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 Main Hubbard Creek in Water Division 4, Delta 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 Main Hubbard Creek in Water Division 4. Field investigations relating to this ISF recommendation were initiated by Colorado Parks and Wildlife (CPW) staff in 2019. In 2024, CPW and Colorado Water Conservation Board (CWCB) staff completed the necessary field data collection to bring this recommendation forward. Main Hubbard 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 Delta County Commissioners in 2024, the North Fork Water Users in 2023 and the Ragged Mountain Water User Association 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 Main Hubbard 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 Main Hubbard Creek from the headwaters (located at UTM 13S 269584.73 4324943.67) to Overland Canal diversion structure (located at UTM 13S 272485.73 4326413.75). The reach is approximately 2.5 miles in length. The proposed reach is entirely on public lands managed under the Grand Mesa 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), 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, and secure and enhance watershed conditions they rely upon. CPW believes that flow protection can be achieved by establishing an ISF water right. This is a measurable conservation action aligned with the goal of "securing and enhancing watershed conditions" and will support the core conservation populations of CRCT which are resident to Main Hubbard Creek. 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 species.

Natural Environment and Biological Summary
Main Hubbard Creek is a tributary of Hubard Creek which flows into the North Fork Gunnison River near the town of Somerset. Main Hubbard Creek is a first order headwaters stream whose hydrology is snow-melt dominated with good baseflows throughout the year. Mean annual precipitation in the basin is approximately 37 inches. The drainage basin contributing to the ISF reach is approximately 1.3 square miles and is densely forested with stands of pine and aspen. Mean basin elevation is 10,300 feet.

Main Hubbard Creek has a high-gradient, confined channel with substrate ranges from small boulder to small gravels with predominantly large cobble and small boulder substrate. There are some gravels suitable for spawning. Fish habitat is complex and includes undercut banks, deep pools, and excellent

cover. There is ample large woody debris in the channel. Step-pools are numerous and mainly created by log jams in the channel. There is ample resting habitat in the pools and beaver dam complexes at the upstream portion of the ISF reach. The creek supports a healthy riparian community. The creek also supports a diverse macroinvertebrate community. Flatheaded mayfly and three species of caddisfly were observed in the field.

Main Hubbard Creek supports a core conservation population of Colorado River cutthroat trout of the Gunnison Basin lineage. Core conservation population indicates the species have very high genetic purity and limited hybridization has occurred with non-native trout species. Length-frequency data from CPW collected in 2007 shows multiple age classes of fish. Multiple age classes indicate that the cutthroat trout are a self-sustaining population with natural recruitment occurring.

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 2021 and 2024, CPW and CWCB staff visited Main Hubbard Creek to collect data upstream of the Overland Canal diversion structure. Streamflows were exceptionally low in 2021 due to the multi-year drought, so streamflow and cross-section results from 2021 will not be incorporated into flow recommendations. The in-range R2Cross results from 2024 are summarized below:

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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

	Bankfull Top Width	Date Measured	Flow Measured	Flow Meeting Two Criteria	Flow Meeting Three Criteria
1	13.08 ft	8/13/2024	0.38 cfs	1.31 cfs	2.75 cfs
2	16.68 ft	8/13/2024	0.38 cfs	1.42 cfs	2.98 cfs
			Recommended Flow Rates:	**1.40 cfs**	**2.86 cfs**

The biological flow recommendation during the baseflow period is 1.40 cfs. This flow rate will be protective by maintaining over 50 percent wetted perimeter in the active stream and average velocity of 1 foot per second (fps) in cross-section one and average depth of 0.2 feet in cross-section two. The biological flow recommendation in the summer is 2.9 cfs. This flow rate will also maintain wetted perimeter, average depth, and average velocity criteria in both surveyed cross-sections.

Water Availability Refined Flow Recommendations

In order to make a preliminary determination where water is available for the R2Cross-based flow recommendations and to determine appropriate seasonal transition dates, CPW examined basic hydrological data and water rights information for Main Hubbard Creek. There is a gage on Main Hubbard Creek that was maintained by the USGS between 1960 and 1968 (USGS '9132700'). This dataset was analyzed by CWCB staff to help inform physical water availability to meet the biological flow recommendations. CPW's analysis indicates that the following flows are needed to protect the natural environment to a reasonable degree. There are water availability limitations during the transitional and baseflow periods. Therefore, CPW's flow recommendations have been refined to the following:

- Baseflow Recommendation (December 1 through March 31): **0.2 cfs**
  - This flow recommendation has been reduced due to water availability constraints but will maintain holding habitats in pools. This will support fish during overwintering periods when metabolic activity is limited, and they are overwintering in discrete habitat features (i.e. not moving longitudinally throughout the stream).
- April Flow Recommendation (April 1 through April 30): **0.6 cfs**
  - This flow recommendation has been reduced due to water availability constraints but will maintain adequate wetted perimeter in riffles and glides and will support plenty of holding habitat in pools. As spring runoff begins, this flow rate will support increased metabolic activity of trout.
- High Flow Recommendation (May 1 through June 30): **2.9 cfs**
  - Maintains adequate depth, velocity, and wetted perimeter during in the time period surrounding spring runoff when resident trout are active feeding and spawning. This flow rate supports ideal conditions for cutthroat trout who spawn in the early months of summer, as well as productivity of the macroinvertebrate community.
- July Flow Recommendation (July 1 through July 31): **2.6 cfs**
  - Maintains sufficient depth, velocity, and wetted perimeter after the receeding limb of runoff. This flow recommendation has been reduced slightly but will support sufficient depth, velocities, and wetted perimeter to support rearing habitats for fish. Longer days and warmer water temperature facilitate growth. This flow rate will provide rearing and refuge habitats during this critical time period.

- Late Summer Flow Recommendation (August 1 through August 31): **0.8 cfs**
  - This flow recommendation will maintain adequate wetted perimeter in riffles and will provide sufficient habitat availability in riffles, pools, and glides. This flow recommendation has been reduced due to water availability constraints but will provide refuge habitats during the late summer period when fish are active and feeding.
- Fall Flow Recommendation (September 1 through November 30): **0.3 cfs**
  - This flow recommendation will provide sufficient habitat availability in deeper habitat features like pools and glides. This flow recommendation has been reduced due to water availability constraints but will provide fish overwintering habitat.

