COLORADO
Parks and Wildlife
Department of Natural Resources

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

January 11, 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 West Steuben Creek in Water Division 4, Gunnison 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 West Steuben Creek in Water Division 4. The field investigations relating to this ISF recommendation were conducted by Colorado Parks and Wildlife (CPW), Colorado Water Conservation Board (CWCB), and Colorado Water Trust (CWT) staff beginning in 2020. West Steuben 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 2022. Outreach was also conducted to the Gunnison County Commissioners in September 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 West Steuben 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 West Steuben Creek from its headwaters (located at UTM 12S 310056.82 4281796.13) to its confluence with Steuben Creek (UTM 12S 314936.78 4275906.50). The reach is approximately 5.4 miles in length. Almost all of the proposed reach is on public lands managed as West Elk Wilderness. A short approximately 100 yard reach of West Steuben Creek near its confluence with East Steuben Creek is under private ownership as an inholding surronded by Gunnison National Forest and West Elk Wilderness.

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 flow protection by means of establishing an ISF water right is a conservation action aligned with "securing and enhancing conservation populations" and will support the core conservation population of CRCT in West Steuben Creek. Information about the species and CPW's conservation strategy can be found here: CPW Cutthroat Trout Research.

Natural Environment and Biological Summary

West Steuben Creek is a tributary of Steuben Creek located west of the town of Gunnison in the West Elk Wilderness. The stream drains southly from South Baldy Mountain in Baldy Basin to Blue Mesa Reservoir. 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 5 square miles in size with an average basin elevation of 10,854 feet. It is forested, mainly containing stands of aspen interspersed with fir and spruce. West Steuben Creek supports a healthy riparian area consisting of dense willow and alder.

West Steuben Creek is a first order headwaters stream. The stream is mainly confined and high-gradient. There is a high elevation meadow in Baldy Basin which is lower gradient and braided, but the majority of the proposed ISF reach is high-gradient. The channel is mainly single thread with substrate ranging from bedrock to coarst clasts and some cobbles and gravels. West Steuben Creek has a variety of complex fish habitat including ample woody debris in the channel, undercut banks, pocket pool habitats, and riparian cover and shading. There is plenty of overwinter and resting zones for fish, including large pools and sizeable glides. There are a variety of types of pools, including plunge pools

created by large woody debris and scour pools from bedrock control features and large boulders. The creek supports a robust macroinvertebrate community including stonefly, caddifly, and mayfly, which were all observed in the field.

The CRCT population in West Steuben Creek are isolated with no risk of hybridization due to a waterfall serving as a natural fish barrier on West Steuben Creek. The population is considered a "core conservation population" meaning genetic analyses indicate 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 2011 indicates multiple age classes of CRCT (see attached), which reinforces that the CRCT in West Steuben Creek are a self-sustaining population. CPW staff observed cutthroat trout in West Steuben Creek during R2Cross field investigations. Below the barrier, West Steuben Creek sampling indicates both CRCT and brook trout present.

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 of fish from riffle to riffle 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 2020 and 2021, CPW collected the following cross-section data sets on West Steuben 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	12.6 ft	8/11/2020	0.288 cfs	0.57 cfs	6.21 cfs
2	11.9 ft	8/11/2020	0.275 cfs	1.08 cfs	2.73 cfs
3	17.3 ft	8/4/2021	0.47 cfs	2.08 cfs	3.23 cfs

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

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

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

4	17.1 ft	8/4/2021	0.47 cfs	0.61 cfs	5.65 cfs
Recommended Flow Rates				**1.1 cfs**	**4.5 cfs**

The initial biological flow recommendation in the winter is 1.1 cfs. This rate during the baseflow period should be protective by maintaining an average depth of 0.2 feet and percent wetted perimeter of 50 percent of the bankfull top width across riffle cross-sections. The initial biological flow recommendation in the summer is 4.5 cfs, which will maintain these hydraulic parameters in critical riffle transects, as well as average velocity of 1 foot per second (fps).

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 West Steuben Creek. The only water rights CPW is aware of on West Steuben Creek are the Elk Home No. 1 and No. 2 diversions.

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. Final flow recommendations have been refined based on water availability to the following:

- Early Spring (April 1 through April 30): **2.2 cfs**
    - Earlier spring snowmelt may be a reality in a changing climate. This early season flow recommendation will support beneficial spawning conditions for cutthroat trout, a species that spawn in the spring.
- Summer Flow Recommendation (May 1 through July 31): **4.5 cfs**
    - Maintains adequate depth, velocity, and wetted perimeter during the high flow period when fish are active and moving throughout the creek. This flow rate will support ideal spawning conditions for cutthroat trout during runoff and the receeding limb of the hydrograph.
- Late-Summer Flow Recommendation (August 1 through September 30): **1.5 cfs**
    - Maintains available habitat, depth, and wetted perimeter and allows fish to move as flows recede during the late-summer.
- Fall Flow Recommendation (October 1 through November 30): **1.1 cfs**
    - Maintains adequate wetted perimeter and depth to support habitat availability during baseflow conditions.
- Baseflow Recommendation (December 1 through March 31): **0.8 cfs**
    - The flow recommendation is reduced due to water availability constraints but will provide sufficient overwintering habitat, specifically in pools and deep glides.

The purpose of this letter is to formally transmit this ISF recommendation to CWCB for the Board's consideration. CPW believes that there is a flow-dependent natural environment in West Steuben 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.

[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.

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)

Discharge Measurement Summary

Site name	W steuben
Site number	1
Operator(s)	
File name	Site 1_20200811.ft
Comment	

Start time	8/11/2020 12:36 PM
End time	8/11/2020 1:04 PM
Start location latitude	38.653
Start location longitude	-107.184
Calculations engine	FlowTracker2

Sensor type	Top Setting
Handheld serial number	FT2H2010014
Probe serial number	FT2P2010019
Probe firmware	1.30
Handheld software	1.6

# Stations	Avg interval (s)	Total discharge (ft³/s)
16	40	0.288

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
5.600	1.640	5.712

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
24.286	0.293	0.175

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
56.421	0.500	0.492

Discharge Uncertainty		
Category	**ISO**	**IVE**
Accuracy	1.0%	1.0%
Depth	0.7%	9.4%
Velocity	2.0%	15.8%
Width	0.2%	0.2%
Method	3.4%	
# Stations	3.1%	
Overall	**5.2%**	**18.4%**

