COLORADO
Parks and Wildlife
Department of Natural Resources

Water Resources Section – Aquatic, Terrestrial, and Natural Resources Branch

January 10, 2023

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 Recommendations for Kelly Creek in Water Division 4, Montrose County to be presented at the January 2023 CWCB Meeting

Dear Mr. Viehl:

The information contained in and referred to in this letter forms the scientific and biological basis for an instream flow (ISF) recommendation on Kelly Creek in Water Division 4. The field investigations relating to this ISF recommendation were conducted by Colorado Parks and Wildlife (CPW) staff beginning in 2020. Kelly Creek supports a core conservation population of Colorado River cutthroat trout (CRCT) of the Gunnison Basin lineage. This stream reach was presented to interested parties at the ISF Workshop in January 2020. Outreach was also conducted to the Montrose County Commissioners in November 2022. It is the 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 Kelly Creek and to specifically address the findings required in Rule 5(i) of the Instream Flow Program Rules.

CPW participates in the ISF Program and develops instream flow recommendations for the Board's consideration in an effort to address CPW's legislative declarations "… 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" (See §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." (See §33-10-101 (1) C.R.S.).

In addition to these broad statutory guidelines, CPW's current strategic planning document (CPW Strategic Plan, 2015) explains current agency 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 directed by the State Wildlife Action Plan (2002, Revised 2015). The goals and priorities from these 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 ISF and Natural Lake Level (NLL) Program.

Recommended Segments

CPW is proposing an ISF recommendation on Kelly Creek from its headwaters (located at UTM 12S 219127.685436 4244823.741627) to its confluence with Red Canyon Creek (UTM 12S 221016.683927 4243319.899789). The reach is approximately 1.6 miles in length. All of the proposed reach is on public lands managed as Uncompahgre National Forest.

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). Conservation measures include actions that reduce or eliminate threats that warrant CRCT being listed as a special status species by federal agencies and might lead to listing under the Endangered Species Act of 1973. 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 conservation populations, secure and enhance conservation populations, restore populations, secure and enhance watershed conditions, public outreach, data sharing, and coordination. CPW believes that securing an instream flow water right on Kelly Creek is a conservation action which will support "securing and enhancing conservation populations" by maintaining flows necessary to CRCT in Kelly and Red Canyon Creeks. 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 and conservation of these iconic native trout.

Natural Environment and Biological Summary

Kelly Creek is a tributary of Red Canyon Creek located east of the town of Nucla. The stream drains southeasterly off the west side of the Uncompahgre Plateau. The stream's hydrology is dominated by snowmelt; the basin receives approximately 31 inches of precipitation a year. The drainage basin contributing to the ISF reach is approximately 1.4 square miles in size with a mean basin elevation of 9,458 feet. It is forested, mainly containing stands of aspen interspersed with blue spruce, ponderosa, and scrub oak. Kelly Creek supports a healthy riparian area consisting of willow and alder.

Kelly Creek is a first order headwaters stream. The stream is a high-gradient, single thread channel with some bedrock outcroppings and substrate ranging from small bouder to large sands and gravels. Kelly Creek has a variety of fish habitat including cascading boulder drops which form large pools and ample woody debris and riparian cover. The creek supports a robust macroinvertebrate community including three species of caddisfly, two species of mayflies, aquatic beetle larvae, water strider, and diptera, which were all observed in the field.

The cutthroat trout population in Kelly Creek are fluvial fish considered part of the Red Canyon Creek core conservation population of CRCT. Core conservation population indicates that genetic testing shows greater than 99% purity. CRCT are state species of special concern and considered federally

sensitive species (State Wildlife Action Plan, 2015). Length-frequency data collected by CPW in 2009 and 2017 (see attached) indicates multiple age classes of CRCT. This is evidence that the cutthroat trout in the Red Canyon Creek and Kelly Creek are a self-sustaining population. CPW staff observed cutthroat trout of multiple age classes, including young-of-the-year trout, during R2Cross field investigations to Kelly Creek. Only occular fish surveys have been conducted on Kelly Creek to date.

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 type in streams during low flow events, so maintaining specific 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 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 2021 and 2022, CPW collected the following cross-section data sets on Kelly Creek. The results of the R2Cross analysis are summarized below.

	Bankfull Top Width	Date Measured	Flow Measured	Flow Meeting Two Criteria	Flow Meeting Three Criteria
1	14.3 ft	6/3/2021	0.24 cfs	1.32 cfs	Velocity criterion not reached
2	9.9 ft	5/19/2022	1.483 cfs	0.96 cfs	2.7 cfs
Recommended Flow Rates				**1.1 cfs**	**2.7 cfs**

The initial biological flow recommendation in the winter is 1.1 cfs. This rate during the baseflow period should be protective during the overwintering period by maintaining an average depth of 0.2 feet and percent wetted perimeter of 50 percent of the bankfull top width. The initial biological flow recommendation in the summer is 2.7 cfs, which will maintain these hydraulic parameters in critical riffle transects, as well as average velocity of 1 foot per second (fps).

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[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

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 Kelly Creek. Kelly Creek does not have any gage data, and because it is high-elevation and undeveloped, CPW relied upon regression estimates 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 Recommendation

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 availability limitations during the baseflow period, as well as slight limitations in the summer. Therefore, our flow recommendation has been refined to the following based on water availability:

- April Flow Recommendation (April 1 through April 30): **1.3 cfs**
    - Earlier spring snowmelt may be a reality in a changing climate. This early spring flow recommendation will support spawning conditions for cutthroat trout, a species that spawn during runoff and the receding limb of runoff. This flow recommendation is reduced due to water availability constraints but will support sufficient water depths and wetted perimeter that allows fish to move longitudinally between pools and riffles.
- May Flow Recommendation (May 1 through May 31): **2.6 cfs**
    - Earlier spring snowmelt may be a reality in a changing climate. This spring flow recommendation will support ideal spawning conditions for cutthroat trout. This recommendation has been reduced by 0.1 cfs because of water availability constraints, but sufficient velocity of nearly 1 fps on average will be maintained.
- June Flow Recommendation (June 1 through June 30): **2.7 cfs**
    - Maintains adequate depth, velocity, and wetted perimeter during the month of June when fish are active and moving throughout the creek. This flow rate will support ideal spawning conditions for cutthroat trout.
- July Flow Recommendation (July 1 through July 31): **1.2 cfs**
    - Maintains adequate depth and wetted perimeter and allows fish movement as flows recede after the high flow period. Provides additional refuge habitat during periods when stream and air temperatures are likely to be high.
- Late-Summer to Fall Flow Recommendation (August 1 through October 31): **0.45 cfs**
    - This flow recommendation is reduced due to water availability constraints but will maintain adequate wetted perimeter and available habitat as flows recede to baseflow conditions.
- Baseflow Recommendation (November 1 through March 31): **0.2 cfs**
    - The flow recommendation has been reduced due to water availability constraints but will provide sufficient habitat availability in pools for fish during the overwintering period.

The purpose of this letter is to formally transmit this ISF recommendation to CWCB for the Board's consideration. CPW believes there is a flow-dependent natural environment in Kelly Creek that can be preserved to a reasonable degree with an ISF water right in the recommended rates. Please refer to

[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.

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 2023 CWCB meeting to answer any questions that the Board might have regarding these flow recommendations. We appreciate your consideration.

Sincerely,

Katie Birch

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

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME:					CROSS-SECTION NO.:
CROSS-SECTION LOCATION: Kelly Creek UTM 12S 745688 4242364					
DATE: 6/3/21	OBSERVERS: Birch McDowell				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:		WATER DIVISION:		DOW WATER CODE:
MAP(S):	USGS:				
	USFS:				

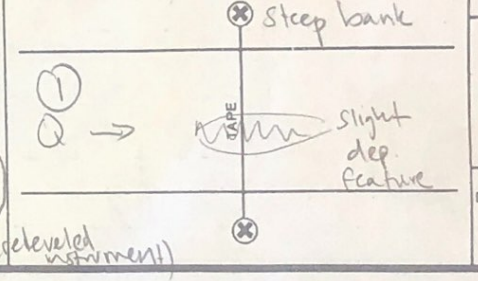
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES (NO)	METER TYPE: Hach			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: small cobble - boulder - bedrock (upstream)	PHOTOGRAPHS TAKEN: (YES)/NO DM	NUMBER OF PHOTOGRAPHS: 4		

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	~~5.50/ 5.47~~
② WS Upstream	14.00	5.01
③ WS Downstream		5.64
SLOPE	4.5%	5.46/5.42

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
Mayfly hatch & aquatic n[illegible]y																	
Stnefly (2), caddis (2)																	
Trout observed in large pools																	

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

COMMENTS

Bench Mark: 5.19 ✓ Q = 0.24 cfs
Flow measured d/s at game trail Xing
Cold, clear water, no recent precip
Hab: good cover (instream & riparian) upland pine & aspen, abundant willow