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 Main Hubbard 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 Frequency Data

Water **49355** **Hubbard Creek, Main** Date **8/8/2007**

Station **GU1580** **ABV Overland Ditch Rd @ Gauge**

Drainage **Gunnison River**	UtmX **272455**	UtmY **4326386**	Elevation **2963 m**		
	Length **67 m**	Width **2.58 m**	Area **0.02 Ha**		
Surveyors **FRAME, DEBERARD**					
Gear **NOT LISTED**	Effort **1.00**	Metric **PASS**	Protocol **PRESENCE/ABSENCE**		
Total catch **7**					

Species	Count	Length (mm)	Weight (gm)	Status	Mark	Tag ID	Habitat
CRN	1	70	3	1			A
CRN	1	155	37	1			A
CRN	1	187	65	1			A
CRN	1	176	57	1			A
CRN	1	164	45	1			A
CRN	1	66	2	1			A
CRN	1	73	3	1			A

Notes: N 39.05690 W 107.62920 zero fish on 2nd pass "water 9C, air 14C" GPS

FIELD DATA
FOR
INSTREAM FLOW DETERMINATIONS

COLORADO WATER CONSERVATION BOARD

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Main Hubbard creek	CROSS-SECTION NO.: 1

CROSS-SECTION LOCATION: Above Overland canal
UTM 272336 4326311 (135)

DATE: 8/13/24	OBSERVERS: KB LC

LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:

COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:

MAP(S):	USGS:
	USFS:
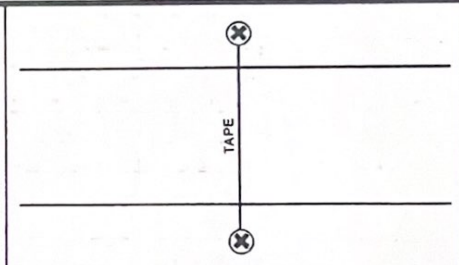
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / (NO)	METER TYPE: FTZ by KB

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)
(X) Tape @ Stake LB	0.0	~
(X) Tape @ Stake RB	0.0	~
(1) WS @ Tape LB/RB	0.0	7.15 / 7.16
(2) WS Upstream	6.76	>15.5
(3) WS Downstream	5.5	
SLOPE		

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

SKETCH

TAPE

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:

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Main Hubbard Creek		CROSS-SECTION NO.: 1	DATE: 8/13/24	SHEET 1 OF 1

BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE)	LEFT / (RIGHT)	Gage Reading: ___ ft	TIME: 11:30 AM

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		0.6		5.78								
		1.9		6.54								
		2.7		7.1								
WS		4.4		7.16	Ø							
		4.8		7.32	0.18							
		5.2		7.27	0.1							
		5.6		7.15	0							
		6.0		7.3	0 HE 0.12							
		6.4		7.23	0.09							
		6.8		7.21	0.12							
		7.2		7.27	0.23							
		7.6		7.19	0.09							
		8.0		7.37	0.25							
		8.4		7.33	0.2							
Rock		8.8		6.96	0							
R		9.2		6.76	0							
		9.6		6.76	0							
		10.0		7.19	0.07							
R		10.4		7.06	0							
		10.8		7.23	0.14							
		11.2		7.22	0.07							
WS		11.6		7.16	Ø							
		12.3		7.1								
		12.7		6.86								
		13.2		6.7								
BF		13.7		5.79								

TOTALS:							

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

FIELD DATA
FOR
INSTREAM FLOW DETERMINATIONS

COLORADO WATER CONSERVATION BOARD

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Main Hubbard Creek	CROSS-SECTION NO.: 2

CROSS-SECTION LOCATION: Above Overland Canal

UTM 13S 272364 4326310

DATE: 8/13/24   OBSERVERS: KB LC

LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:

COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:

| MAP(S) | USGS: |
| | USFS: |
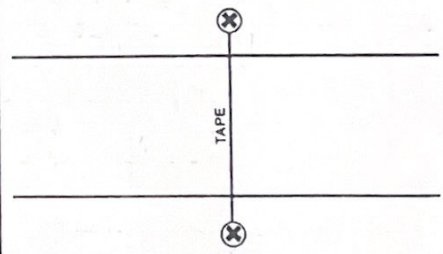
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / (NO)	METER TYPE: FT by KB in downstream glide

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	5.92 / 5.88
② WS Upstream	6.19	> 7.1
③ WS Downstream	6.50	
SLOPE		

SKETCH

TAPE

LEGEND:
Stake ⊗
Station ①
Photo ◇▷
Direction of Flow →

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO	DISTANCE ELECTROFISHED: _____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO

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

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

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

COMMENTS

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Main Hubbard			CROSS-SECTION NO.: 2	DATE: 8/13/24	SHEET 1 OF 1

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

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 Obser-vation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft²)	Discharge (cfs)
BF		3.2		4.84								
		4.9		5.29								
WS		6.1		5.92	0							
		6.7		5.95	0.01							
R		7.3		5.92	0							
		7.9		6.05	0.1							
R		8.5		5.72	0							
		9.1		6.23	0.13							
		9.7		6.23	0.19							
		10.3		6.2	0.2							
		10.9		6.02	0							
		11.5		6.22	0.23							
		12.1		6.25	0.09							
		12.7		6.3	0.2							
		13.2		6.26	0.21							
		13.7		6.3	0.25							
		14.2		6.45	0.4							
		14.7		6.17	0.02							
		15.2		6.11	0.03							
		15.7		6.13	0.12							
		16.2		6.06	0.12							
		16.7		5.75	0							
WS		17.3		5.98								
		18.9		5.61								
		20		4.75								
BF		20.7		4.56								
TOTALS:												

