022
Operator(s)	Lfs
File name	BeaverCr_20220525-130841.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	
19	1:07 PM	1.600	None	0.200	0.000	0.000	0	0.000	1.000	0.950	0.040	0.038	2.021	✓
18	1:06 PM	2.000	0.6	0.550	0.600	0.330	80	0.950	1.000	0.950	0.165	0.157	8.338	✓
17	1:05 PM	2.200	0.6	0.550	0.600	0.330	80	0.955	1.000	0.955	0.110	0.105	5.588	✓
16	1:04 PM	2.400	0.6	0.550	0.600	0.330	80	1.012	1.000	1.012	0.110	0.111	5.917	✓
15	1:03 PM	2.600	0.6	0.540	0.600	0.324	80	1.302	1.000	1.302	0.108	0.141	7.479	✓
14	1:02 PM	2.800	0.6	0.540	0.600	0.324	80	1.373	1.000	1.373	0.108	0.148	7.887	✓
13	1:01 PM	3.000	0.6	0.540	0.600	0.324	80	1.547	1.000	1.547	0.108	0.167	8.884	✓
12	12:59 PM	3.200	0.6	0.520	0.600	0.312	80	1.754	1.000	1.754	0.104	0.182	9.699	✓
11	12:58 PM	3.400	0.6	0.480	0.600	0.288	80	1.930	1.000	1.930	0.096	0.185	9.853	✓
10	12:57 PM	3.600	0.6	0.550	0.600	0.330	80	1.735	1.000	1.735	0.110	0.191	10.151	✓
9	12:56 PM	3.800	0.6	0.550	0.600	0.330	80	1.668	1.000	1.668	0.110	0.184	9.760	✓
8	12:55 PM	4.000	0.6	0.600	0.600	0.360	80	1.471	1.000	1.471	0.120	0.176	9.385	✓
7	12:54 PM	4.200	0.6	0.550	0.600	0.330	80	1.217	1.000	1.217	0.110	0.134	7.118	✓
6	12:52 PM	4.400	0.6	0.550	0.600	0.330	80	0.449	1.000	0.449	0.110	0.049	2.625	✓
5	12:51 PM	4.600	0.6	0.650	0.600	0.390	80	0.303	1.000	0.303	0.130	0.039	2.093	✓
4	12:50 PM	4.800	0.6	0.580	0.600	0.348	80	-0.229	1.000	-0.229	0.116	-0.027	-1.411	✓
3	12:49 PM	5.000	0.6	0.600	0.600	0.360	80	-0.330	1.000	-0.330	0.120	-0.040	-2.103	✓
2	12:47 PM	5.200	0.6	0.600	0.600	0.360	80	-0.343	1.000	-0.343	0.120	-0.041	-2.189	✓
1	12:45 PM	5.400	0.6	0.570	0.600	0.342	80	-0.187	1.000	-0.187	0.086	-0.016	-0.851	✓
0	12:43 PM	5.500	None	0.490	0.000	0.000	0	0.000	1.000	-0.187	0.024	-0.005	-0.244	✓

Discharge Measurement Summary

Site name	BeaverCr
Site number	5252022
Operator(s)	Lfs
File name	BeaverCr_20220525-130841.ft
Comment	

Quality Control Settings	
Maximum depth change	50.000%
Maximum spacing change	100.000%
SNR threshold	10.000 dB
Standard error threshold	0.033 ft/s
Spike threshold	10.000%
Maximum velocity angle	20.000 deg
Maximum tilt angle	5.000 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
15	1:03 PM	2.600	0.6	0.540	0.600	0.324	Standard Error > QC
14	1:02 PM	2.800	0.6	0.540	0.600	0.324	Standard Error > QC
13	1:01 PM	3.000	0.6	0.540	0.600	0.324	Standard Error > QC
12	12:59 PM	3.200	0.6	0.520	0.600	0.312	Standard Error > QC
10	12:57 PM	3.600	0.6	0.550	0.600	0.330	Standard Error > QC,High Stn % Discharge
9	12:56 PM	3.800	0.6	0.550	0.600	0.330	Standard Error > QC
8	12:55 PM	4.000	0.6	0.600	0.600	0.360	Standard Error > QC
7	12:54 PM	4.200	0.6	0.550	0.600	0.330	Standard Error > QC
6	12:52 PM	4.400	0.6	0.550	0.600	0.330	Standard Error > QC
5	12:51 PM	4.600	0.6	0.650	0.600	0.390	Standard Error > QC
4	12:50 PM	4.800	0.6	0.580	0.600	0.348	Velocity Angle > QC
3	12:49 PM	5.000	0.6	0.600	0.600	0.360	Boundary Interference,Velocity Angle > QC
2	12:47 PM	5.200	0.6	0.600	0.600	0.360	Velocity Angle > QC
1	12:45 PM	5.400	0.6	0.570	0.600	0.342	Boundary Interference,Velocity Angle > QC