FORM #ISF FD 1-85

-19.2

5.30

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Kelly creek | CROSS-SECTION NO.: 1 | DATE: | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT (circled: 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 (ft²)	Discharge (cfs)
S	1.9		4.99								
BF	5		5.23								
	7.6		5.30								
RWS	8.2		5.42	0							
~~1~~	~~8.5~~		~~5.41~~								
1	9.0		5.59	.10							
2	9.5		5.52	.05							
3	10.0		5.43	0		mid channel depositional feature currently high + dry					
4.	10.5		5.33	0							
5	11.0		5.38	0							
6	11.5		5.47	0							
7	12.0		5.48	.05							
8	12.5		5.52	.4							
9	13.0		5.52	.3							
10	13.5		5.61	.8							
11	14.0		5.60	.1							
12	14.5		5.58	.1							
13	15.0		5.64	.15							
14	15.5		5.62	.2							
15	16.0		5.72	.28							
16	16.5		5.76	.32							
17	17.0		5.70	.22							
18	17.5		5.59	.13							
LWE 19	18.0		5.46	.0							
	19.2		5.30								
BF	19.6		5.10								
S	20.9		4.84								
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: Kelly Creek					CROSS-SECTION NO.: 22-2
CROSS-SECTION LOCATION: 400 yds u/s of confluence w/ Red Canyon creek UTM 12S 745704 4242311					
DATE: 5/19/22	OBSERVERS: Birch Fields-Summers				
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: FT 2 measured u/s 50 yds @ game xing		
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot / TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE:		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	3.36 / 3.36 (6.56) [illegible]
② WS Upstream	Δ15.6	6.44
③ WS Downstream		7.15
SLOPE	0.045	

SKETCH

TAPE

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:

Weather - Cloudy 70-80°F light downstm wind

COMMENTS

Upland: Aspen, Blue spruce, oak, Columbine - red many, Whit iris - [illegible]y, Purple Bea[illegible]/ complex

2+ Species Caddisfly, 2+ species Mayfly includ flathead, Ponderosa, horsetails

2+ Sp of aquatic beetle larve, Giant water Striders, 3+ Sp. diptera

Q = 1.483 cfs

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Kelly CK	CROSS-SECTION NO.: 22-2	DATE: 5/19	SHEET 1 OF 1
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT (LEFT circled)	Gage Reading: ______ft	TIME: 1:00 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 (ft²)	Discharge (cfs)
BF - under cut bank	0.5		5.95								
WS	1ft ~~4ft~~ ~~1.5ft~~ LFS		~~6.65~~ LFS 6.36								
	~~1ft~~ 1.5		6.65		0.24						
	2ft		6.75		0.31						
	2.5		6.98		0.68						
	3		6.7		0.25						
	3.5		6.49		0.11						
	4		6.92		0.54						
	4.5		6.74		0.33						
	5		6.79		0.39						
	5.5		6.74		0.34						
	6		6.67		0.26						
	6.5		6.59		0.18						
	7		6.58		0.18						
	7.5		6.54		0.16						
	8		6.48 ~~6.44~~ LFS		0.07						
	8.5		6.49		0.09						
	9		6.46		0.08						
	9.5		6.49		0.10						
WS	10		6.36								
BF	10.6		6.10								
	11.1		5.47								
	13.1		5.27								
TOTALS:											

End of Measurement	Time:	Gage Reading: ______ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

Profile Name: KELLY
Operator Name: DM
16:15:39 06.03.2021

Stage Reference: 0.00 ft

Model: FH950
s/n: 210851004850
Boot: v1.00
Application: v1.06

Sensor Type: Velocity Only
s/n: 210900339474
Boot: v1.00
Application: v1.02

Filter: FPA Parameter: 10 s
Pre-filter: On Rank: 5
EMI: 60Hz.

Station Entry: Non-fixed
Flow Calculation: Mid-section
Start Edge: Left edge water
# of Stations: 18
Stream Width: 5.20 ft
Total Discharge: 0.24 ft^3/s
Total Area: 1.16 ft^2
Mean Depth: 0.22 ft

Measurement Results:

Time	Station	Location (ft)	Method	Depth (ft)	Edge Factor	Surface (ft/s)	0.2 (ft/s)	0.4 (ft/s)	0.6 (ft/s)	0.8 (ft/s)	Bed (ft/s)	Average Velocity (ft/s)	Area (ft^2)	Flow (ft^3/s)
16:00:27	1	4.5	0 point	0	-	0	0	0	0	0	0	0	0	0
16:02:48	2	4.8	1 point	0.05	-	0	0	0	0.01	0	0	0.01	0.01	0
16:03:37	3	5.1	1 point	0.1	-	0	0	0	0.3	0	0	0.3	0.03	0.01
16:04:55	4	5.4	1 point	0.2	-	0	0	0	0.43	0	0	0.43	0.06	0.02
16:06:07	5	5.7	1 point	0.3	-	0	0	0	0.32	0	0	0.32	0.09	0.03
16:06:45	6	6	1 point	0.2	-	0	0	0	0.27	0	0	0.27	0.06	0.02
16:07:18	7	6.3	1 point	0.2	-	0	0	0	0.2	0	0	0.2	0.06	0.01
16:08:00	8	6.6	1 point	0.3	-	0	0	0	0.31	0	0	0.31	0.09	0.03
16:08:49	9	6.9	1 point	0.3	-	0	0	0	0.26	0	0	0.26	0.09	0.02
16:09:57	10	7.2	1 point	0.35	-	0	0	0	0.29	0	0	0.29	0.1	0.03
16:10:35	11	7.5	1 point	0.35	-	0	0	0	0.14	0	0	0.14	0.1	0.01
16:11:28	12	7.8	1 point	0.2	-	0	0	0	0.03	0	0	0.03	0.06	0
16:12:01	13	8.1	1 point	0.05	-	0	0	0	0.46	0	0	0.46	0.02	0.01
16:12:45	14	8.5	1 point	0.2	-	0	0	0	0.34	0	0	0.34	0.07	0.02
16:13:13	15	8.8	1 point	0.1	-	0	0	0	0.31	0	0	0.31	0.03	0.01
16:13:42	16	9.1	1 point	0.05	-	0	0	0	0.26	0	0	0.26	0.01	0
16:14:17	17	9.4	1 point	0.05	-	0	0	0	0.58	0	0	0.58	0.01	0.01
16:14:46	18	9.7	1 point	0.05	-	0	0	0	0	0	0	0	0.25	0

Discharge Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.ft
Comment	

Start time	5/19/2022 3:12 PM
End time	5/19/2022 3:42 PM
Start location latitude	38.296
Start location longitude	-108.190
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)
23	40	1.483

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
6.600	2.670	6.963

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
51.674	0.405	0.555

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
51.096	0.650	1.114

Discharge Uncertainty		
Category	**ISO**	**IVE**
Accuracy	1.0%	1.0%
Depth	0.4%	5.5%
Velocity	1.9%	5.2%
Width	0.1%	0.1%
Method	2.1%	
# Stations	2.2%	
Overall	**3.8%**	**7.6%**

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 %

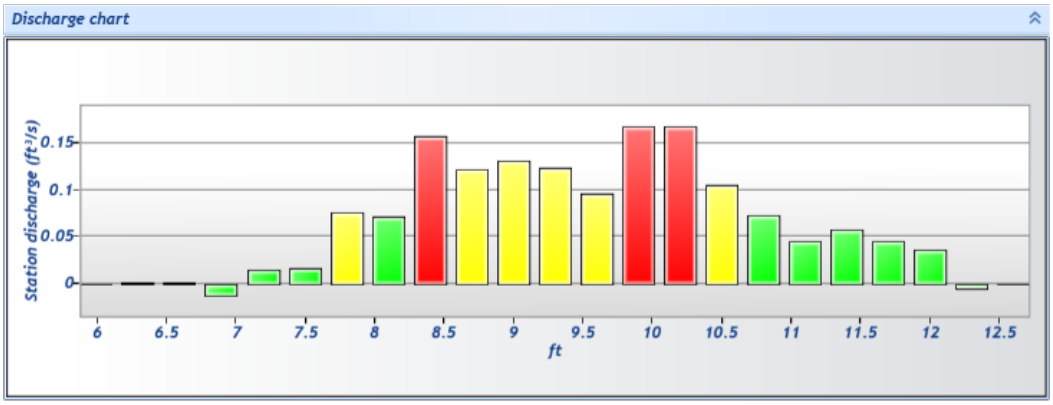
Summary overview

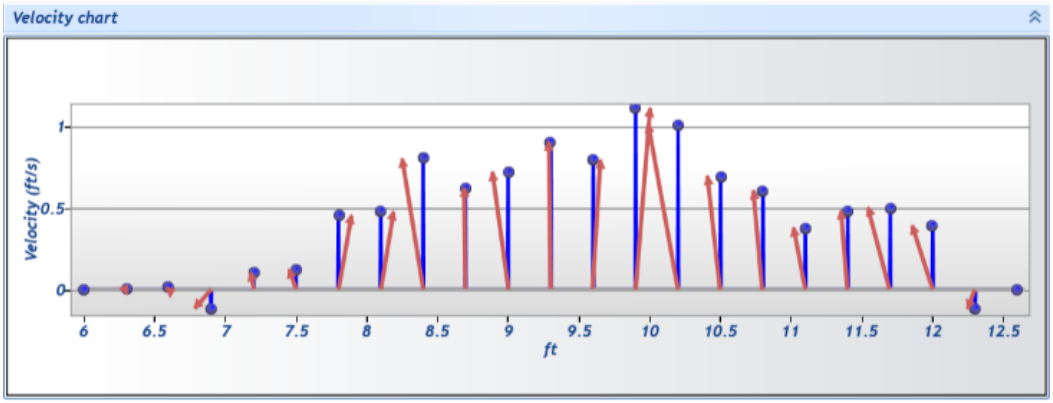
No changes were made to this file
Quality control warnings