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

R2Cross RESULTS

Stream Name: Main Hubbard Creek
Stream Locations: Above Overland Canal
Fieldwork Date: 08/13/2024
Cross-section: 1
Observers: KB LC
Coordinate System: UTM Zone 13
X (easting): 272336
Y (northing): 4326311
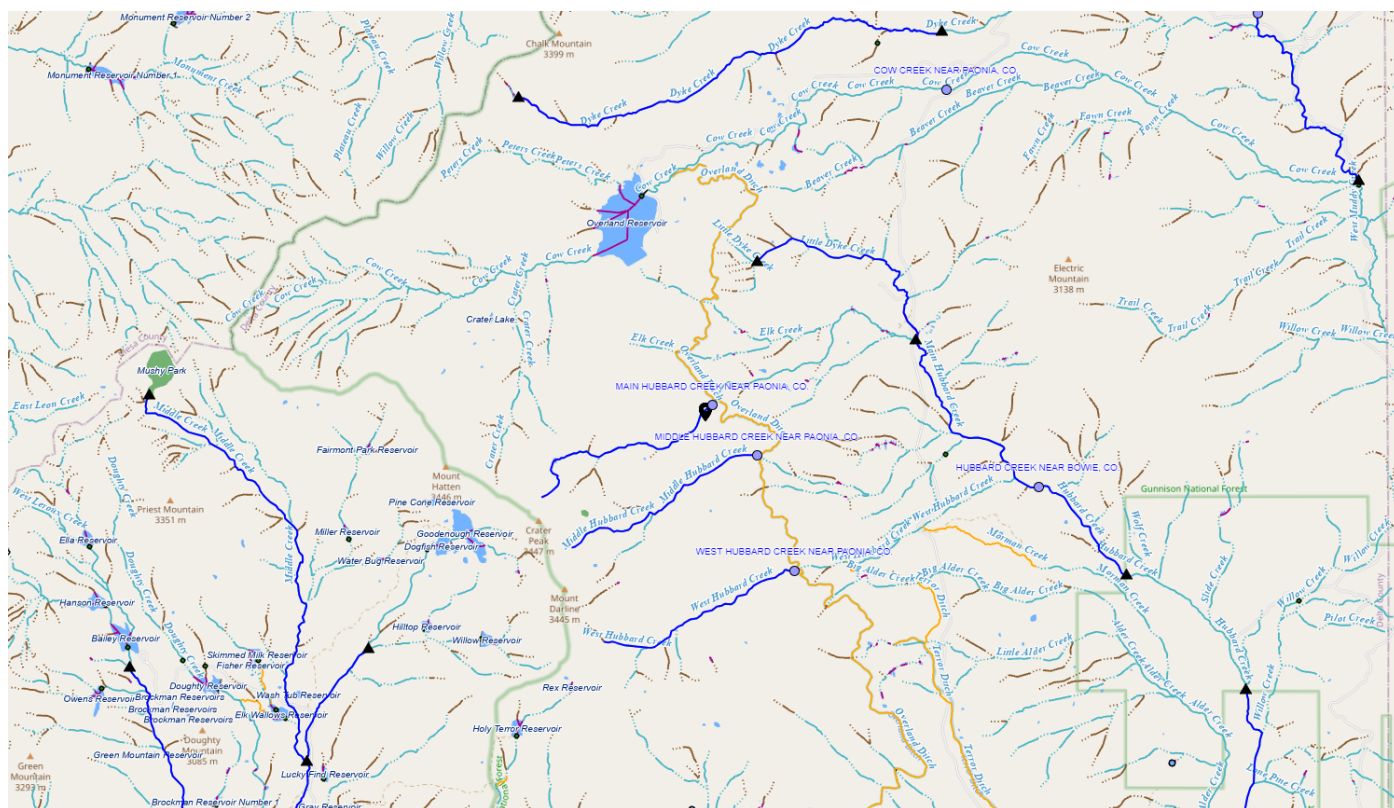**Date Processed:** 09/12/2024
Slope: 0.0813
Discharge: Entered Value: 0.38 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: MainHubbard_R2Cross_XS-1_08-13-24_Q=0.376.xlsx
R2Cross version: 2.0.3

LOCATION

R2Cross RESULTS: Main Hubbard Creek - 08/13/2024 XS 1, Analysis Method: [Ferguson VPE]

ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 13.08

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	2.75
Percent Wetted Perimeter (%)	50.0	0.37
Mean Velocity (ft/s)	1.0	1.31

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	5.79	13.08	1.19	1.58	15.62	14.67	100.0	1.06	0.04	11.86	185.24
	5.82	13.01	1.17	1.55	15.18	14.57	99.28	1.04	0.04	11.62	176.44
	5.87	12.89	1.13	1.5	14.53	14.41	98.21	1.01	0.04	11.27	163.82
	5.92	12.78	1.09	1.45	13.89	14.26	97.15	0.97	0.04	10.91	151.6
	5.97	12.67	1.05	1.4	13.26	14.1	96.09	0.94	0.04	10.55	139.79
	6.02	12.55	1.01	1.35	12.62	13.94	95.02	0.91	0.04	10.17	128.39
	6.07	12.44	0.96	1.3	12.0	13.79	93.96	0.87	0.04	9.78	117.41
	6.12	12.33	0.92	1.25	11.38	13.63	92.89	0.83	0.04	9.39	106.85
	6.17	12.22	0.88	1.2	10.77	13.47	91.83	0.8	0.04	8.98	96.72
	6.22	12.1	0.84	1.15	10.16	13.32	90.77	0.76	0.04	8.57	87.02
	6.27	11.99	0.8	1.1	9.56	13.16	89.7	0.73	0.04	8.14	77.78
	6.32	11.88	0.75	1.05	8.96	13.01	88.64	0.69	0.04	7.7	68.99
	6.37	11.76	0.71	1.0	8.37	12.85	87.57	0.65	0.04	7.25	60.67
	6.42	11.65	0.67	0.95	7.78	12.69	86.51	0.61	0.05	6.79	52.82
	6.47	11.54	0.62	0.9	7.2	12.54	85.45	0.57	0.05	6.31	45.46
	6.52	11.42	0.58	0.85	6.63	12.38	84.38	0.54	0.05	5.82	38.61
	6.57	11.32	0.54	0.8	6.06	12.23	83.37	0.5	0.05	5.32	32.25
	6.62	11.22	0.49	0.75	5.5	12.09	82.39	0.45	0.05	4.8	26.41
	6.67	11.12	0.44	0.7	4.94	11.95	81.41	0.41	0.05	4.28	21.13
	6.72	10.96	0.4	0.65	4.39	11.75	80.08	0.37	0.06	3.76	16.51
	6.77	10.29	0.37	0.6	3.85	11.05	75.3	0.35	0.06	3.45	13.27
	6.82	9.92	0.34	0.55	3.34	10.62	72.36	0.32	0.06	3.02	10.12
	6.87	9.57	0.3	0.5	2.86	10.2	69.54	0.28	0.07	2.59	7.4
	6.92	9.26	0.26	0.45	2.39	9.84	67.06	0.24	0.08	2.13	5.09
	6.97	8.98	0.22	0.4	1.93	9.49	64.65	0.2	0.09	1.67	3.23