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 %

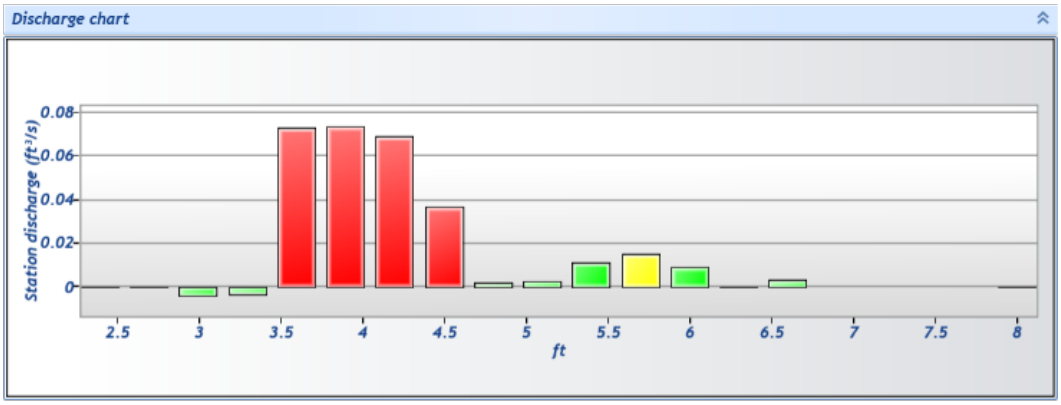
Summary overview

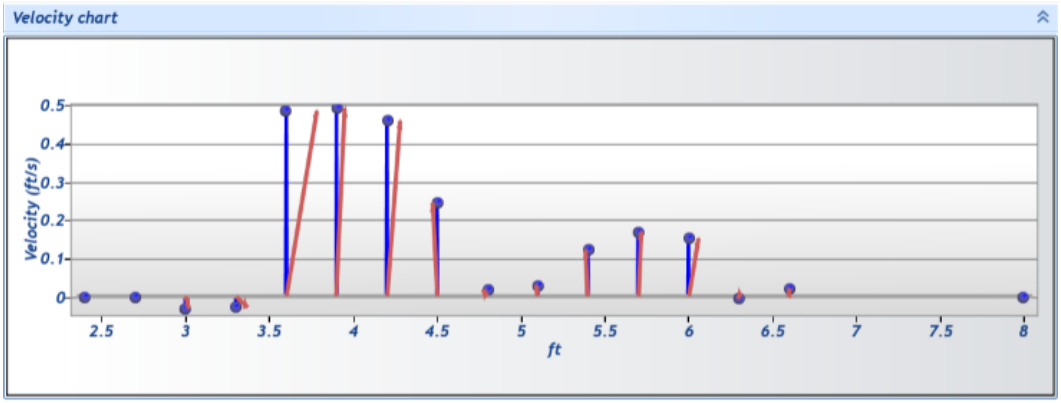
No changes were made to this file
Quality control warnings

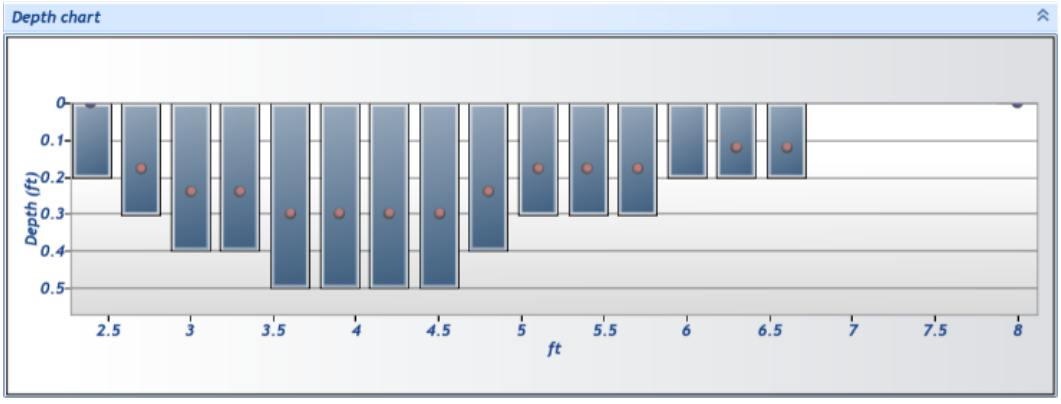
Discharge Measurement Summary

Site name	W steuben
Site number	1
Operator(s)	
File name	Site 1_20200811.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	W steuben
Site number	1
Operator(s)	
File name	Site 1_20200811.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	12:36 PM	2.400	None	0.200	0.000	0.000	0	0.000	0.000	0.000	0.030	0.000	0.000	✓
1	12:38 PM	2.700	0.6	0.300	0.600	0.180	80	0.000	1.000	0.000	0.090	0.000	0.011	✓
2	12:40 PM	3.000	0.6	0.400	0.600	0.240	80	-0.032	1.000	-0.032	0.120	-0.004	-1.343	✓
3	12:41 PM	3.300	0.6	0.400	0.600	0.240	80	-0.028	1.000	-0.028	0.120	-0.003	-1.180	✓
4	12:43 PM	3.600	0.6	0.500	0.600	0.300	80	0.484	1.000	0.484	0.150	0.073	25.260	✓
5	12:44 PM	3.900	0.6	0.500	0.600	0.300	80	0.492	1.000	0.492	0.150	0.074	25.649	✓
6	12:46 PM	4.200	0.6	0.500	0.600	0.300	80	0.459	1.000	0.459	0.150	0.069	23.922	✓
7	12:49 PM	4.500	0.6	0.500	0.600	0.300	80	0.245	1.000	0.245	0.150	0.037	12.780	✓
8	12:52 PM	4.800	0.6	0.400	0.600	0.240	80	0.018	1.000	0.018	0.120	0.002	0.744	✓
9	12:54 PM	5.100	0.6	0.300	0.600	0.180	80	0.029	1.000	0.029	0.090	0.003	0.900	✓
10	12:55 PM	5.400	0.6	0.300	0.600	0.180	80	0.121	1.000	0.121	0.090	0.011	3.800	✓
11	12:57 PM	5.700	0.6	0.300	0.600	0.180	80	0.168	1.000	0.168	0.090	0.015	5.265	✓
12	12:58 PM	6.000	0.6	0.200	0.600	-0.120	80	0.151	1.000	0.151	0.060	0.009	3.152	✓
13	1:00 PM	6.300	0.6	0.200	0.600	0.120	80	-0.007	1.000	-0.007	0.060	0.000	-0.140	✓
14	1:03 PM	6.600	0.6	0.200	0.600	0.120	80	0.020	1.000	0.020	0.170	0.003	1.180	✓
15	1:04 PM	8.000	None	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0.000	✓

Discharge Measurement Summary

Site name	W steuben
Site number	1
Operator(s)	
File name	Site 1_20200811.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	12:38 PM	2.700	0.6	0.300	0.600	0.180	SNR Threshold Variation
3	12:41 PM	3.300	0.6	0.400	0.600	0.240	SNR Threshold Variation
4	12:43 PM	3.600	0.6	0.500	0.600	0.300	Velocity Angle > QC,High Stn % Discharge
5	12:44 PM	3.900	0.6	0.500	0.600	0.300	High Stn % Discharge
6	12:46 PM	4.200	0.6	0.500	0.600	0.300	High Stn % Discharge
7	12:49 PM	4.500	0.6	0.500	0.600	0.300	High Stn % Discharge
8	12:52 PM	4.800	0.6	0.400	0.600	0.240	Large SNR Variation,SNR Threshold Variation
9	12:54 PM	5.100	0.6	0.300	0.600	0.180	Large SNR Variation
10	12:55 PM	5.400	0.6	0.300	0.600	0.180	SNR Threshold Variation
11	12:57 PM	5.700	0.6	0.300	0.600	0.180	SNR Threshold Variation
12	12:58 PM	6.000	0.6	0.200	0.600	-0.120	Large SNR Variation,Velocity Angle > QC
14	1:03 PM	6.600	0.6	0.200	0.600	0.120	Large SNR Variation
15	1:04 PM	8.000	None	0.000	0.000	0.000	Stn Spacing > QC