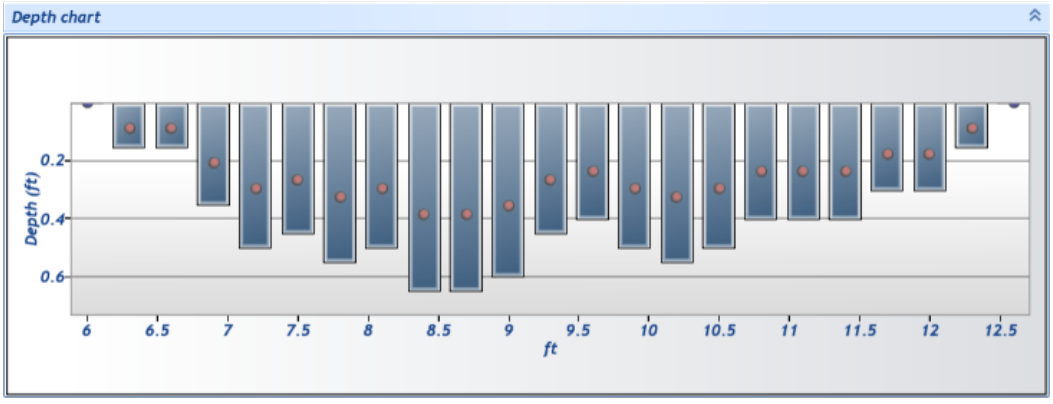
Discharge Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.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 Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.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	3:12 PM	6.000	None	0.000	0.000	0.000	0	0.000		0.006	0.000	0.000	0.000	✓
1	3:13 PM	6.300	0.6	0.150	0.600	0.090	80	0.006	1.000	0.006	0.045	0.000	0.019	✓
2	3:15 PM	6.600	0.6	0.150	0.600	0.090	80	0.009	1.000	0.009	0.045	0.000	0.029	✓
3	3:16 PM	6.900	0.6	0.350	0.600	0.210	80	-0.118	1.000	-0.118	0.105	-0.012	-0.836	✓
4	3:18 PM	7.200	0.6	0.500	0.600	0.300	80	0.102	1.000	0.102	0.150	0.015	1.032	✓
5	3:19 PM	7.500	0.6	0.450	0.600	0.270	80	0.123	1.000	0.123	0.135	0.017	1.117	✓
6	3:21 PM	7.800	0.6	0.550	0.600	0.330	80	0.454	1.000	0.454	0.165	0.075	5.054	✓
7	3:22 PM	8.100	0.6	0.500	0.600	0.300	80	0.477	1.000	0.477	0.150	0.072	4.829	✓
8	3:23 PM	8.400	0.6	0.650	0.600	0.390	80	0.804	1.000	0.804	0.195	0.157	10.569	✓
9	3:25 PM	8.700	0.6	0.650	0.600	0.390	80	0.620	1.000	0.620	0.195	0.121	8.157	✓
10	3:26 PM	9.000	0.6	0.600	0.600	0.360	80	0.722	1.000	0.722	0.180	0.130	8.765	✓
11	3:27 PM	9.300	0.6	0.450	0.600	0.270	80	0.907	1.000	0.907	0.135	0.122	8.253	✓
12	3:28 PM	9.600	0.6	0.400	0.600	0.240	80	0.797	1.000	0.797	0.120	0.096	6.447	✓
13	3:30 PM	9.900	0.6	0.500	0.600	0.300	80	1.114	1.000	1.114	0.150	0.167	11.271	✓
14	3:32 PM	10.200	0.6	0.550	0.600	0.330	80	1.015	1.000	1.015	0.165	0.167	11.290	✓
15	3:33 PM	10.500	0.6	0.500	0.600	0.300	80	0.698	1.000	0.698	0.150	0.105	7.054	✓
16	3:35 PM	10.800	0.6	0.400	0.600	0.240	80	0.608	1.000	0.608	0.120	0.073	4.920	✓
17	3:36 PM	11.100	0.6	0.400	0.600	0.240	80	0.379	1.000	0.379	0.120	0.045	3.065	✓
18	3:37 PM	11.400	0.6	0.400	0.600	0.240	80	0.483	1.000	0.483	0.120	0.058	3.906	✓
19	3:38 PM	11.700	0.6	0.300	0.600	0.180	80	0.503	1.000	0.503	0.090	0.045	3.052	✓
20	3:40 PM	12.000	0.6	0.300	0.600	0.180	80	0.391	1.000	0.391	0.090	0.035	2.373	✓
21	3:41 PM	12.300	0.6	0.150	0.600	0.090	80	-0.121	1.000	-0.121	0.045	-0.005	-0.366	✓
22	3:42 PM	12.600	None	0.000	0.000	0.000	0	0.000		-0.121	0.000	0.000	0.000	✓

Discharge Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.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

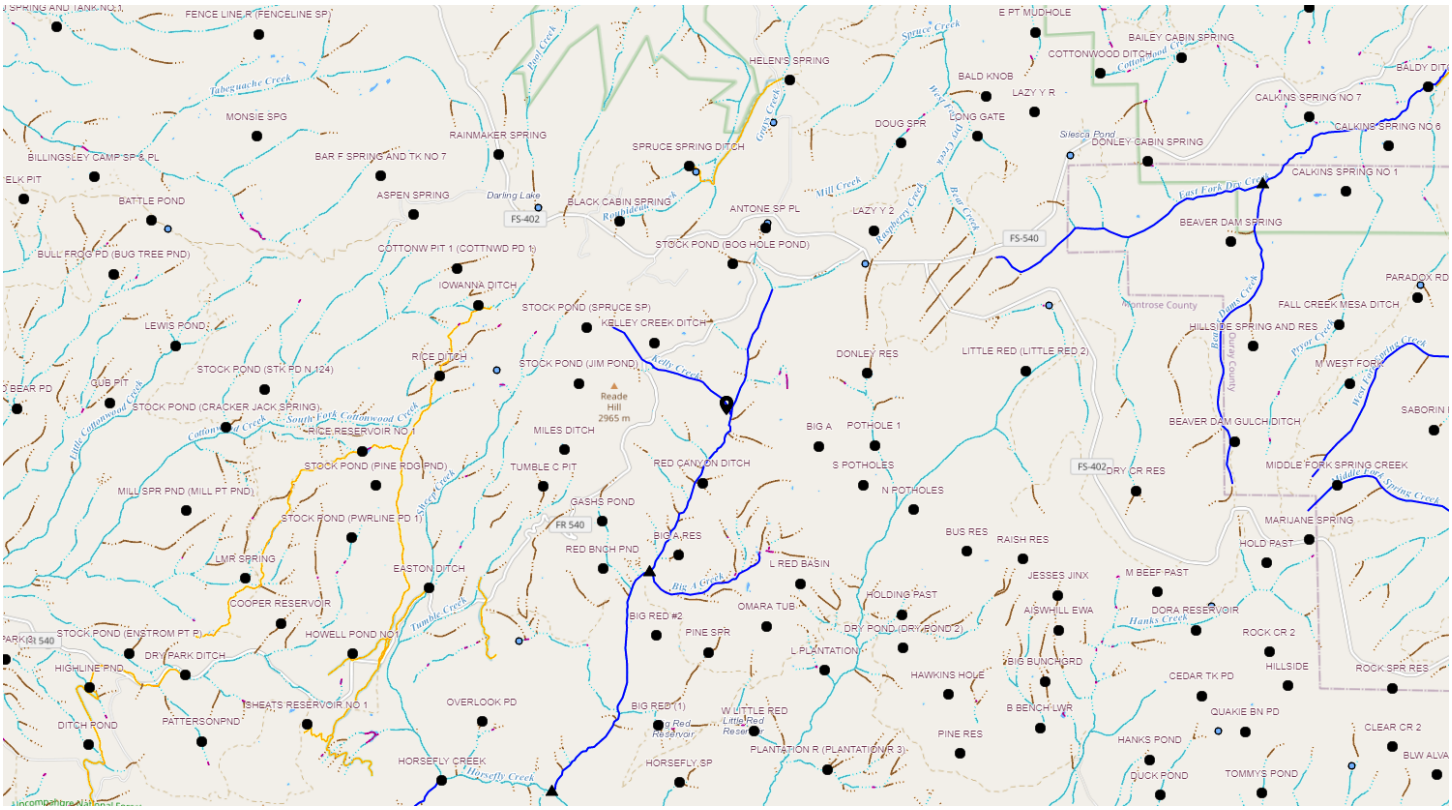
Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
2	3:15 PM	6.600	0.6	0.150	0.600	0.090	Large SNR Variation,SNR Threshold Variation
3	3:16 PM	6.900	0.6	0.350	0.600	0.210	Velocity Angle > QC
5	3:19 PM	7.500	0.6	0.450	0.600	0.270	Velocity Angle > QC
8	3:23 PM	8.400	0.6	0.650	0.600	0.390	Standard Error > QC,High Stn % Discharge
9	3:25 PM	8.700	0.6	0.650	0.600	0.390	Standard Error > QC
10	3:26 PM	9.000	0.6	0.600	0.600	0.360	Standard Error > QC
11	3:27 PM	9.300	0.6	0.450	0.600	0.270	Standard Error > QC
12	3:28 PM	9.600	0.6	0.400	0.600	0.240	Standard Error > QC
13	3:30 PM	9.900	0.6	0.500	0.600	0.300	Standard Error > QC,High Stn % Discharge
14	3:32 PM	10.200	0.6	0.550	0.600	0.330	Standard Error > QC,High Stn % Discharge
15	3:33 PM	10.500	0.6	0.500	0.600	0.300	Standard Error > QC
17	3:36 PM	11.100	0.6	0.400	0.600	0.240	Standard Error > QC
20	3:40 PM	12.000	0.6	0.300	0.600	0.180	Velocity Angle > QC
21	3:41 PM	12.300	0.6	0.150	0.600	0.090	Velocity Angle > QC