R2Cross RESULTS: Main Hubbard Creek - 08/13/2024 XS 1, Analysis Method: [Ferguson VPE]

	7.02	8.72	0.17	0.35	1.49	9.16	62.42	0.16	0.1	1.22	1.81
	7.07	8.39	0.13	0.3	1.06	8.75	59.65	0.12	0.13	0.8	0.84
Waterline	7.12	6.98	0.1	0.25	0.66	7.27	49.52	0.09	0.16	0.53	0.35
	7.17	4.89	0.08	0.2	0.37	5.11	34.81	0.07	0.19	0.38	0.14
	7.22	3.15	0.05	0.15	0.16	3.28	22.38	0.05	0.27	0.21	0.03
	7.27	1.38	0.04	0.1	0.06	1.44	9.81	0.04	0.33	0.15	0.01
	7.32	0.51	0.03	0.05	0.01	0.52	3.57	0.02	0.48	0.07	0.0
	7.36	0.18	0.01	0.01	0.0	0.19	1.28	0.01	1.31	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) =   0.38   (cfs)

Calculated Flow (Qc) =   0.36   (cfs)

(Qm-Qc)/Qm * 100 =   3.09%

Measured Waterline (WLm) =   7.16   (ft)

Calculated Waterline (WLc) =   7.12   (ft)

(WLm-WLc)/WLm * 100 =   0.50%

Max Measured Depth (Dm) =   0.25   (ft)

Max Calculated Depth (Dc) =   0.25   (ft)

(Dm-Dc)/Dm * 100 =   1.57%

Mean Velocity =   0.55   (ft/s)

Manning's n =   0.157

0.4 * Qm =   0.15   (cfs)

2.5 * Qm =   0.94   (cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
Bankfull	0.6	5.78		
	1.9	6.54		
	2.7	7.1		
Waterline	4.4	7.16	0	
	4.8	7.32	0.18	
	5.2	7.27	0.1	
	5.6	7.15	0	
	6	7.3	0.12	
	6.4	7.23	0.09	
	6.8	7.21	0.12	
	7.2	7.27	0.23	
	7.6	7.19	0.09	
	8	7.37	0.25	
	8.4	7.33	0.2	
	8.8	6.96	0	
	9.2	6.76	0	
	9.6	6.76	0	
	10	7.19	0.07	
	10.4	7.06	0	
	10.8	7.23	0.14	
	11.2	7.22	0.07	
Waterline	11.6	7.16	0	
	12.3	7.1		
	12.7	6.86		
	13.2	6.7		
Bankfull	13.7	5.79		

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
0.43	0.18	0.07	0.04	10.84
0.4	0.1	0.04	0.02	6.02
0.42	0	0	0	0
0.43	0.12	0.05	0.03	7.23
0.41	0.09	0.04	0.02	5.42
0.4	0.12	0.05	0.03	7.23
0.4	0.23	0.09	0.05	13.86
0.41	0.09	0.04	0.02	5.42
0.44	0.25	0.1	0.06	15.06
0.4	0.2	0.08	0.05	12.05
0.54	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.59	0.07	0.03	0.02	4.22
0.42	0	0	0	0
0.43	0.14	0.06	0.03	8.43
0.4	0.07	0.03	0.02	4.22
0.4	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: Main Hubbard Creek
Stream Locations: Above Overland Canal
Fieldwork Date: 08/13/2024
Cross-section: 2
Observers: KB LC
Coordinate System: UTM Zone 13
X (easting): 272364
Y (northing): 4326310
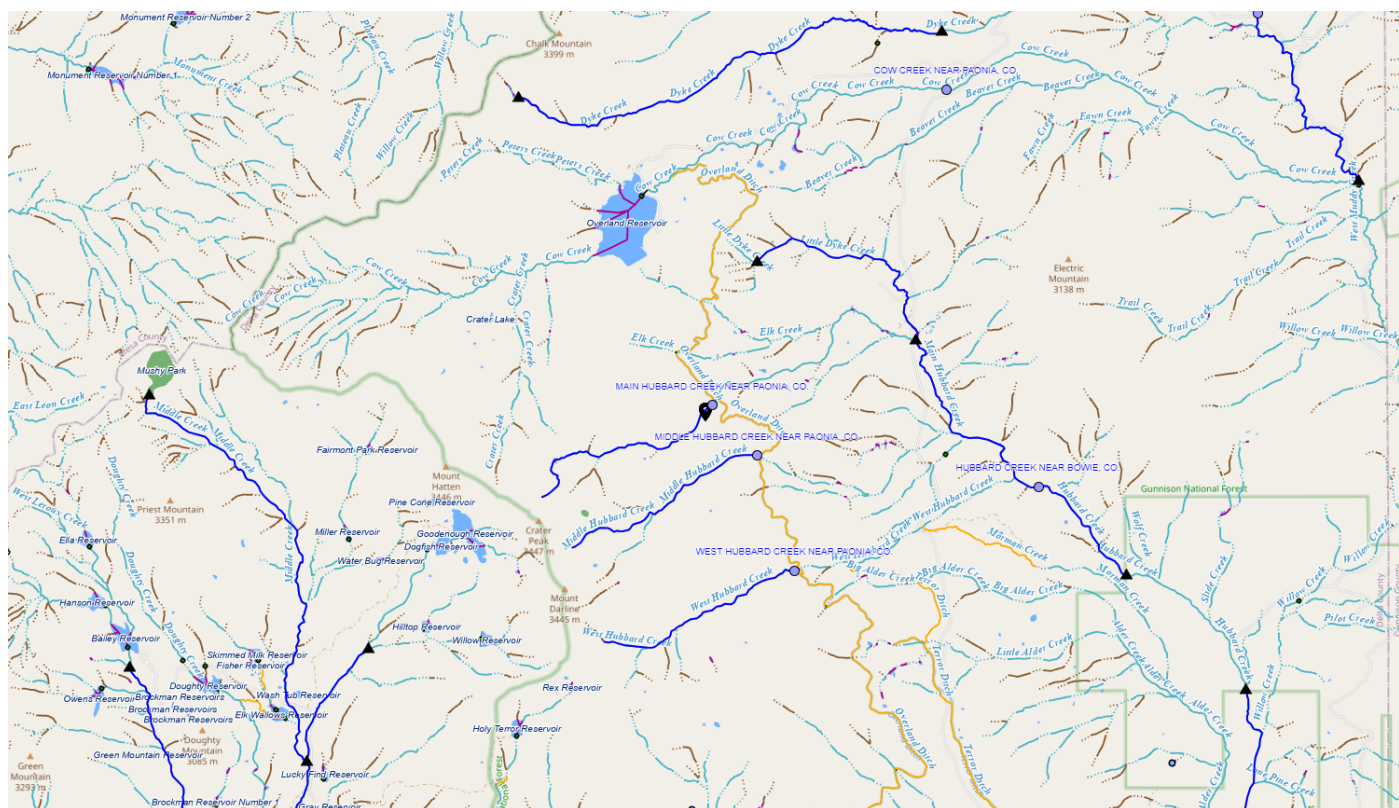**Date Processed:** 09/03/2024
Slope: 0.0437
Discharge: Entered Value: 0.38 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: MainHubbard_R2Cross_XS-2_08-13-24_Q=0.376.xlsx
R2Cross version: 2.0.3