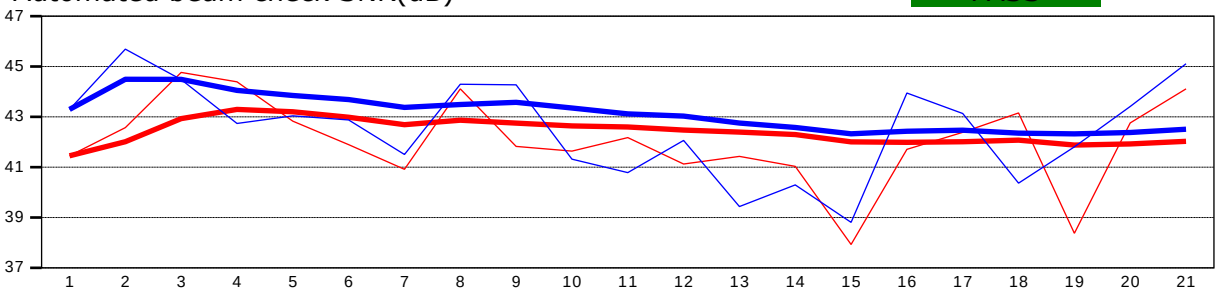
Discharge Measurement Summary

Site name	BeaverCr
Site number	5252022
Operator(s)	Lfs
File name	BeaverCr_20220525-130841.ft
Comment	

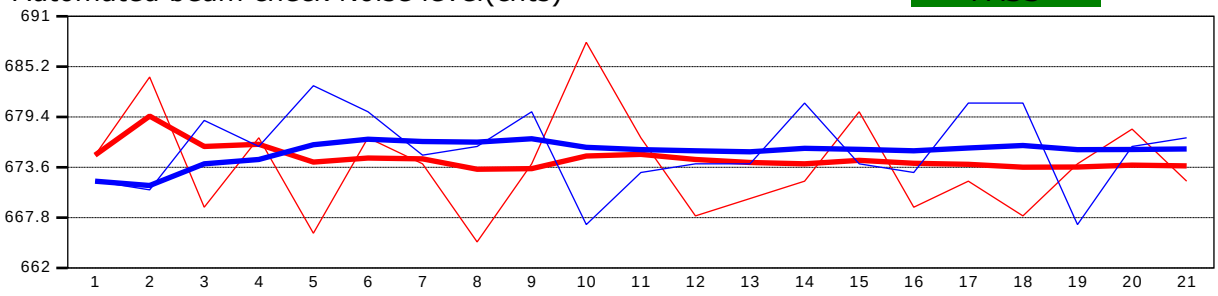
Beam 1	
Beam 2	

Automated beam check Start time 5/25/2022 12:43:10 PM

Automated beam check SNR(dB) PASS



Automated beam check Noise level(cnts) PASS



Automated beam check Quality control warnings

No quality control warnings

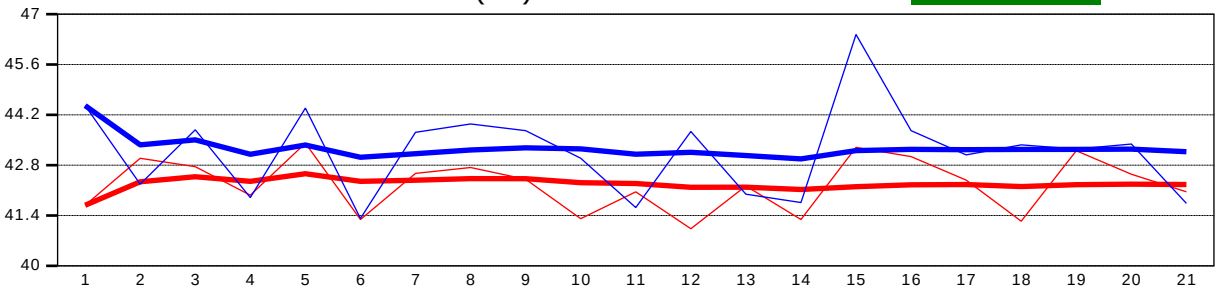
Discharge Measurement Summary

Site name	BeaverCr
Site number	5252022
Operator(s)	Lfs
File name	BeaverCr_20220525-130841.ft
Comment	

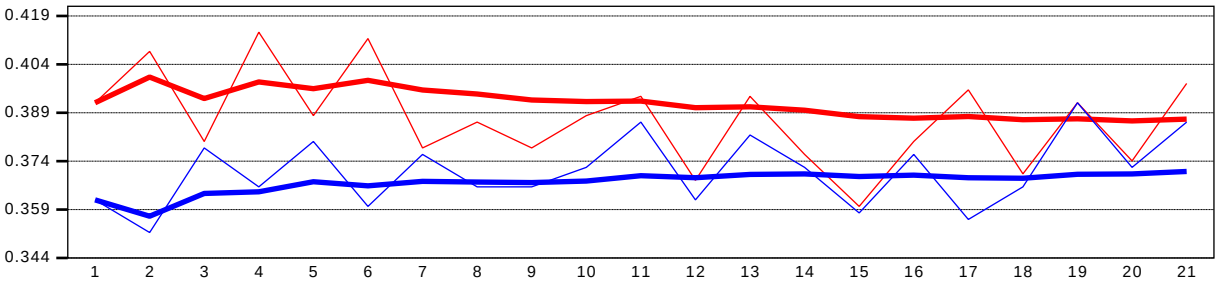
Beam 1	
Beam 2	

Automated beam check Start time 5/25/2022 12:43:10 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

Beaver Dams Creek, Cross Section 1, looking upstream.

Beaver Dams Creek, Cross Section 1, looking downstream.

Beaver Dams Creek, Cross Section 1, looking across from right bank.

Beaver Dams Creek, Cross Section 2, looking upstream.

Beaver Dams Creek, Cross Section 2, looking downstream from left bank.

Beaver Dams Creek, Cross Section 2, looking downstream.