R2Cross RESULTS

Stream Name: Kelly Creek
Stream Locations: Red Canyon
Fieldwork Date: 06/03/2021
Cross-section: 1
Observers: Birch/McDowell
Coordinate System: UTM Zone 12
X (easting): 745688
Y (northing): 4242364
Date Processed: 11/22/2022
Slope: 0.045
Discharge: Entered Value: 0.24 (cfs)
Computation method: Ferguson VPE
a1: 6.5
a2: 2.5
R2Cross data filename: R2Cross_Kelly_6_3_2021_1-Q=0.24.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 14.34

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.32
Percent Wetted Perimeter (%)	50.0	0.23
Mean Velocity (ft/s)	NA	NA

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	5.23	14.34	0.24	0.53	3.5	14.49	100.0	0.24	0.15	0.79	2.78
	5.24	13.82	0.24	0.52	3.31	13.97	96.4	0.24	0.16	0.77	2.56
	5.26	13.3	0.24	0.5	3.14	13.45	92.8	0.23	0.16	0.75	2.36
	5.27	12.78	0.23	0.49	2.96	12.92	89.19	0.23	0.16	0.73	2.18
	5.28	12.27	0.23	0.48	2.8	12.4	85.59	0.23	0.16	0.72	2.01
	5.3	11.75	0.22	0.46	2.64	11.88	81.99	0.22	0.16	0.7	1.85
	5.31	11.48	0.22	0.45	2.48	11.61	80.14	0.21	0.17	0.66	1.65
	5.32	11.32	0.21	0.44	2.33	11.44	78.98	0.2	0.18	0.62	1.44
	5.34	11.06	0.2	0.42	2.18	11.18	77.19	0.2	0.18	0.58	1.27
	5.35	10.7	0.19	0.41	2.04	10.82	74.65	0.19	0.19	0.55	1.13
	5.36	10.33	0.18	0.4	1.9	10.45	72.11	0.18	0.19	0.52	0.99
	5.38	9.97	0.18	0.38	1.77	10.08	69.56	0.18	0.2	0.5	0.87
	5.39	9.64	0.17	0.37	1.64	9.75	67.29	0.17	0.21	0.46	0.76
	5.4	9.34	0.16	0.36	1.51	9.44	65.15	0.16	0.21	0.43	0.65
	5.42	9.03	0.15	0.34	1.39	9.13	63.01	0.15	0.22	0.4	0.56
	5.43	8.73	0.15	0.33	1.27	8.82	60.89	0.14	0.23	0.37	0.47
	5.44	8.42	0.14	0.32	1.16	8.51	58.73	0.14	0.24	0.34	0.39
	5.46	8.11	0.13	0.3	1.05	8.2	56.57	0.13	0.26	0.31	0.33
	5.47	7.83	0.12	0.29	0.94	7.91	54.61	0.12	0.27	0.28	0.26
Waterline	5.47	7.83	0.12	0.29	0.94	7.91	54.57	0.12	0.27	0.28	0.26
	5.48	7.12	0.12	0.28	0.84	7.19	49.63	0.12	0.28	0.27	0.23
	5.5	6.76	0.11	0.27	0.75	6.83	47.16	0.11	0.29	0.25	0.19
	5.51	6.41	0.1	0.25	0.66	6.48	44.7	0.1	0.31	0.22	0.15
	5.52	5.57	0.1	0.24	0.58	5.63	38.84	0.1	0.31	0.23	0.13
	5.53	5.29	0.1	0.23	0.51	5.34	36.86	0.1	0.33	0.2	0.1

	5.55	5.0	0.09	0.21	0.44	5.05	34.88	0.09	0.35	0.18	0.08
	5.56	4.72	0.08	0.2	0.38	4.77	32.9	0.08	0.38	0.15	0.06
	5.57	4.44	0.07	0.19	0.32	4.48	30.92	0.07	0.42	0.13	0.04
	5.59	3.9	0.07	0.17	0.26	3.93	27.15	0.07	0.44	0.12	0.03
	5.6	3.27	0.07	0.16	0.21	3.3	22.81	0.06	0.45	0.11	0.02
	5.61	2.6	0.07	0.15	0.18	2.63	18.16	0.07	0.44	0.12	0.02
	5.63	2.21	0.06	0.13	0.14	2.23	15.4	0.06	0.45	0.11	0.02
	5.64	1.67	0.07	0.12	0.12	1.69	11.63	0.07	0.42	0.13	0.01
	5.65	1.54	0.06	0.11	0.1	1.56	10.74	0.06	0.47	0.11	0.01
	5.67	1.41	0.05	0.09	0.08	1.43	9.85	0.05	0.52	0.09	0.01
	5.68	1.29	0.05	0.08	0.06	1.3	8.95	0.05	0.6	0.07	0.0
	5.69	1.16	0.04	0.07	0.04	1.17	8.06	0.04	0.72	0.05	0.0
	5.71	1.01	0.03	0.05	0.03	1.01	6.99	0.03	0.9	0.03	0.0
	5.72	0.83	0.02	0.04	0.02	0.83	5.74	0.02	1.21	0.02	0.0
	5.73	0.55	0.01	0.03	0.01	0.55	3.83	0.01	1.69	0.01	0.0

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

MODEL SUMMARY

Measured Flow (Qm) =	0.24	(cfs)
Calculated Flow (Qc) =	0.25	(cfs)
(Qm-Qc)/Qm * 100 =	-4.06%	
Measured Waterline (WLm) =	5.44	(ft)
Calculated Waterline (WLc) =	5.47	(ft)
(WLm-WLc)/WLm * 100 =	-0.53%	
Max Measured Depth (Dm) =	0.32	(ft)
Max Calculated Depth (Dc) =	0.29	(ft)
(Dm-Dc)/Dm * 100 =	9.01%	
Mean Velocity =	0.27	(ft/s)
Manning's n =	0.287	
a1	6.5	
a2	2.5	
0.4 * Qm =	0.1	(cfs)
2.5 * Qm =	0.6	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	1.8	4.99		
Bankfull	5	5.23		
	7.6	5.3		
Waterline	8.2	5.42	0	
	9	5.59	0.1	
	9.5	5.52	0.05	
	10	5.43	0	
	10.5	5.33	0	
	11	5.38	0	
	11.5	5.47	0	
	12	5.48	0.05	
	12.5	5.52	0.04	
	13	5.52	0.03	
	13.5	5.61	0.08	
	14	5.6	0.1	
	14.5	5.58	0.1	
	15	5.64	0.15	
	15.5	5.62	0.2	
	16	5.72	0.28	
	16.5	5.76	0.32	
	17	5.7	0.22	
	17.5	5.59	0.13	
Waterline	18	5.46	0	
	19.2	5.3	0	
Bankfull	19.6	5.1	0	
	20.9	4.84	0	

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
0.82	0.1	0.07	0.02	6.92
0.5	0.05	0.03	0.01	2.66
0.51	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.5	0.05	0.03	0.01	2.66
0.5	0.04	0.02	0.01	2.13
0.5	0.03	0.01	0	1.6
0.51	0.08	0.04	0.01	4.25
0.5	0.1	0.05	0.01	5.32
0.5	0.1	0.05	0.01	5.32
0.5	0.15	0.07	0.02	7.98
0.5	0.2	0.1	0.03	10.64
0.51	0.28	0.14	0.04	14.89
0.5	0.32	0.16	0.04	17.02
0.5	0.22	0.11	0.03	11.7
0.51	0.13	0.07	0.02	6.92
0.52	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