LOCATION

R2Cross RESULTS: Main Hubbard Creek - 08/13/2024 XS 2, Analysis Method: [Ferguson VPE]

ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 16.68

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.04
Percent Wetted Perimeter (%)	50.0	1.42
Mean Velocity (ft/s)	1.0	2.98

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	4.84	16.68	1.04	1.61	17.41	17.79	100.0	0.98	0.05	5.86	102.07
	4.89	16.44	1.01	1.56	16.59	17.52	98.47	0.95	0.05	5.65	93.71
	4.94	16.18	0.98	1.51	15.78	17.24	96.91	0.91	0.05	5.43	85.61
	4.99	15.93	0.94	1.46	14.98	16.97	95.36	0.88	0.05	5.2	77.89
	5.04	15.68	0.9	1.41	14.19	16.69	93.8	0.85	0.06	4.97	70.56
	5.09	15.42	0.87	1.36	13.41	16.42	92.25	0.82	0.06	4.74	63.6
	5.14	15.17	0.83	1.31	12.64	16.14	90.69	0.78	0.06	4.51	57.02
	5.19	14.92	0.8	1.26	11.89	15.86	89.14	0.75	0.06	4.27	50.81
	5.24	14.67	0.76	1.21	11.15	15.59	87.59	0.72	0.06	4.03	44.98
	5.29	14.41	0.72	1.16	10.42	15.31	86.03	0.68	0.06	3.79	39.53
	5.34	14.25	0.68	1.11	9.71	15.12	84.96	0.64	0.07	3.52	34.17
	5.39	14.09	0.64	1.06	9.0	14.93	83.9	0.6	0.07	3.25	29.21
	5.44	13.93	0.6	1.01	8.3	14.74	82.84	0.56	0.07	2.97	24.64
	5.49	13.77	0.55	0.96	7.61	14.55	81.78	0.52	0.07	2.69	20.48
	5.54	13.62	0.51	0.91	6.92	14.36	80.72	0.48	0.08	2.42	16.72
	5.59	13.46	0.46	0.86	6.24	14.18	79.66	0.44	0.08	2.14	13.36
	5.64	13.21	0.42	0.81	5.58	13.9	78.14	0.4	0.09	1.88	10.49
	5.69	12.9	0.38	0.76	4.92	13.57	76.28	0.36	0.1	1.64	8.06
	5.74	12.53	0.34	0.71	4.29	13.17	74.04	0.33	0.1	1.41	6.03
	5.79	11.9	0.31	0.66	3.68	12.48	70.13	0.29	0.11	1.22	4.49
	5.84	11.23	0.28	0.61	3.1	11.73	65.95	0.26	0.12	1.04	3.23
	5.89	10.56	0.24	0.56	2.55	10.99	61.76	0.23	0.14	0.87	2.22
	5.94	9.06	0.23	0.51	2.05	9.42	52.94	0.22	0.14	0.79	1.62
	5.99	7.89	0.21	0.46	1.64	8.19	46.01	0.2	0.15	0.7	1.14
Waterline	6.04	7.3	0.17	0.41	1.25	7.55	42.41	0.17	0.18	0.53	0.67

R2Cross RESULTS: Main Hubbard Creek - 08/13/2024 XS 2, Analysis Method: [Ferguson VPE]

6.09	6.62	0.14	0.36	0.91	6.81	38.3	0.13	0.21	0.38	0.35
6.14	5.21	0.12	0.31	0.61	5.37	30.15	0.11	0.24	0.3	0.18
6.19	4.54	0.08	0.26	0.37	4.66	26.18	0.08	0.33	0.17	0.06
6.24	2.69	0.06	0.21	0.17	2.77	15.58	0.06	0.4	0.12	0.02
6.29	1.18	0.06	0.16	0.07	1.25	7.0	0.05	0.44	0.1	0.01
6.34	0.57	0.06	0.11	0.03	0.61	3.44	0.05	0.46	0.09	0.0
6.39	0.31	0.03	0.06	0.01	0.34	1.88	0.03	0.76	0.04	0.0
6.43	0.08	0.01	0.01	0.0	0.08	0.47	0.01	2.44	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) =	0.38	(cfs)
Calculated Flow (Qc) =	0.49	(cfs)
(Qm-Qc)/Qm * 100 =	-29.67%	
Measured Waterline (WLm) =	5.95	(ft)
Calculated Waterline (WLc) =	6.04	(ft)
(WLm-WLc)/WLm * 100 =	-1.50%	
Max Measured Depth (Dm) =	0.4	(ft)
Max Calculated Depth (Dc) =	0.41	(ft)
(Dm-Dc)/Dm * 100 =	-2.66%	
Mean Velocity =	0.39	(ft/s)
Manning's n =	0.242	
0.4 * Qm =	0.15	(cfs)
2.5 * Qm =	0.94	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
Bankfull	3.2	4.84		
	4.9	5.29		
Waterline	6.1	5.92	0	
	6.7	5.95	0.01	
	7.3	5.92	0	
	7.9	6.05	0.1	
	8.5	5.72	0	
	9.1	6.23	0.13	
	9.7	6.23	0.19	
	10.3	6.2	0.2	
	10.9	6.02	0	
	11.5	6.22	0.23	
	12.1	6.25	0.09	
	12.7	6.3	0.2	
	13.2	6.26	0.21	
	13.7	6.3	0.25	
	14.2	6.45	0.4	
	14.7	6.17	0.02	
	15.2	6.11	0.03	
	15.7	6.13	0.12	
	16.2	6.06	0.12	
	16.7	5.75	0	
Waterline	17.3	5.98	0	
	18.9	5.61		
Bankfull	20	4.75		
	20.7	4.56		