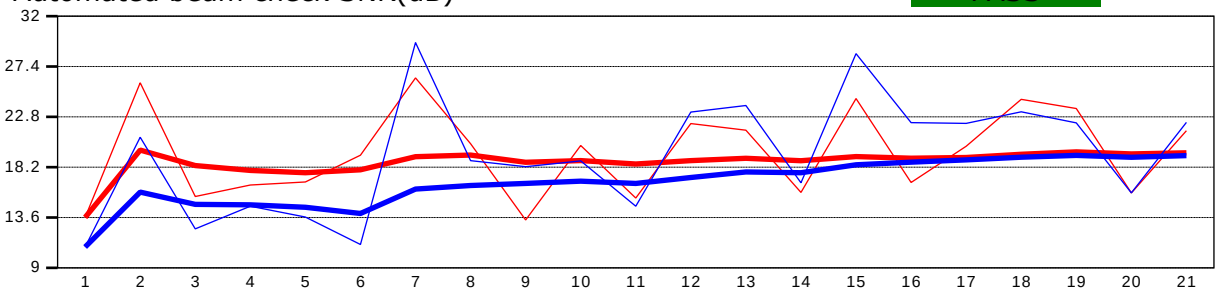
Discharge Measurement Summary

Site name	W steuben
Site number	1
Operator(s)	
File name	Site 1_20200811.ft
Comment	

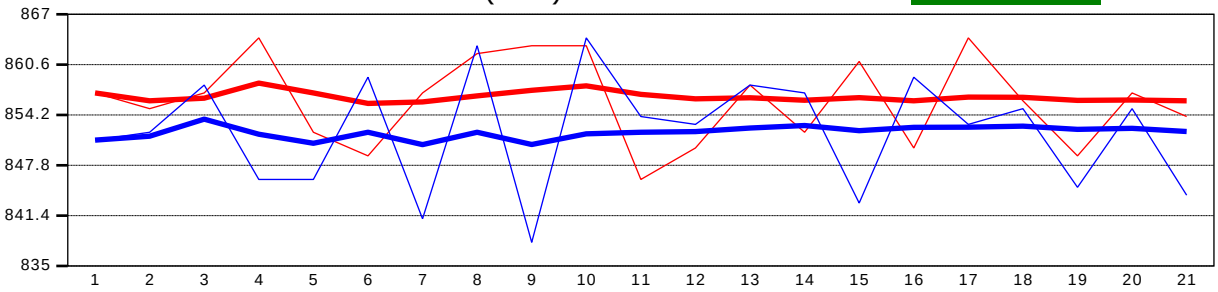
Beam 1	
Beam 2	

Automated beam check Start time 8/11/2020 12:35:58 PM

Automated beam check SNR(dB) PASS



Automated beam check Noise level(cnts) PASS



Automated beam check Quality control warnings

No quality control warnings

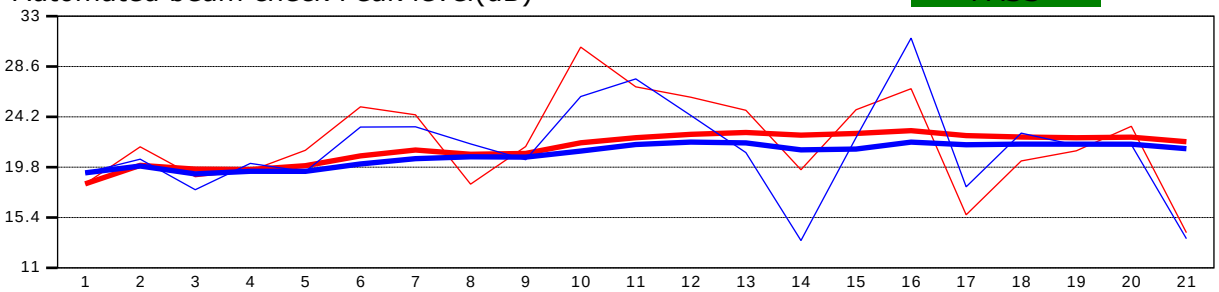
Discharge Measurement Summary

Site name	W steuben
Site number	1
Operator(s)	
File name	Site 1_20200811.ft
Comment	

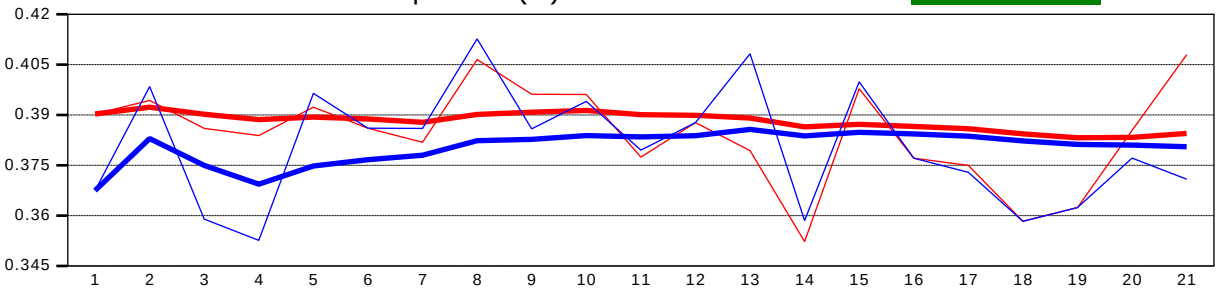
Beam 1	
Beam 2	

Automated beam check Start time 8/11/2020 12:35:58 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

Discharge Measurement Summary

Site name	W stub redo
Site number	2
Operator(s)	
File name	Site 2_20200811.ft
Comment	

Start time	8/11/2020 2:30 PM
End time	8/11/2020 2:51 PM
Start location latitude	38.651
Start location longitude	-107.183
Calculations engine	FlowTracker2

Sensor type	Top Setting
Handheld serial number	FT2H2010014
Probe serial number	FT2P2010019
Probe firmware	1.30
Handheld software	1.6

# Stations	Avg interval (s)	Total discharge (ft³/s)
13	40	0.275

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
4.300	0.973	4.428

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
25.360	0.226	0.282

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
60.053	0.400	0.916

Discharge Uncertainty		
Category	**ISO**	**IVE**
Accuracy	1.0%	1.0%
Depth	0.7%	14.0%
Velocity	1.8%	18.6%
Width	0.2%	0.2%
Method	3.6%	
# Stations	3.9%	
Overall	**5.7%**	**23.3%**

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

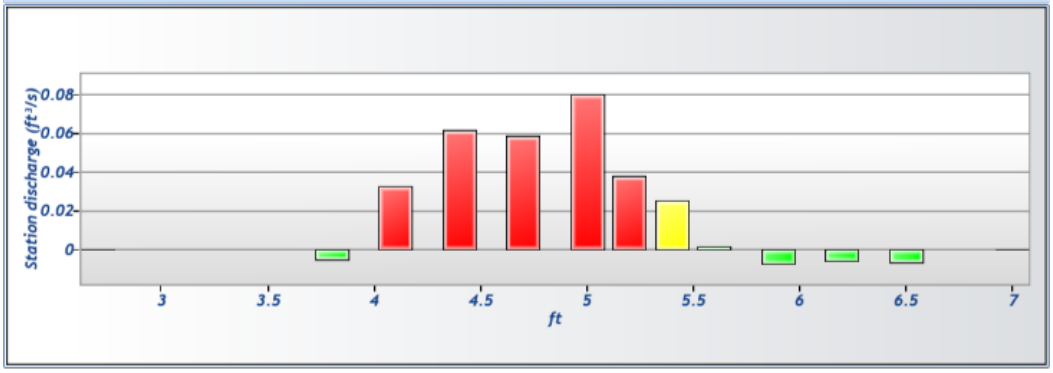
No changes were made to this file
Quality control warnings