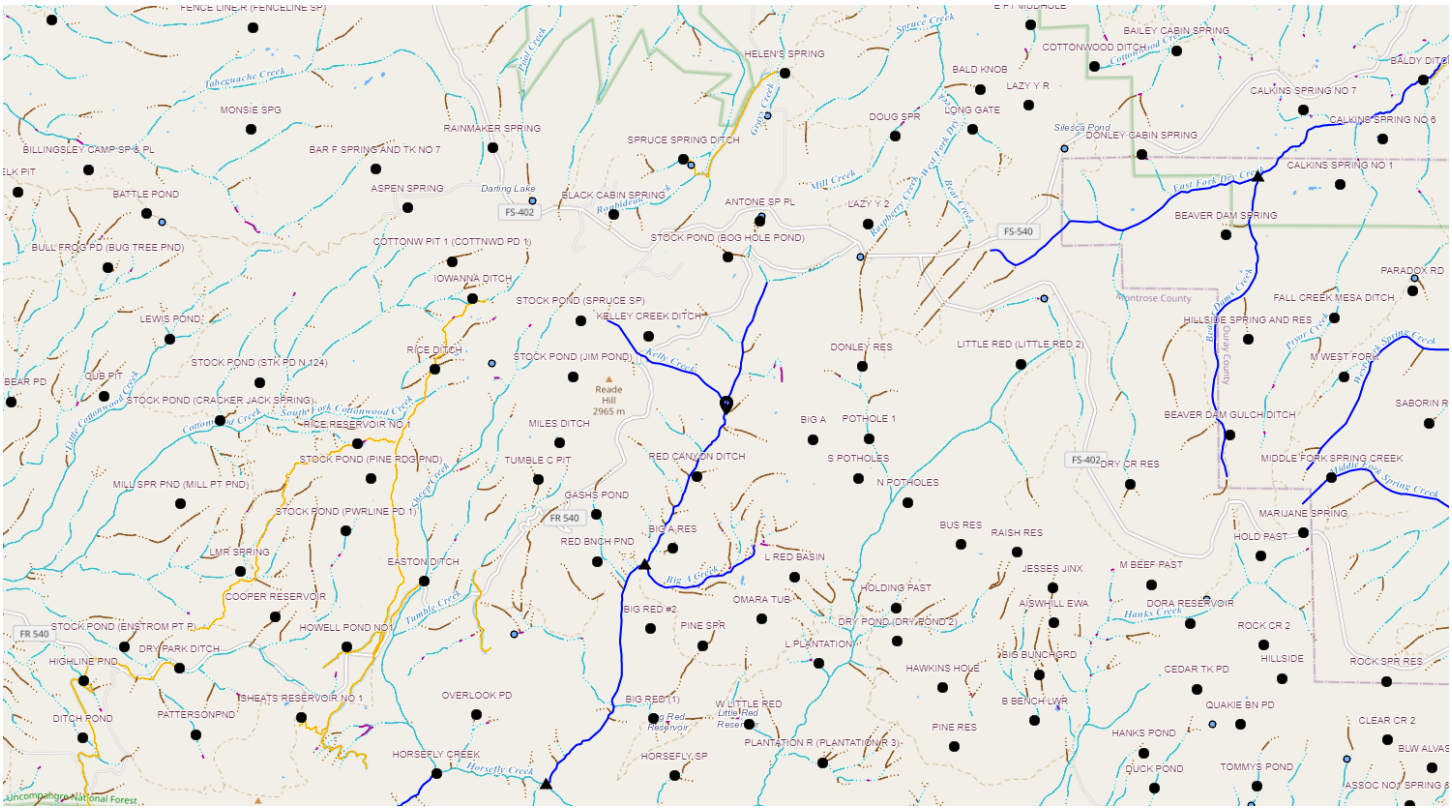
DISCLAIMER

"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: Kelly Creek
Stream Locations: 400 yds u/s of confluence with Red Canyon Creek
Fieldwork Date: 05/19/2022
Cross-section: 2
Observers: Birch Fields-Sommers
Coordinate System: UTM Zone 12
X (easting): 745704
Y (northing): 4242311
Date Processed: 11/22/2022
Slope: 0.0455
Discharge: Entered Value: 1.48 (cfs)
Computation method: Ferguson VPE
a1: 6.5
a2: 2.5
R2Cross data filename: R2Cross_Kelly_5_19_22_2-Q=1.483.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 9.92

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.96
Percent Wetted Perimeter (%)	50.0	0.3
Mean Velocity (ft/s)	1.0	2.7

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	6.1	9.92	0.5	0.88	4.93	10.55	100.0	0.47	0.09	2.05	10.12
	6.12	9.84	0.48	0.86	4.71	10.46	99.15	0.45	0.1	1.95	9.19
	6.14	9.76	0.46	0.84	4.5	10.37	98.29	0.43	0.1	1.85	8.32
	6.17	9.68	0.44	0.81	4.28	10.28	97.44	0.42	0.1	1.75	7.49
	6.19	9.61	0.42	0.79	4.07	10.19	96.59	0.4	0.1	1.65	6.71
	6.21	9.53	0.41	0.77	3.86	10.1	95.73	0.38	0.11	1.55	5.98
	6.23	9.45	0.39	0.75	3.65	10.01	94.88	0.36	0.11	1.45	5.3
	6.25	9.37	0.37	0.73	3.44	9.92	94.03	0.35	0.12	1.35	4.66
	6.28	9.3	0.35	0.7	3.24	9.83	93.17	0.33	0.12	1.26	4.07
	6.3	9.22	0.33	0.68	3.03	9.74	92.32	0.31	0.13	1.16	3.52
	6.32	9.14	0.31	0.66	2.83	9.65	91.47	0.29	0.13	1.06	3.01
	6.34	9.06	0.29	0.64	2.63	9.56	90.61	0.28	0.14	0.97	2.55
	6.36	8.98	0.27	0.62	2.43	9.46	89.69	0.26	0.15	0.88	2.14
	6.39	8.86	0.25	0.59	2.24	9.33	88.44	0.24	0.15	0.79	1.78
Waterline	6.4	8.77	0.24	0.58	2.1	9.24	87.56	0.23	0.16	0.73	1.54
	6.41	8.73	0.23	0.57	2.04	9.2	87.2	0.22	0.16	0.71	1.45
	6.43	8.61	0.22	0.55	1.85	9.07	85.95	0.2	0.18	0.63	1.16
	6.45	8.49	0.2	0.53	1.67	8.94	84.71	0.19	0.19	0.55	0.91
	6.47	7.9	0.19	0.51	1.48	8.34	79.03	0.18	0.2	0.51	0.76
	6.5	6.61	0.2	0.48	1.33	7.04	66.7	0.19	0.19	0.56	0.74
	6.52	6.31	0.19	0.46	1.18	6.72	63.68	0.18	0.2	0.5	0.6
	6.54	6.01	0.17	0.44	1.05	6.4	60.65	0.16	0.21	0.45	0.47
	6.56	5.62	0.16	0.42	0.92	5.99	56.76	0.15	0.22	0.41	0.38
	6.58	5.08	0.16	0.4	0.8	5.43	51.45	0.15	0.23	0.39	0.31
	6.61	4.56	0.15	0.37	0.7	4.89	46.37	0.14	0.23	0.37	0.26

	6.63	4.31	0.14	0.35	0.6	4.62	43.78	0.13	0.25	0.32	0.19
	6.65	4.06	0.12	0.33	0.51	4.34	41.18	0.12	0.28	0.27	0.14
	6.67	3.73	0.11	0.31	0.42	4.0	37.93	0.11	0.3	0.24	0.1
	6.69	3.39	0.1	0.29	0.34	3.64	34.5	0.09	0.33	0.2	0.07
	6.72	3.05	0.09	0.26	0.27	3.29	31.16	0.08	0.37	0.16	0.04
	6.74	2.72	0.08	0.24	0.21	2.94	27.84	0.07	0.42	0.13	0.03
	6.76	2.1	0.07	0.22	0.16	2.3	21.78	0.07	0.43	0.12	0.02
	6.78	1.49	0.08	0.2	0.12	1.66	15.73	0.07	0.42	0.13	0.01
	6.8	1.15	0.08	0.18	0.09	1.3	12.34	0.07	0.43	0.12	0.01
	6.83	0.98	0.07	0.15	0.06	1.11	10.48	0.06	0.49	0.1	0.01
	6.85	0.81	0.06	0.13	0.04	0.91	8.62	0.05	0.56	0.08	0.0
	6.87	0.63	0.05	0.11	0.03	0.71	6.76	0.04	0.66	0.06	0.0
	6.89	0.46	0.04	0.09	0.02	0.52	4.89	0.03	0.79	0.04	0.0
	6.91	0.28	0.03	0.07	0.01	0.32	3.03	0.03	0.92	0.03	0.0
	6.94	0.17	0.02	0.04	0.0	0.2	1.85	0.02	1.21	0.02	0.0
	6.96	0.09	0.01	0.02	0.0	0.1	0.93	0.01	2.16	0.01	0.0

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

MODEL SUMMARY

Measured Flow (Qm) =	1.48	(cfs)
Calculated Flow (Qc) =	1.51	(cfs)
(Qm-Qc)/Qm * 100 =	-1.79%	
Measured Waterline (WLm) =	6.36	(ft)
Calculated Waterline (WLc) =	6.4	(ft)
(WLm-WLc)/WLm * 100 =	-0.65%	
Max Measured Depth (Dm) =	0.58	(ft)
Max Calculated Depth (Dc) =	0.58	(ft)
(Dm-Dc)/Dm * 100 =	0.28%	
Mean Velocity =	0.72	(ft/s)
Manning's n =	0.164	
a1	6.5	
a2	2.5	
0.4 * Qm =	0.59	(cfs)
2.5 * Qm =	3.71	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
Bankfull	0.5	5.95		
Waterline	1	6.36	0	
	1.5	6.65	0.24	
	2	6.75	0.3	
	2.5	6.98	0.58	
	3	6.7	0.25	
	3.5	6.49	0.11	
	4	6.92	0.54	
	4.5	6.74	0.33	
	5	6.79	0.39	
	5.5	6.74	0.34	
	6	6.67	0.26	
	6.5	6.59	0.18	
	7	6.58	0.18	
	7.5	6.54	0.16	
	8	6.48	0.07	
	8.5	6.49	0.09	
	9	6.46	0.08	
	9.5	6.49	0.1	
Waterline	10	6.36	0	
Bankfull	10.6	6.1		
	11.1	5.47		
	13.1	5.27		

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
0.58	0.24	0.12	0.08	5.71
0.51	0.3	0.15	0.11	7.14
0.55	0.58	0.29	0.2	13.81
0.57	0.25	0.12	0.09	5.95
0.54	0.11	0.06	0.04	2.62
0.66	0.54	0.27	0.19	12.86
0.53	0.33	0.17	0.12	7.86
0.5	0.39	0.2	0.14	9.29
0.5	0.34	0.17	0.12	8.1
0.5	0.26	0.13	0.09	6.19
0.51	0.18	0.09	0.06	4.29
0.5	0.18	0.09	0.06	4.29
0.5	0.16	0.08	0.06	3.81
0.5	0.07	0.04	0.02	1.67
0.5	0.09	0.04	0.03	2.14
0.5	0.08	0.04	0.03	1.91
0.5	0.1	0.05	0.04	2.38
0.52	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.