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
0.6	0.01	0.01	0	0.48
0.6	0	0	0	0
0.61	0.1	0.06	0.02	4.78
0.68	0	0	0	0
0.79	0.13	0.08	0.02	6.21
0.6	0.19	0.11	0.03	9.08
0.6	0.2	0.12	0.04	9.56
0.63	0	0	0	0
0.63	0.23	0.14	0.04	11
0.6	0.09	0.05	0.02	4.3
0.6	0.2	0.11	0.03	8.77
0.5	0.21	0.1	0.03	8.37
0.5	0.25	0.12	0.04	9.96
0.52	0.4	0.2	0.06	15.94
0.57	0.02	0.01	0	0.8
0.5	0.03	0.01	0	1.2
0.5	0.12	0.06	0.02	4.78
0.5	0.12	0.06	0.02	4.78
0.59	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

DISCLAIMER

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

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

Div	Name	CWCB Case Number	Segment ID	Meas. Date	UTM	Location	Flow Amount (cfs)	Meas #	Standard Error	Station ID
4	Main Hubbard Creek		4-84CW412	08/03/2018	UTMx: 275813 UTMy: 4327377	Main Hubbard upstream of Hubbard Park Rd, at culvert.	0.165	1	>8%	Main Hubbard
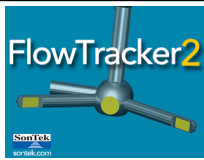
Discharge Measurement Summary

Site name	Mainhubbard
Site number	081324
Operator(s)	Kb
File name	Mainhubbard_20240813-193751.ft
Comment	

Start time	8/13/2024 7:18 PM	Sensor type	Top Setting
End time	8/13/2024 7:37 PM	Handheld serial number	FT2H2113010
Start location latitude	-	Probe serial number	FT2P2114008
Start location longitude	-	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
20	40	0.376

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
5.700	2.010	6.011

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
38.935	0.353	0.187

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
49.479	0.600	0.261

Discharge Uncertainty

Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	6.2%
Velocity	0.9%	4.0%
Width	0.1%	0.1%
Method	2.1%	
# Stations	2.5%	
Overall	3.5%	7.4%

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
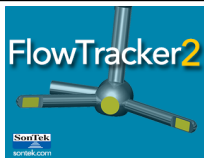
Discharge Measurement Summary

Site name	Mainhubbard
Site number	081324
Operator(s)	Kb
File name	Mainhubbard_20240813-193751.ft
Comment	

Station Warning Settings

Station discharge OK	Station discharge < 5.000%	(green)
Station discharge caution	5.000% >= Station discharge < 10.000%	(yellow)
Station discharge warning	Station discharge >= 10.000%	(red)
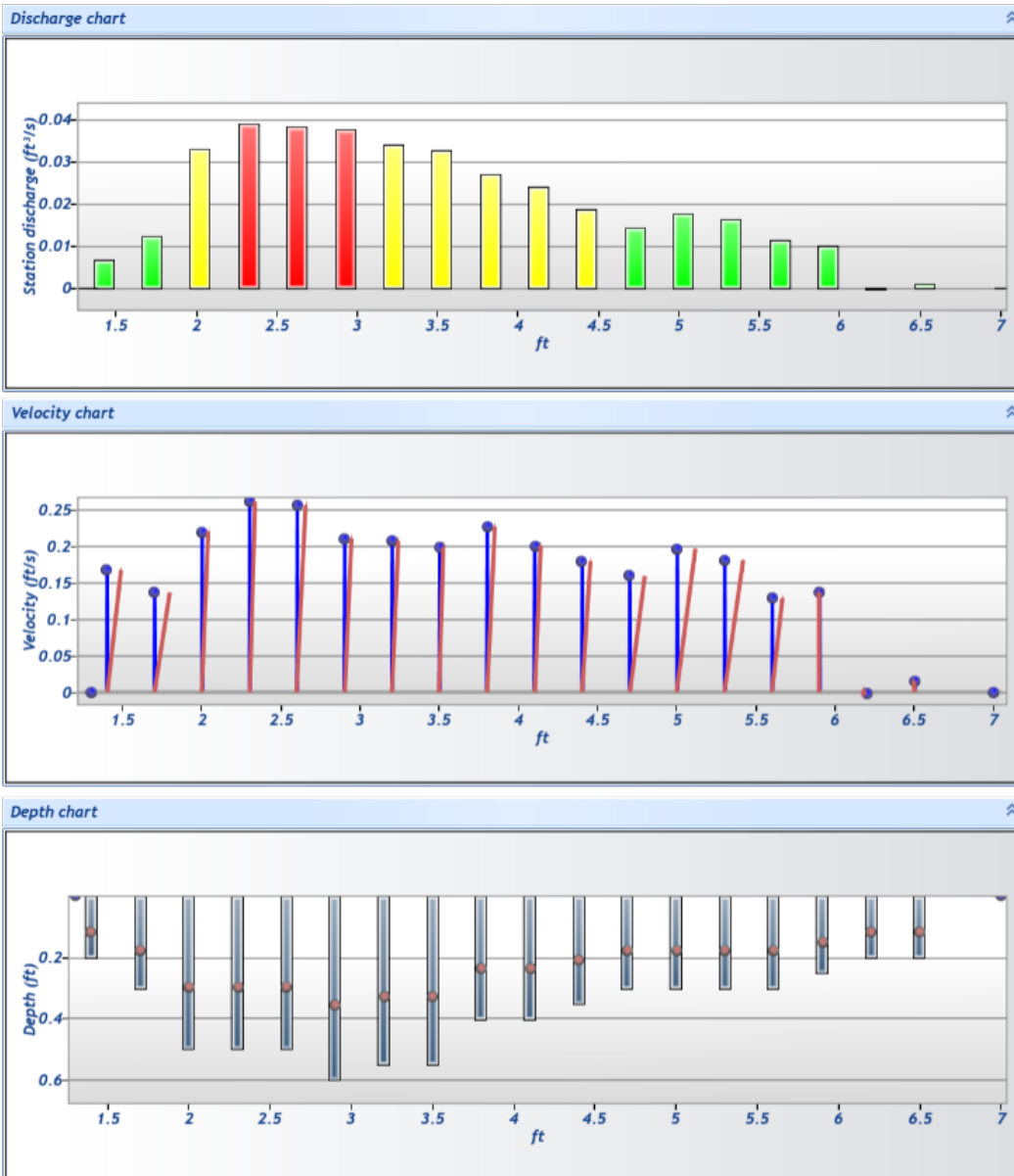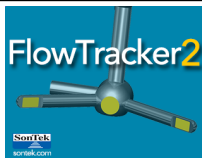
Discharge chart