Discharge Measurement Summary

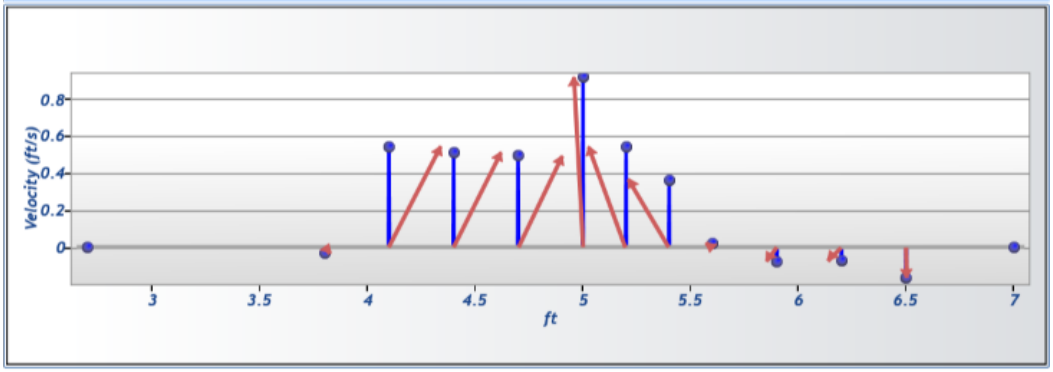
Site name	W stub redo
Site number	2
Operator(s)	
File name	Site 2_20200811.ft
Comment	

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

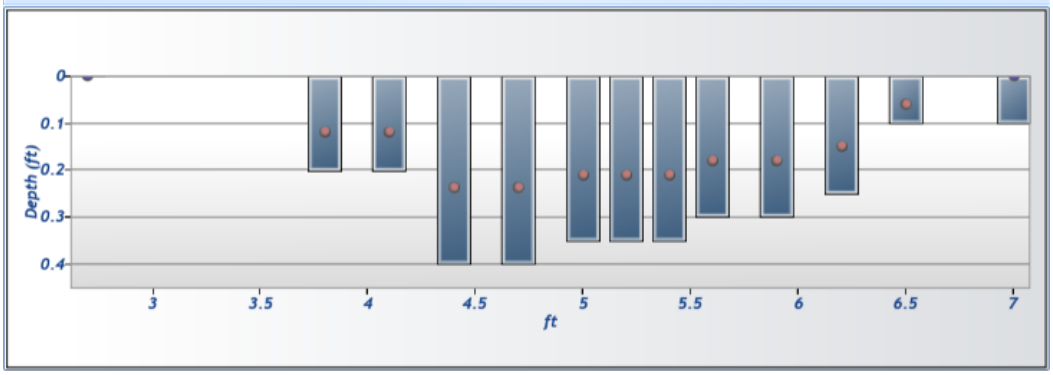
Discharge chart



Velocity chart



Depth chart



Discharge Measurement Summary

Site name	W stub redo
Site number	2
Operator(s)	
File name	Site 2_20200811.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	
12	2:51 PM	2.700	None	0.000	0.000	0.000	0	0.000		-0.034	0.000	0.000	0.000	✓
11	2:50 PM	3.800	0.6	0.200	0.600	0.120	80	-0.034	1.000	-0.034	0.140	-0.005	-1.715	✓
10	2:47 PM	4.100	0.6	0.200	0.600	0.120	80	0.544	1.000	0.544	0.060	0.033	11.878	✓
9	2:45 PM	4.400	0.6	0.400	0.600	0.240	80	0.510	1.000	0.510	0.120	0.061	22.287	✓
8	2:44 PM	4.700	0.6	0.400	0.600	0.240	80	0.491	1.000	0.491	0.120	0.059	21.470	✓
7	2:42 PM	5.000	0.6	0.350	0.600	0.210	80	0.916	1.000	0.916	0.087	0.080	29.197	✓
6	2:41 PM	5.200	0.6	0.350	0.600	0.210	80	0.540	1.000	0.540	0.070	0.038	13.771	✓
5	2:39 PM	5.400	0.6	0.350	0.600	0.210	80	0.366	1.000	0.366	0.070	0.026	9.320	✓
4	2:37 PM	5.600	0.6	0.300	0.600	0.180	80	0.024	1.000	0.024	0.075	0.002	0.659	✓
3	2:35 PM	5.900	0.6	0.300	0.600	0.180	80	-0.076	1.000	-0.076	0.090	-0.007	-2.493	✓
2	2:33 PM	6.200	0.6	0.250	0.600	0.150	80	-0.073	1.000	-0.073	0.075	-0.005	-1.980	✓
1	2:32 PM	6.500	0.6	0.100	0.600	0.060	80	-0.164	1.000	-0.164	0.040	-0.007	-2.394	✓
0	2:30 PM	7.000	None	0.100	0.000	0.000	0	0.000	0.000	0.000	0.025	0.000	0.000	✓

Discharge Measurement Summary

Site name	W stub redo
Site number	2
Operator(s)	
File name	Site 2_20200811.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
10	2:47 PM	4.100	0.6	0.200	0.600	0.120	Velocity Angle > QC,High Stn % Discharge
9	2:45 PM	4.400	0.6	0.400	0.600	0.240	Velocity Angle > QC,High Stn % Discharge
8	2:44 PM	4.700	0.6	0.400	0.600	0.240	Velocity Angle > QC,High Stn % Discharge
7	2:42 PM	5.000	0.6	0.350	0.600	0.210	High Stn % Discharge
6	2:41 PM	5.200	0.6	0.350	0.600	0.210	High Stn % Discharge
5	2:39 PM	5.400	0.6	0.350	0.600	0.210	Velocity Angle > QC
4	2:37 PM	5.600	0.6	0.300	0.600	0.180	Boundary Interference
3	2:35 PM	5.900	0.6	0.300	0.600	0.180	Velocity Angle > QC
2	2:33 PM	6.200	0.6	0.250	0.600	0.150	Velocity Angle > QC
1	2:32 PM	6.500	0.6	0.100	0.600	0.060	Velocity Angle > QC

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: W Stueben creek					CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: Belw Elk Hme #2 Div. point / Trib					
DATE: 8/11/20	OBSERVERS: Birch White LaFrecca				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:		WATER DIVISION:		DOW WATER CODE:
MAP(S): USGS: 135 0310027					
USFS: 4280381					

SUPPLEMENTAL DATA

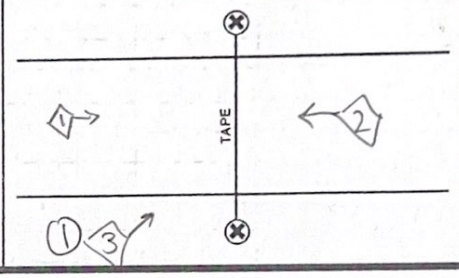
SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) / NO	METER TYPE: Flow Meter measured by T. LaFrecca			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: large gravel/med. Cobble	PHOTOGRAPHS TAKEN: (YES) NO	NUMBER OF PHOTOGRAPHS:		

CHANNEL PROFILE DATA

~~5.14/5.17~~

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	5.14 / 5.15
② WS Upstream	Ø	5.05
③ WS Downstream	18.6'	6.03
SLOPE	0.054	