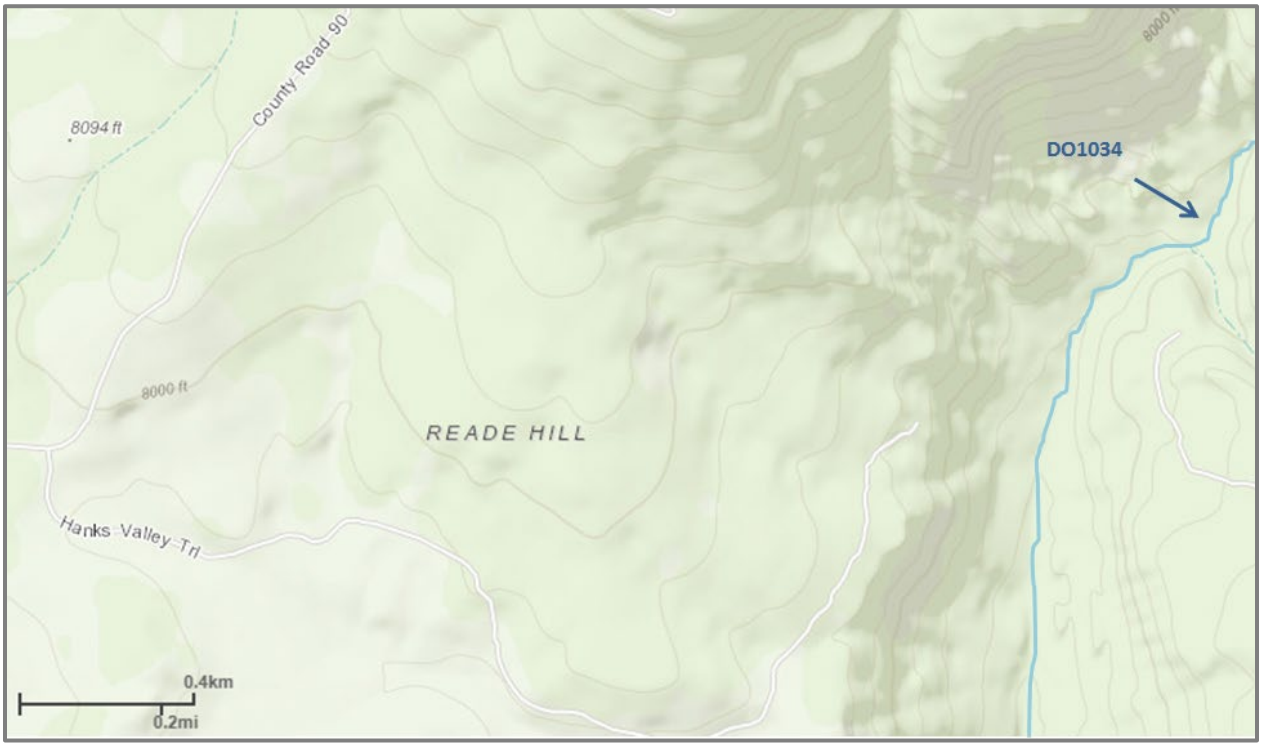
Red Canyon Creek

Eric Gardunio
Aquatic Biologist
Southwest Region

Water: Red Canyon Creek
Location: DO1034
Sampling Date: 9/11/2017
Gear: LR-24 Smith Root backpack electrofisher
Drainage: Dolores
Water Code: 42452

OBJECTIVE

Red Canyon Creek was sampled in 2017 using backpack electrofishing to monitor the status of the conservation population of Colorado River cutthroat trout.



Map 1: Sampling location on Red Canyon Creek (DO1034) sampled in 2017 and 2009.

HISTORY

Red Canyon Creek is currently a Category 202 Native Fish Conservation Management Native cutthroat recovery/conservation stream. Red Canyon Creek is home to a Green Lineage Conservation Population of Colorado River cutthroat trout and was last sampled in July of 2009 when a population of 553 fish per mile was estimated.

RESULTS

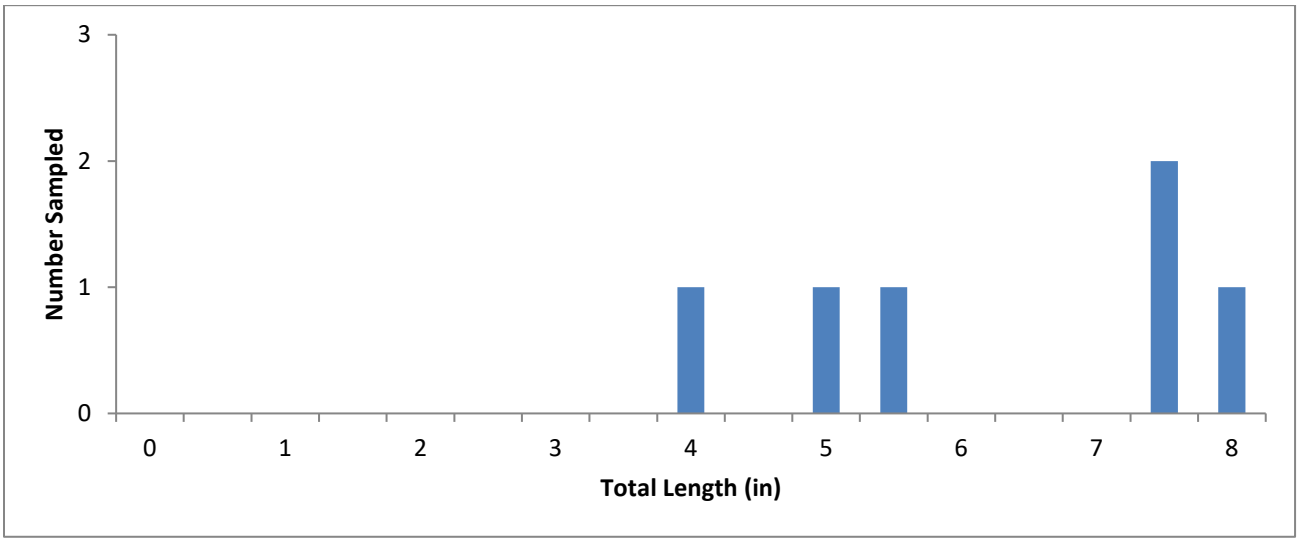


Figure 1: Length frequency histogram for Colorado River cutthroat trout sampled from Red Canyon Creek on September 11, 2017.

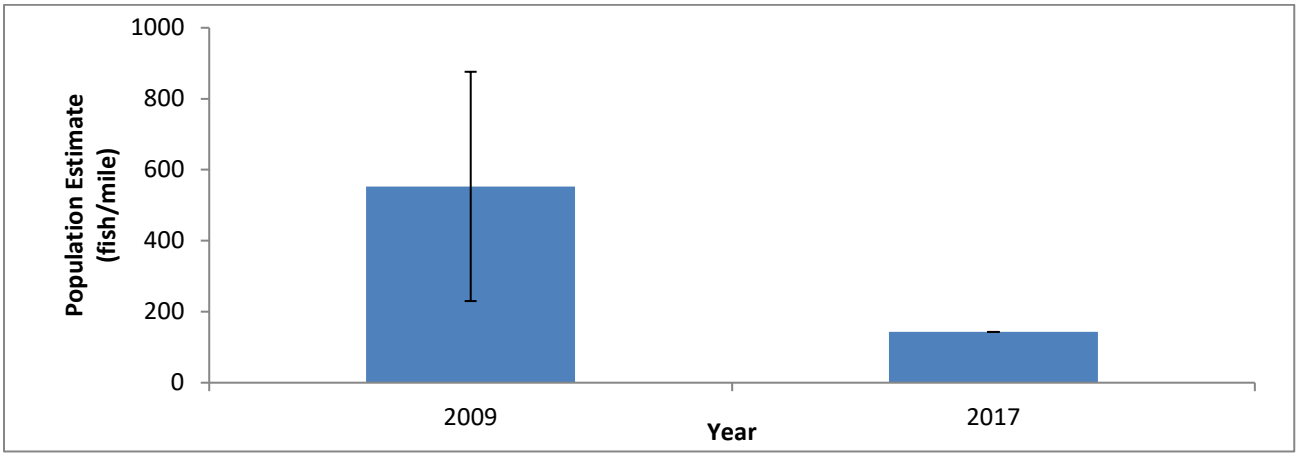


Figure 1: Population estimate (fish/mile) for Colorado River cutthroat trout sampled from Red Canyon Creek on September 11, 2017 and July 6, 2009.

CONCLUSIONS

The Conservation Population of Colorado River cutthroat trout still inhabits Red Canyon Creek, and no other species were sampled in 2017. The 2017 sampling captured cutthroat trout from multiple age classes (Figure 1) indicating that there is natural reproduction occurring. Unfortunately, the population estimate in 2017 was far lower than in 2009 (143 compared to 553 fish/mile; Figure 2). The sampling crew noted that there was a high amount of sediment in the section of stream sampled (pictures 1 and 2) and that the sediment disappeared upstream of the sampling site (DO1034). They also noted that they were seeing more fish upstream of the sampling site, once the sediment decreased. The sediment could be limiting reproduction and invertebrate production within the sampling reach, causing fish to inhabit the better habitat upstream. An effort should be made to identify the source of the sediment, and if it is not a natural occurrence, it should be addressed. Despite the sediment, and the decrease in population, it appears that the Red Canyon Creek population will persist over the near future.