Velocity chart

Depth chart

9/12/2024 3:39:49 PM

Discharge Measurement Summary

Site name	Mainhubbard
Site number	081324
Operator(s)	Kb
File name	Mainhubbard_20240813-193751.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	7:18 PM	1.300	None	0.000	0.000	0.000	0	0.000		0.167	0.000	0.000	0.000	✓
1	7:18 PM	1.400	0.6	0.200	0.600	0.120	62	0.167	1.000	0.167	0.040	0.007	1.779	✓
2	7:19 PM	1.700	0.6	0.300	0.600	0.180	80	0.137	1.000	0.137	0.090	0.012	3.277	✓
3	7:20 PM	2.000	0.6	0.500	0.600	0.300	62	0.220	1.000	0.220	0.150	0.033	8.769	✓
4	7:21 PM	2.300	0.6	0.500	0.600	0.300	62	0.261	1.000	0.261	0.150	0.039	10.421	✓
5	7:22 PM	2.600	0.6	0.500	0.600	0.300	62	0.256	1.000	0.256	0.150	0.038	10.235	✓
6	7:23 PM	2.900	0.6	0.600	0.600	0.360	62	0.210	1.000	0.210	0.180	0.038	10.083	✓
7	7:24 PM	3.200	0.6	0.550	0.600	0.330	62	0.207	1.000	0.207	0.165	0.034	9.089	✓
8	7:25 PM	3.500	0.6	0.550	0.600	0.330	62	0.199	1.000	0.199	0.165	0.033	8.723	✓
9	7:26 PM	3.800	0.6	0.400	0.600	0.240	62	0.227	1.000	0.227	0.120	0.027	7.235	✓
10	7:27 PM	4.100	0.6	0.400	0.600	0.240	61	0.200	1.000	0.200	0.120	0.024	6.403	✓
11	7:28 PM	4.400	0.6	0.350	0.600	0.210	62	0.179	1.000	0.179	0.105	0.019	5.012	✓
12	7:29 PM	4.700	0.6	0.300	0.600	0.180	73	0.159	1.000	0.159	0.090	0.014	3.814	✓
13	7:30 PM	5.000	0.6	0.300	0.600	0.180	80	0.196	1.000	0.196	0.090	0.018	4.705	✓
14	7:31 PM	5.300	0.6	0.300	0.600	0.180	62	0.181	1.000	0.181	0.090	0.016	4.334	✓
15	7:32 PM	5.600	0.6	0.300	0.600	0.180	62	0.129	1.000	0.129	0.090	0.012	3.082	✓
16	7:33 PM	5.900	0.6	0.250	0.600	0.150	62	0.136	1.000	0.136	0.075	0.010	2.724	✓
17	7:34 PM	6.200	0.6	0.200	0.600	0.120	80	-0.002	1.000	-0.002	0.060	0.000	-0.025	✓
18	7:35 PM	6.500	0.6	0.200	0.600	0.120	62	0.016	1.000	0.016	0.080	0.001	0.340	✓
19	7:37 PM	7.000	None	0.000	0.000	0.000	0	0.000		0.016	0.000	0.000	0.000	✓
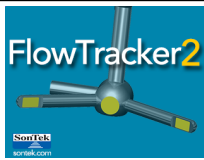
Discharge Measurement Summary

Site name	Mainhubbard
Site number	081324
Operator(s)	Kb
File name	Mainhubbard_20240813-193751.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
1	7:18 PM	1.400	0.6	0.200	0.600	0.120	Boundary Interference, Velocity Angle > QC
2	7:19 PM	1.700	0.6	0.300	0.600	0.180	Boundary Interference, Velocity Angle > QC
4	7:21 PM	2.300	0.6	0.500	0.600	0.300	High Stn % Discharge
5	7:22 PM	2.600	0.6	0.500	0.600	0.300	High Stn % Discharge
6	7:23 PM	2.900	0.6	0.600	0.600	0.360	High Stn % Discharge
12	7:29 PM	4.700	0.6	0.300	0.600	0.180	Velocity Angle > QC
13	7:30 PM	5.000	0.6	0.300	0.600	0.180	Boundary Interference, Velocity Angle > QC
14	7:31 PM	5.300	0.6	0.300	0.600	0.180	Boundary Interference, Velocity Angle > QC
15	7:32 PM	5.600	0.6	0.300	0.600	0.180	Velocity Angle > QC
17	7:34 PM	6.200	0.6	0.200	0.600	0.120	Large SNR Variation
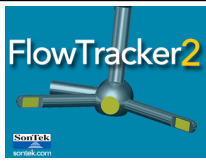
Discharge Measurement Summary

Site name	Mainhubbard
Site number	081324
Operator(s)	Kb
File name	Mainhubbard_20240813-193751.ft
Comment	