SKETCH



LEGEND:
- Stake ⊗
- Station ①
- Photo ①→
- Direction of Flow ←→

AQUATIC SAMPLING SUMMARY

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

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

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

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

mayfly, caddisfly

COMMENTS

Q = 0.3 measured in glide 17' upstream T = 56.57°F
(0.5) w/out negative velocity
Great cutthroat hab! good size ✓ step pools. undercut banks. veg. cover
Healthy willow riparian zone, braiding upland Fir & spruce mixed conifer

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: W Stueben	CROSS-SECTION NO.:	DATE:	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME:

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
S	0		4.05								
	3.0		4.15								
	3.9		4.3								
BF	4.3		4.6								
	4.5		5.3								
LWS	4.6		6.14	0							
	4.6		5.35	0.25							
	5.0		5.17	0.05							
	5.4		5.33	0.2							
	5.8		5.3	0.2							
	6.2		5.45	0.25							
	6.6		5.3	0.2							
	7.0		5.25	0.15							
	7.4		5.2	0.1							
	7.8		5.27	0.2							
	8.2		5.3	0.2							
	8.6		5.25	0.18							
	9.0		5.2	0.15							
	9.4		5.2	0.15							
	9.8		5.15	0.1							
Rok	10.2		5.1	0.05							
	10.6		5.3	0.25							
	11.0		5.2	0.2							
	11.4		5.25	0.25							
	11.8		5.2	0.2							
	12.2		5.3	0.25							
	12.6		5.2	0.15							
	13.0		5.25	0.2							
	13.4		5.15	0.1							
Rok	13.8		5.05	0.01							
	14.2		5.1	0.03							
	14.6		5.1	0.03							
	15.0		5.15	0							
	15.4		5.0								
	15.6		4.95								
	15.8		4.9								
	16.1		4.8								
	16.4		4.7								
	16.8		4.65								
BF	16.9		4.6								
	21.5		4.5								
	27.8		3.65								
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: W Stueben					CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: Bel W Elk Hme #2 Div./Trib					
DATE: 8/11/20	OBSERVERS: Birch White Latrieca				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:		WATER DIVISION:		DOW WATER CODE:
MAP(S): USGS: UTM 13S 031 0035	USFS: 4280351				

SUPPLEMENTAL DATA

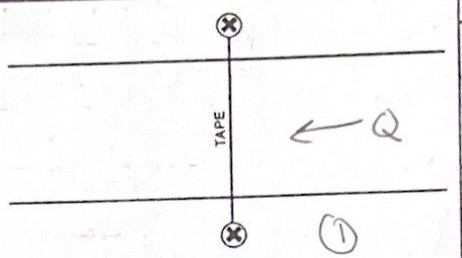
SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO	METER TYPE: Flow Tracker by T. Latrieca			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: small cobble - large boulder	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS:		

CHANNEL PROFILE DATA

6.25

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	X
⊗ Tape @ Stake RB	0.0	X
① WS @ Tape LB/RB	0.0	6.25 / 6.25
② WS Upstream	8.5'	6.07
③ WS Downstream	6.7'	6.28
SLOPE	0.21 / 15.2 = 0.013375	

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
caddis (2)																	
may																	

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

COMMENTS

① = 0.3 cfs measured in u/s glide T = 60.5°F

Two XS taken in high elevation meadow. Lower gradient than the rest of W Stueben which is a confined, high gradient channel. Good fish habitat

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO.:	DATE:	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME:

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
S	0		5.0								
	2.2		5.35								
	2.9		5.55								
* BF↑	3.3		5.65								
BF↓	4.2		5.76								
	4.5		5.9								
LWS	5.0		6.25	0							
	5.05		6.4	0.15							
	5.5		6.4	0.15							
	6.0		6.33	0.05							
Rock	6.5		6.25	0							
	7.0		6.35	0.1							
	7.5		6.3	0.05							
	8.0		6.5	0.28							
	8.5		6.45	0.2							
	9.0		6.34	0.1							
	9.5		6.35	0.12							
	10.0		6.4	0.2							
	10.5		6.42	0.22							
	11.0		6.38	0.16							
	11.5		6.4	0.18							
	12.0		6.25	0.0							
	12.5		6.32	0.10							
	13.0		6.25	0.01							
RWS	13.5		6.24	0.00	0						
	13.9		6.15								
	14.1		6.0								
	13.8		5.8								
~~BF~~	15.3		5.6								
	16.1		5.25								
X	16.5		4.95								
	17.5		4.75								
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: West Steuben Creek					CROSS-SECTION NO.: 1-3(21)
CROSS-SECTION LOCATION: Belw EH 1 & 2 tnb. confluences					
DATE: 8/4/21	OBSERVERS: Birch McDnell				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:		WATER DIVISION:		DOW WATER CODE:
MAP(S): USGS: UTM 13S 310049 4279529					
USFS:					

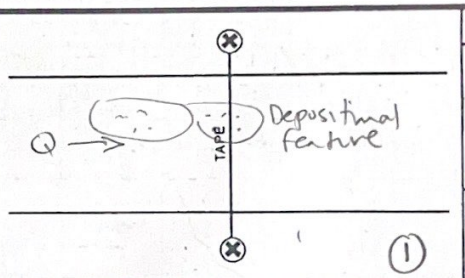
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE: Haeh (measured in d/S glide) Q=0.47 cfs			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: small cobble – small boulder (*) Pebble cnt	PHOTOGRAPHS TAKEN: YES/NO KB	NUMBER OF PHOTOGRAPHS: 3		

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	3.96 / 3.99
② WS Upstream	3.48 > 19.3'	
③ WS Downstream	3.99 /	
SLOPE	2.4% = .024	

SKETCH



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

AQUATIC SAMPLING SUMMARY

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

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

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

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

COMMENTS

Benchmark = 3.70 common stonefly, caddis Mayfly

Recent precip. Cold, clear water. Confined, high gradient channel w/ bedrock outcroppings, some portions of the channel bedrock bed. Large pools created by log jams boulder scour pool, & bedrock control features.

- Elk Home no. 2 diversion taking most of the flow of UT. & West Steuben
- most flow comes out of EH no. 2 unnamed trib. Photos taken.

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

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

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

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
S	0		.86								
BF	.8		2.80								
	1.2		2.44								
	1.7		3.12								
	1.8		3.24								
	2.3		3.36								
	2.9		3.58								
	3.6		3.82								
WS	4.2		3.99								
	4.9		4.08	.1							
	5.6		4.02	.02							
R	6.3		4.89	0							
	7.0		4.00	.01							
	7.7		3.98	.1							
	8.4		4.04	.14							
	9.1		4.01	.10							
R	9.8		3.98	.04							
	10.5		4.00	.06							
	11.2		4.12	.17							
	11.9		4.16	.15							
	12.6		4.08	.09							
	13.3		4.08	.10							
	14.0		4.18	.21							
	14.7		[illegible]								
			4.26	.34							
	15.4		4.21	.30							
WS	16.1		3.96								
	17.2		3.79								
	17.7		3.62								
	18.3		3.20								
BF	18.6		2.98								
	20.4		2.90								
	22.8		1.56								
S	24.6		2.06								
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: West Stuetzen creek					CROSS-SECTION NO.: 2-4(21)
CROSS-SECTION LOCATION: Below XS 1					
DATE: 8/4/21	OBSERVERS: Birch / McDaniel				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:		
MAP(S): USGS: 13S 310062 4279519					
USFS:					