MANAGEMENT RECOMMENDATION SUMMARY

1. *Management:* Maintain current management strategy as Category 202 native cutthroat stream. Monitor in 2-3 years to determine status of population following 2017 decline.
2. *Stocking:* None necessary.
3. *Regulations:* Current regulations of artificial only with catch and release for cutthroat conservation population.
4. *Habitat Improvement*: None needed, but attempt to determine source of sediment at sampling location.
5. *Access/Facilities:* Public access is suitable.
6. *Information/Education:* None needed.


Pictures 1 & 2: Red Canyon Creek taken during 2017 sampling

Picture 3: Colorado River cutthroat trout caught during 2017 Red Canyon Creek sampling

Combined Summaries

Water **42452** Red Canyon Creek

Station **DO1034** ABV Big A Creek

Date **9/11/2017**

Drainage **Dolores River**

UtmX **219665** UtmY **4240892** Elevation **7521 ft**

Length Width Area

Surveyors **Palmer, Temple**

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

Proportional Stocking Density and Catch/Unit Effort

Species	Total Catch	Min Cut inch	Max Cut inch	Total used	Proportional Stock Density (%)	Percent Stock Size	Percent Quality Size	Percent Preferred Size	Percent Memorable Size	Percent Trophy Size	Max Length inches
COLORADO RIVER CUTTHROAT	6	3.94		6	0.00	100.00					8.19

Mean, Minimum and Maximum Length and Weight

Species	Total Catch	Min cut inch	Max cut inch	Total Used	Length (inches) Mean	Minimum	Maximum	Weight (lb) Mean	Minimum	Maximum
COLORADO RIVER CUTTHROAT	6	3.94		6	6.58	4.49	8.19	0.13	0.10	0.15

Relative Abundance and Catch/Unit Effort

Species	Total Catch	Min.Cut inch	Max.Cut inch	Total used	Weight Lbs	Percent Number	Percent Weight	Catch per Unit Effort Number/Effort	Catch per Unit Effort Lbs/Effort
COLORADO RIVER CUTTHROAT	6	3.94		6	0.79	100.00	100.00		

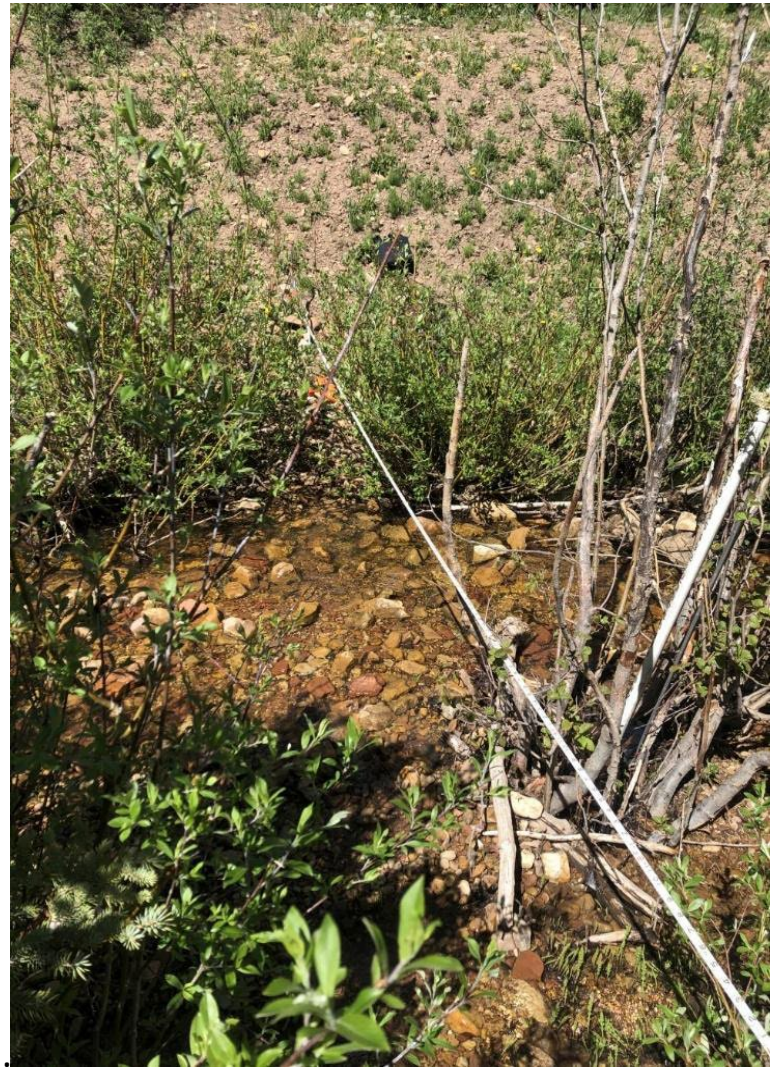
Abundance and Biomass

Species	Total Catch	Min.Cut inch	Max.Cut inch	Total Used	Population estimate	Biomass Lbs	Percent Number	Percent Weight	Density estimates Lb/Acre	Density estimates Fish/Acre	Density estimates Fish/Mile
COLORADO RIVER CUTTHROAT	6	3.94		6	6	0.79	100.00	100.00			

Notes: 2 pass depletion population estimate. Very silty throughout this reach. We hiked up the stream about half a mile past where we ened our reach and it became less silty and saw more fish the further up we went. NO FISH caught on E2. E1 = 1156 seconds and E2 = 1071 seconds. Total electrofishing effort = 2227 seconds.

Kelly Creek Cross Section 1, Looking Upstream

Kelly Creek Cross Section 1, Looking Downstream



Kelly Creek Cross Section 1, Right Bank Overview

Kelly Creek, Fish Habitat Overview

Kelly Creek, Looking upstream of Cross Section 2

Kelly Creek, Benthic Macroinvertebrate (Cased Caddisfly)

Discharge Measurment Field Visit Data Report *(Filters: Name begins with Kelly Creek; Division = 4;)*

Div	Name	CWCB Case Number	Segment ID	Meas. Date	UTM	Location	Flow Amount (cfs)	Meas #	Rating	Station ID
4	Kelly Creek		21/4/A-009	05/19/2022	UTMx: 745704 UTMy: 4242311	Kelly Creek abv Red Canyon Creek confl	1.48	1	g	

Profile Name: KELLY
Operator Name: DM
16:15:39 06.03.2021

Stage Reference: 0.00 ft

Model: FH950
s/n: 210851004850
Boot: v1.00
Application: v1.06

Sensor Type: Velocity Only
s/n: 210900339474
Boot: v1.00
Application: v1.02

Filter: FPA Parameter: 10 s
Pre-filter: On Rank: 5
EMI: 60Hz.

Station Entry: Non-fixed
Flow Calculation: Mid-section
Start Edge: Left edge water
# of Stations: 18
Stream Width: 5.20 ft
Total Discharge: 0.24 ft^3/s
Total Area: 1.16 ft^2
Mean Depth: 0.22 ft

Measurement Results:

Time	Station	Location (ft)	Method	Depth (ft)	Edge Factor	Surface (ft/s)	0.2 (ft/s)	0.4 (ft/s)	0.6 (ft/s)	0.8 (ft/s)	Bed (ft/s)	Average Velocity (ft/s)	Area (ft^2)	Flow (ft^3/s)
16:00:27	1	4.5	0 point	0	-	0	0	0	0	0	0	0	0	0
16:02:48	2	4.8	1 point	0.05	-	0	0	0	0.01	0	0	0.01	0.01	0
16:03:37	3	5.1	1 point	0.1	-	0	0	0	0.3	0	0	0.3	0.03	0.01
16:04:55	4	5.4	1 point	0.2	-	0	0	0	0.43	0	0	0.43	0.06	0.02
16:06:07	5	5.7	1 point	0.3	-	0	0	0	0.32	0	0	0.32	0.09	0.03
16:06:45	6	6	1 point	0.2	-	0	0	0	0.27	0	0	0.27	0.06	0.02
16:07:18	7	6.3	1 point	0.2	-	0	0	0	0.2	0	0	0.2	0.06	0.01
16:08:00	8	6.6	1 point	0.3	-	0	0	0	0.31	0	0	0.31	0.09	0.03
16:08:49	9	6.9	1 point	0.3	-	0	0	0	0.26	0	0	0.26	0.09	0.02
16:09:57	10	7.2	1 point	0.35	-	0	0	0	0.29	0	0	0.29	0.1	0.03
16:10:35	11	7.5	1 point	0.35	-	0	0	0	0.14	0	0	0.14	0.1	0.01
16:11:28	12	7.8	1 point	0.2	-	0	0	0	0.03	0	0	0.03	0.06	0
16:12:01	13	8.1	1 point	0.05	-	0	0	0	0.46	0	0	0.46	0.02	0.01
16:12:45	14	8.5	1 point	0.2	-	0	0	0	0.34	0	0	0.34	0.07	0.02
16:13:13	15	8.8	1 point	0.1	-	0	0	0	0.31	0	0	0.31	0.03	0.01
16:13:42	16	9.1	1 point	0.05	-	0	0	0	0.26	0	0	0.26	0.01	0
16:14:17	17	9.4	1 point	0.05	-	0	0	0	0.58	0	0	0.58	0.01	0.01
16:14:46	18	9.7	1 point	0.05	-	0	0	0	0	0	0	0	0.25	0

Discharge Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.ft
Comment	

Start time	5/19/2022 3:12 PM
End time	5/19/2022 3:42 PM
Start location latitude	38.296
Start location longitude	-108.190
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)
23	40	1.483