Beam 1	
Beam 2	

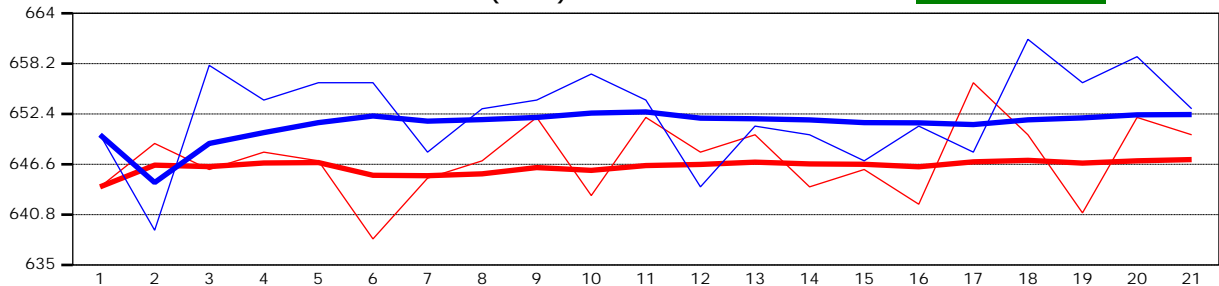Automated beam check Start time 8/13/2024 7:17:41 PM

Automated beam check SNR(dB)　　　　　PASS
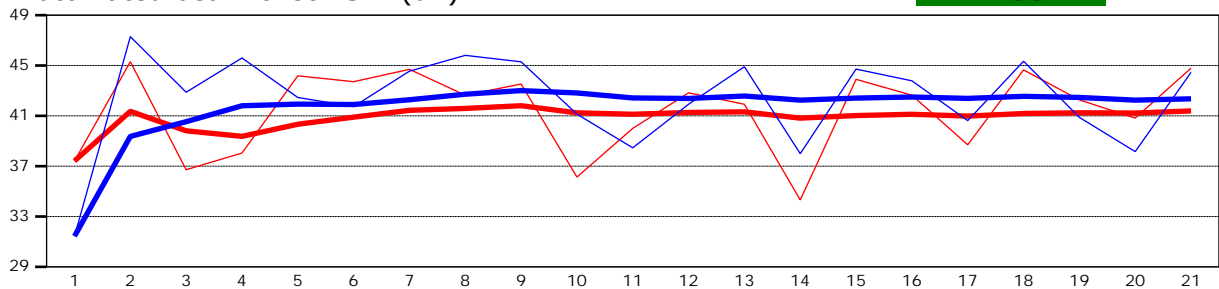
Automated beam check Noise level(cnts)　　　　　PASS

Automated beam check Quality control warnings
No quality control warnings
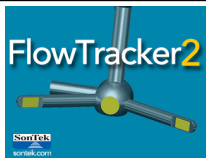
9/12/2024 3:39:49 PM

Discharge Measurement Summary

Site name	Mainhubbard
Site number	081324
Operator(s)	Kb
File name	Mainhubbard_20240813-193751.ft
Comment	

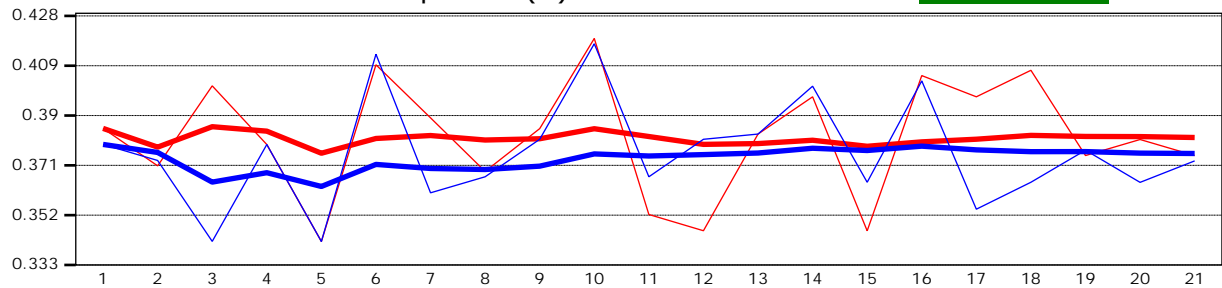|	
Beam 1	🟥
Beam 2	🟦

Automated beam check Start time 8/13/2024 7:17:41 PM

Automated beam check Peak level(dB)   PASS
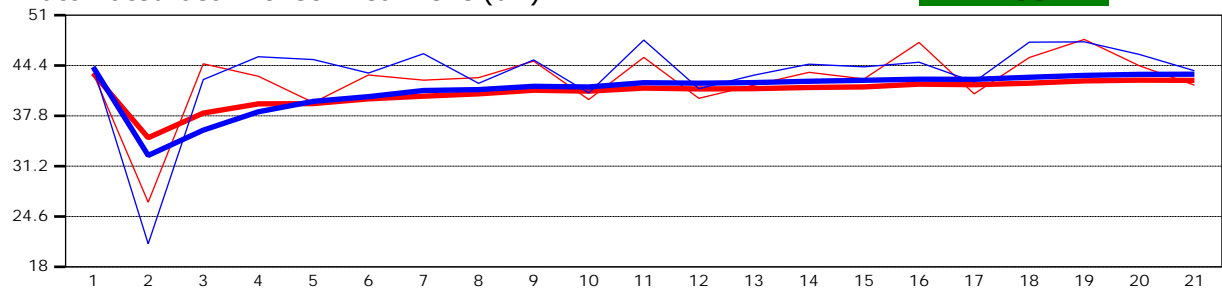
Automated beam check Peak position(ft)   PASS

Automated beam check Quality control warnings
No quality control warnings

9/12/2024 3:39:49 PM

Main Hubbard Creek, Cross Section 1, looking downstream.

Main Hubbard Creek, Cross Section 1, looking upstream.

Main Hubbard Creek, Habitat upstream of cross-section 1.

Main Hubbard Creek, Cross Section 2, looking across from left bank.

Main Hubbard Creek, Cross Section 2, looking downstream

Main Hubbard Creek, Cross Section 2, looking upstream

Main Hubbard Creek, Cross Section 2, looking upstream

Main Hubbard Creek, Spawning habitat

Main Hubbard Creek, Fish habitat overview

Main Hubbard Creek, Large woody debris and pocket pool habitat

Main Hubbard Creek, Overview of channel characteristics

Main Hubbard Creek, Step-pool habitat and undercut banks

Main Hubbard Creek, Large step pool

Main Hubbard Creek, Habitat overview

Main Hubbard Creek, Large woody debris in channel

Main Hubbard Creek, Habitat overview

Main Hubbard Creek, Overview