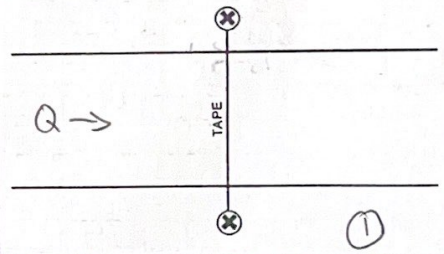
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES NO	METER TYPE: Hach ~ Flow measured in excavated riffle XS.			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: Pebble cnnt collected	PHOTOGRAPHS TAKEN: YES/NO KB	NUMBER OF PHOTOGRAPHS: 3		

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	4.47/4.48
2 WS Upstream	3.95 > 22.6	
3 WS Downstream	5.17	
SLOPE	5.4% = .54	

SKETCH



LEGEND: Stake, Station 1, Photo 1, Direction of Flow

AQUATIC SAMPLING SUMMARY

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

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

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL
Mayfly																	
common Stonefly																	
caddis																	
fish observed in all front																	

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

COMMENTS

Bench mark: 4.20 ✓
Higher gradient riffle than XS 1, more representative of HGRs downstream
Large pools & pocket pool habitat created by numerous large boulders.
Forested w/ healthy riparian plants & wildflowers. Lots of down wood in channel & habitat complexity.

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

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

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

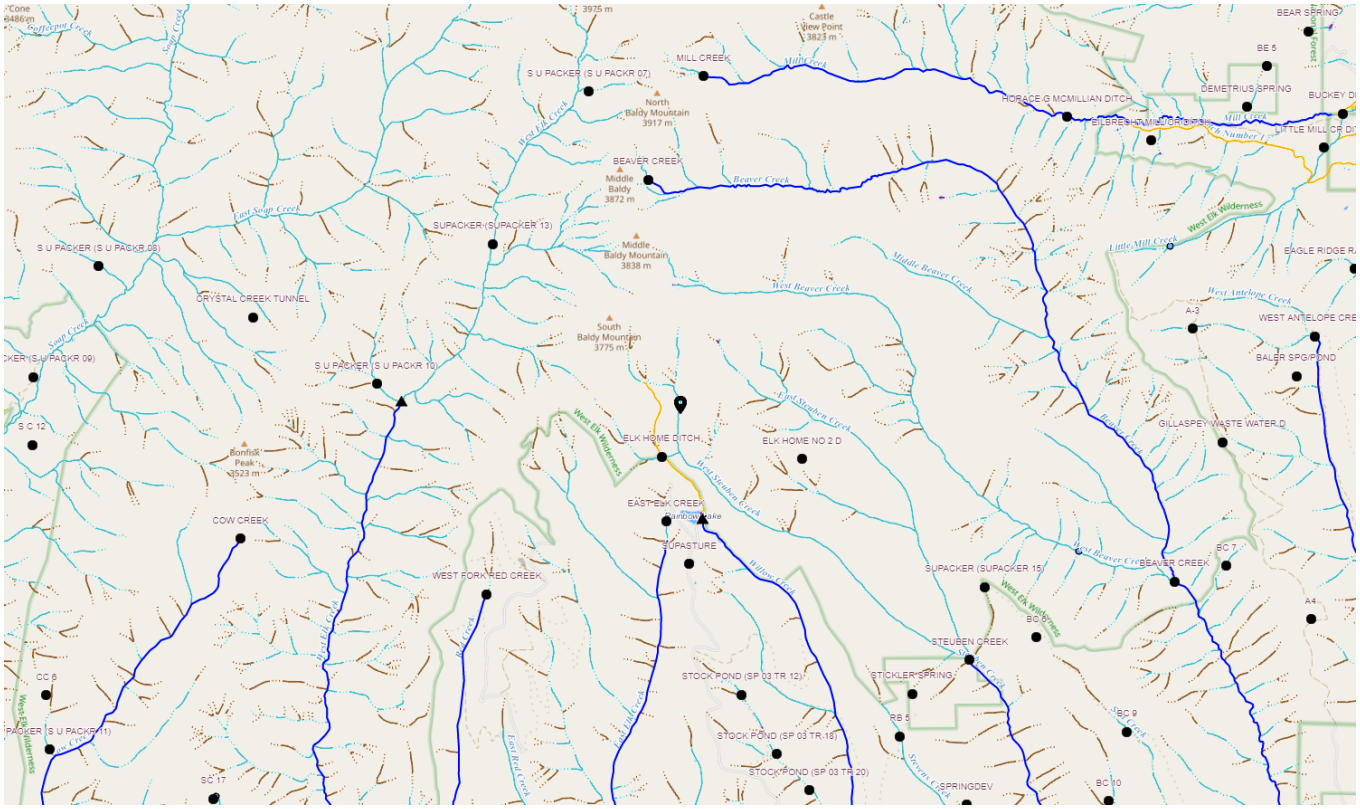
Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
S	0		2.74	→	+	.7	3.21				
~~(RS)~~	1.0		3.52								
	2.2		3.72								
	2.7		3.88								
	3.9		3.88								
	4.5		4.06								
	5.2		4.36								
WS	5.8		4.48								
	6.0		4.55	.06							
	6.5		4.55	.07							
	7.0		4.64	.16							
	7.5		4.68	.21							
	8.0		4.70	.30							
	8.5		4.70	.30							
	9.0		4.64	.27							
	9.5		4.71	.34							
	10.0		4.83	.45							
	10.5		4.81	.43							
	11.0		4.76	.40							
	11.5		4.61	.22							
	12.0		4.53	.13							
	12.5		4.56	.18							
R	13.0		4.40	0							
	13.5		4.44	.04							
	14.0		4.48	.07							
	14.5		4.46	.05							
	15.0		4.52	.04							
	15.5		4.54	.05							
WS	16.0		4.48								
	16.5		3.99								
	16.9		3.72								
	17.4		3.64								
BF↓	18.2		3.45								
	~~20.0~~		~~3.~~								
BF↑	19.7		3.44								
	20.9		3.24								
	22.0		2.80								
TOTALS:											

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

R2Cross RESULTS

Stream Name: West Stueben Creek
Stream Locations: Below Elk Home #2 Diversion/Trib.
Fieldwork Date: 08/11/2020
Cross-section: 1
Observers: Birch White LaGreca
Coordinate System: UTM Zone 13
X (easting): 310027
Y (northing): 4280381
Date Processed: 10/17/2022
Slope: 0.0527
Discharge: Entered Value: 0.29 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: 1-R2Cross_West-Stueben_8-11-2020-q=0.288.xlsx
R2Cross version: 2.0.0

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 12.6

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.57
Percent Wetted Perimeter (%)	50.0	0.02
Mean Velocity (ft/s)	1.0	6.21