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
6.600	2.670	6.963

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
51.674	0.405	0.555

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
51.096	0.650	1.114

Discharge Uncertainty		
Category	**ISO**	**IVE**
Accuracy	1.0%	1.0%
Depth	0.4%	5.5%
Velocity	1.9%	5.2%
Width	0.1%	0.1%
Method	2.1%	
# Stations	2.2%	
Overall	**3.8%**	**7.6%**

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 %

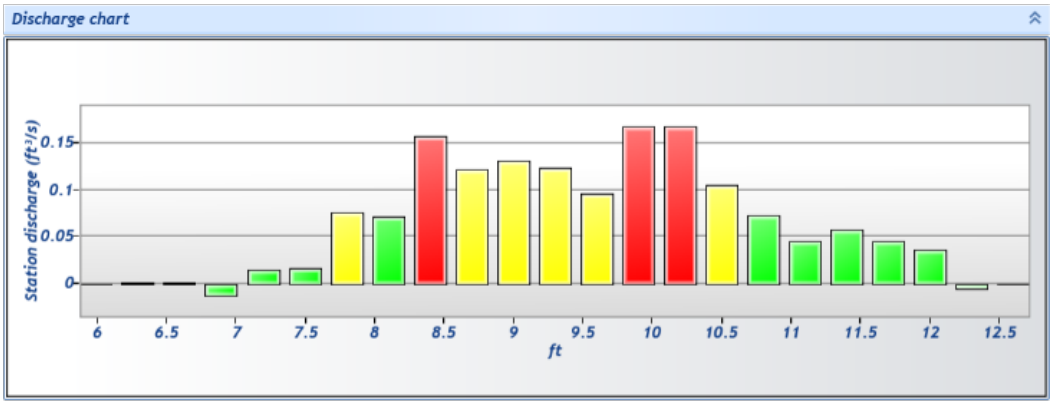
Summary overview

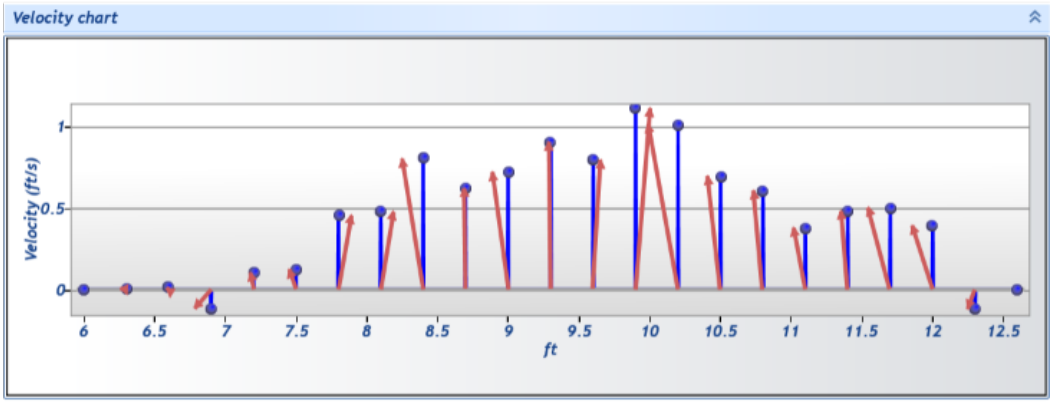
No changes were made to this file
Quality control warnings

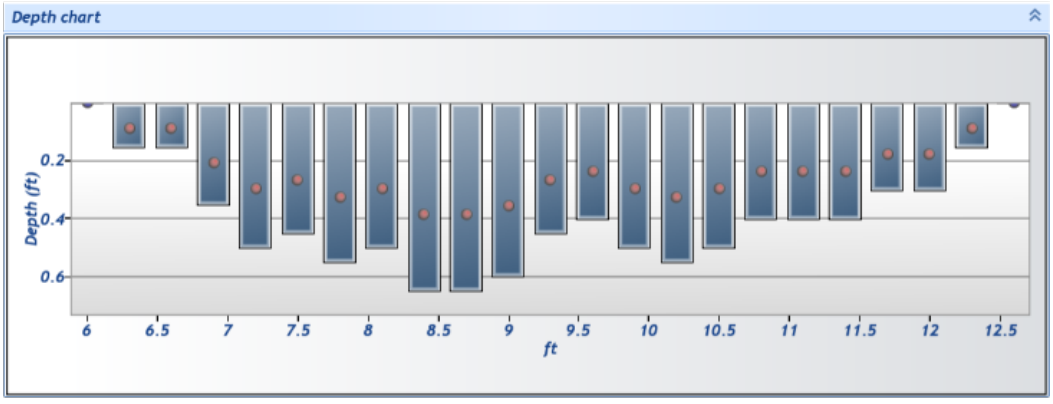
Discharge Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.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 Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.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	3:12 PM	6.000	None	0.000	0.000	0.000	0	0.000		0.006	0.000	0.000	0.000	✓
1	3:13 PM	6.300	0.6	0.150	0.600	0.090	80	0.006	1.000	0.006	0.045	0.000	0.019	✓
2	3:15 PM	6.600	0.6	0.150	0.600	0.090	80	0.009	1.000	0.009	0.045	0.000	0.029	✓
3	3:16 PM	6.900	0.6	0.350	0.600	0.210	80	-0.118	1.000	-0.118	0.105	-0.012	-0.836	✓
4	3:18 PM	7.200	0.6	0.500	0.600	0.300	80	0.102	1.000	0.102	0.150	0.015	1.032	✓
5	3:19 PM	7.500	0.6	0.450	0.600	0.270	80	0.123	1.000	0.123	0.135	0.017	1.117	✓
6	3:21 PM	7.800	0.6	0.550	0.600	0.330	80	0.454	1.000	0.454	0.165	0.075	5.054	✓
7	3:22 PM	8.100	0.6	0.500	0.600	0.300	80	0.477	1.000	0.477	0.150	0.072	4.829	✓
8	3:23 PM	8.400	0.6	0.650	0.600	0.390	80	0.804	1.000	0.804	0.195	0.157	10.569	✓
9	3:25 PM	8.700	0.6	0.650	0.600	0.390	80	0.620	1.000	0.620	0.195	0.121	8.157	✓
10	3:26 PM	9.000	0.6	0.600	0.600	0.360	80	0.722	1.000	0.722	0.180	0.130	8.765	✓
11	3:27 PM	9.300	0.6	0.450	0.600	0.270	80	0.907	1.000	0.907	0.135	0.122	8.253	✓
12	3:28 PM	9.600	0.6	0.400	0.600	0.240	80	0.797	1.000	0.797	0.120	0.096	6.447	✓
13	3:30 PM	9.900	0.6	0.500	0.600	0.300	80	1.114	1.000	1.114	0.150	0.167	11.271	✓
14	3:32 PM	10.200	0.6	0.550	0.600	0.330	80	1.015	1.000	1.015	0.165	0.167	11.290	✓
15	3:33 PM	10.500	0.6	0.500	0.600	0.300	80	0.698	1.000	0.698	0.150	0.105	7.054	✓
16	3:35 PM	10.800	0.6	0.400	0.600	0.240	80	0.608	1.000	0.608	0.120	0.073	4.920	✓
17	3:36 PM	11.100	0.6	0.400	0.600	0.240	80	0.379	1.000	0.379	0.120	0.045	3.065	✓
18	3:37 PM	11.400	0.6	0.400	0.600	0.240	80	0.483	1.000	0.483	0.120	0.058	3.906	✓
19	3:38 PM	11.700	0.6	0.300	0.600	0.180	80	0.503	1.000	0.503	0.090	0.045	3.052	✓
20	3:40 PM	12.000	0.6	0.300	0.600	0.180	80	0.391	1.000	0.391	0.090	0.035	2.373	✓
21	3:41 PM	12.300	0.6	0.150	0.600	0.090	80	-0.121	1.000	-0.121	0.045	-0.005	-0.366	✓
22	3:42 PM	12.600	None	0.000	0.000	0.000	0	0.000		-0.121	0.000	0.000	0.000	✓

Discharge Measurement Summary

Site name	Kelly
Site number	02
Operator(s)	Kb
File name	Kelly_20220519-154336.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
2	3:15 PM	6.600	0.6	0.150	0.600	0.090	Large SNR Variation,SNR Threshold Variation
3	3:16 PM	6.900	0.6	0.350	0.600	0.210	Velocity Angle > QC
5	3:19 PM	7.500	0.6	0.450	0.600	0.270	Velocity Angle > QC
8	3:23 PM	8.400	0.6	0.650	0.600	0.390	Standard Error > QC,High Stn % Discharge
9	3:25 PM	8.700	0.6	0.650	0.600	0.390	Standard Error > QC
10	3:26 PM	9.000	0.6	0.600	0.600	0.360	Standard Error > QC
11	3:27 PM	9.300	0.6	0.450	0.600	0.270	Standard Error > QC
12	3:28 PM	9.600	0.6	0.400	0.600	0.240	Standard Error > QC
13	3:30 PM	9.900	0.6	0.500	0.600	0.300	Standard Error > QC,High Stn % Discharge
14	3:32 PM	10.200	0.6	0.550	0.600	0.330	Standard Error > QC,High Stn % Discharge
15	3:33 PM	10.500	0.6	0.500	0.600	0.300	Standard Error > QC
17	3:36 PM	11.100	0.6	0.400	0.600	0.240	Standard Error > QC
20	3:40 PM	12.000	0.6	0.300	0.600	0.180	Velocity Angle > QC
21	3:41 PM	12.300	0.6	0.150	0.600	0.090	Velocity Angle > QC