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	4.6	12.6	0.56	0.8	7.08	13.76	100.0	0.51	0.19	1.17	8.28
	4.62	12.55	0.54	0.78	6.83	13.69	99.52	0.5	0.19	1.12	7.63
	4.64	12.51	0.53	0.76	6.58	13.63	99.05	0.48	0.2	1.06	7.0
	4.66	12.4	0.51	0.74	6.33	13.5	98.15	0.47	0.2	1.02	6.45
	4.68	12.24	0.5	0.72	6.08	13.32	96.82	0.46	0.21	0.98	5.97
	4.7	12.07	0.48	0.7	5.84	13.14	95.5	0.44	0.21	0.94	5.51
	4.72	12.01	0.47	0.68	5.6	13.06	94.89	0.43	0.22	0.89	5.01
	4.74	11.94	0.45	0.66	5.36	12.97	94.28	0.41	0.22	0.85	4.54
	4.76	11.87	0.43	0.64	5.12	12.89	93.67	0.4	0.23	0.8	4.1
	4.78	11.81	0.41	0.62	4.89	12.8	93.06	0.38	0.24	0.75	3.68
	4.8	11.74	0.4	0.6	4.65	12.72	92.45	0.37	0.25	0.71	3.29
	4.82	11.68	0.38	0.58	4.42	12.64	91.84	0.35	0.26	0.66	2.92
	4.84	11.61	0.36	0.56	4.18	12.55	91.23	0.33	0.27	0.62	2.58
	4.86	11.55	0.34	0.54	3.95	12.47	90.61	0.32	0.28	0.57	2.26
	4.88	11.48	0.32	0.52	3.72	12.38	90.0	0.3	0.29	0.53	1.97
	4.9	11.41	0.31	0.5	3.49	12.3	89.39	0.28	0.3	0.49	1.7
	4.92	11.33	0.29	0.48	3.27	12.2	88.64	0.27	0.32	0.45	1.45
	4.94	11.24	0.27	0.46	3.04	12.09	87.89	0.25	0.34	0.41	1.23
	4.96	11.16	0.25	0.44	2.82	11.99	87.14	0.23	0.35	0.37	1.03
	4.98	11.07	0.23	0.42	2.59	11.89	86.39	0.22	0.38	0.33	0.85
	5.0	10.99	0.22	0.4	2.37	11.78	85.64	0.2	0.4	0.29	0.69
	5.02	10.93	0.2	0.38	2.15	11.71	85.08	0.18	0.43	0.25	0.55
	5.04	10.87	0.18	0.36	1.94	11.63	84.51	0.17	0.47	0.22	0.42
	5.06	10.69	0.16	0.34	1.72	11.43	83.06	0.15	0.51	0.19	0.32
Waterline	5.07	10.51	0.15	0.33	1.59	11.23	81.63	0.14	0.54	0.17	0.27

	5.08	10.39	0.15	0.32	1.51	11.11	80.72	0.14	0.56	0.16	0.24
	5.1	9.69	0.13	0.3	1.3	10.39	75.48	0.13	0.59	0.14	0.19
	5.12	9.19	0.12	0.28	1.12	9.86	71.65	0.11	0.65	0.12	0.14
	5.14	8.69	0.11	0.26	0.94	9.33	67.81	0.1	0.72	0.1	0.1
	5.16	8.29	0.09	0.24	0.77	8.87	64.46	0.09	0.81	0.08	0.06
	5.18	7.94	0.08	0.22	0.6	8.46	61.52	0.07	0.95	0.06	0.04
	5.2	7.15	0.06	0.2	0.45	7.61	55.3	0.06	1.11	0.05	0.02
	5.22	5.76	0.06	0.18	0.32	6.15	44.66	0.05	1.23	0.04	0.01
	5.24	4.38	0.05	0.16	0.22	4.68	34.02	0.05	1.35	0.03	0.01
	5.26	3.27	0.04	0.14	0.14	3.5	25.44	0.04	1.5	0.03	0.0
	5.28	2.37	0.04	0.12	0.09	2.53	18.37	0.03	1.74	0.02	0.0
	5.3	1.39	0.04	0.1	0.05	1.48	10.74	0.03	1.77	0.02	0.0
	5.32	0.86	0.03	0.08	0.03	0.92	6.71	0.03	1.97	0.02	0.0
	5.34	0.5	0.03	0.06	0.01	0.53	3.85	0.03	2.11	0.01	0.0
	5.36	0.32	0.02	0.04	0.01	0.33	2.4	0.02	2.81	0.01	0.0
	5.38	0.16	0.01	0.02	0.0	0.16	1.2	0.01	5.01	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) =	0.29	(cfs)
Calculated Flow (Qc) =	0.28	(cfs)
(Qm-Qc)/Qm * 100 =	2.23%	
Measured Waterline (WLm) =	5.14	(ft)
Calculated Waterline (WLc) =	5.07	(ft)
(WLm-WLc)/WLm * 100 =	1.41%	
Max Measured Depth (Dm) =	0.25	(ft)
Max Calculated Depth (Dc) =	0.33	(ft)
(Dm-Dc)/Dm * 100 =	-31.11%	
Mean Velocity =	0.18	(ft/s)
Manning's n =	0.523	
0.4 * Qm =	0.12	(cfs)
2.5 * Qm =	0.72	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	4.05		
	3	4.15		
	3.9	4.3		
Bankfull	4.3	4.6		
	4.5	5.3		
Waterline	4.6	5.14	0	
	4.6	5.35	0.25	
	5	5.17	0.05	
	5.4	5.33	0.2	
	5.8	5.3	0.2	
	6.2	5.4	0.25	
	6.6	5.3	0.2	
	7	5.25	0.15	
	7.4	5.2	0.1	
	7.8	5.27	0.2	
	8.2	5.3	0.2	
	8.6	5.25	0.18	
	9	5.2	0.15	
	9.4	5.2	0.15	
	9.8	5.15	0.1	
	10.2	5.1	0.05	
	10.6	5.3	0.25	
	11	5.2	0.2	
	11.4	5.25	0.25	
	11.8	5.2	0.2	
	12.2	5.3	0.25	
	12.6	5.2	0.15	
	13	5.25	0.2	
	13.4	5.15	0.1	
	13.8	5.05	0.01	

	14.2	5.1	0.03
	14.6	5.1	0.03
Waterline	15	5.15	0
	15.4	5	
	15.6	4.95	
	15.8	4.9	
	16.1	4.8	
	16.4	4.7	
	16.8	4.65	
Bankfull	16.9	4.6	
	21.5	4.5	
	27.8	3.65	

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.21	0.25	0.05	0.01	3.15
0.44	0.05	0.02	0	1.26
0.43	0.2	0.08	0.01	5.03
0.4	0.2	0.08	0.01	5.03
0.41	0.25	0.1	0.02	6.29
0.41	0.2	0.08	0.01	5.03
0.4	0.15	0.06	0.01	3.77
0.4	0.1	0.04	0.01	2.52
0.41	0.2	0.08	0.01	5.03
0.4	0.2	0.08	0.01	5.03
0.4	0.18	0.07	0.01	4.53
0.4	0.15	0.06	0.01	3.77
0.4	0.15	0.06	0.01	3.77
0.4	0.1	0.04	0.01	2.52
0.4	0.05	0.02	0	1.26
0.45	0.25	0.1	0.02	6.29
0.41	0.2	0.08	0.01	5.03
0.4	0.25	0.1	0.02	6.29
0.4	0.2	0.08	0.01	5.03
0.41	0.25	0.1	0.02	6.29
0.41	0.15	0.06	0.01	3.77
0.4	0.2	0.08	0.01	5.03
0.41	0.1	0.04	0.01	2.52
0.41	0.01	0	0	0.25

0.4	0.03	0.01	0	0.75
0.4	0.03	0.01	0	0.75
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
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

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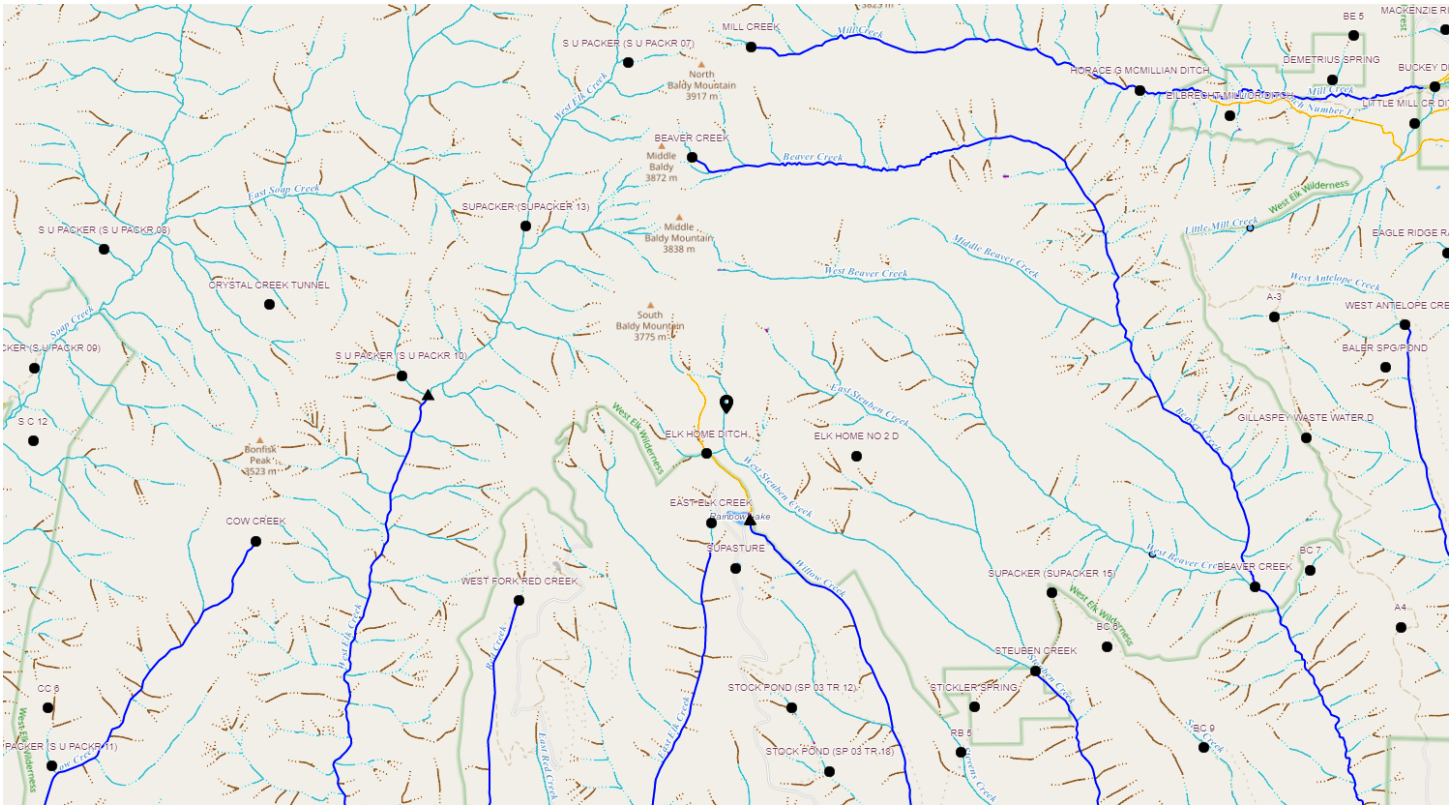
R2Cross RESULTS

Stream Name: West Stueben Creek
Stream Locations: Below Elk Home #2 Diversion/Trib.
Fieldwork Date: 08/11/2020
Cross-section: 2
Observers: Birch White LaGreca
Coordinate System: UTM Zone 13
X (easting): 310035
Y (northing): 4280351
Date Processed: 10/17/2022
Slope: 0.0138
Discharge: Entered Value: 0.28 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: 2-R2Cross_West-Stueben_8-11-2020-q=0.275.xlsx
R2Cross version: 2.0.0

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 11.88

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.08
Percent Wetted Perimeter (%)	50.0	0.06
Mean Velocity (ft/s)	1.0	2.73

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	5.65	11.88	0.57	0.85	6.79	12.36	100.0	0.55	0.05	2.33	15.86
	5.67	11.63	0.56	0.83	6.54	12.12	97.98	0.54	0.05	2.29	14.97
	5.69	11.39	0.55	0.81	6.3	11.87	95.96	0.53	0.05	2.24	14.12
	5.71	11.14	0.54	0.79	6.06	11.62	93.94	0.52	0.05	2.2	13.31
	5.74	10.9	0.53	0.77	5.82	11.37	91.92	0.51	0.05	2.15	12.52
	5.76	10.7	0.52	0.74	5.6	11.16	90.25	0.5	0.05	2.1	11.72
	5.78	10.6	0.51	0.72	5.37	11.05	89.4	0.49	0.05	2.02	10.82
	5.8	10.51	0.49	0.7	5.14	10.95	88.56	0.47	0.05	1.94	9.96
	5.82	10.39	0.47	0.68	4.92	10.83	87.56	0.45	0.06	1.86	9.16
	5.84	10.27	0.46	0.66	4.7	10.7	86.55	0.44	0.06	1.78	8.39
	5.86	10.16	0.44	0.64	4.49	10.58	85.54	0.42	0.06	1.71	7.65
	5.88	10.04	0.43	0.62	4.27	10.45	84.53	0.41	0.06	1.63	6.95
	5.91	9.93	0.41	0.59	4.06	10.33	83.54	0.39	0.06	1.55	6.29
	5.93	9.82	0.39	0.57	3.85	10.21	82.61	0.38	0.06	1.47	5.65
	5.95	9.72	0.37	0.55	3.64	10.1	81.69	0.36	0.06	1.39	5.05
	5.97	9.61	0.36	0.53	3.44	9.99	80.76	0.34	0.07	1.31	4.49
	5.99	9.51	0.34	0.51	3.23	9.87	79.83	0.33	0.07	1.22	3.95
	6.01	9.43	0.32	0.49	3.03	9.78	79.09	0.31	0.07	1.14	3.45
	6.03	9.37	0.3	0.47	2.83	9.71	78.5	0.29	0.07	1.05	2.97
	6.05	9.31	0.28	0.45	2.63	9.63	77.92	0.27	0.08	0.96	2.53
	6.08	9.25	0.26	0.42	2.44	9.56	77.33	0.25	0.08	0.87	2.13
	6.1	9.19	0.24	0.4	2.24	9.49	76.74	0.24	0.09	0.79	1.76
	6.12	9.13	0.22	0.38	2.05	9.42	76.16	0.22	0.09	0.7	1.43
	6.14	9.07	0.2	0.36	1.85	9.34	75.57	0.2	0.1	0.61	1.14
	6.16	8.98	0.18	0.34	1.66	9.24	74.75	0.18	0.1	0.53	0.89

	6.18	8.86	0.17	0.32	1.47	9.11	73.67	0.16	0.11	0.46	0.68
	6.2	8.73	0.15	0.3	1.28	8.98	72.59	0.14	0.12	0.39	0.5
	6.22	8.61	0.13	0.28	1.1	8.84	71.5	0.12	0.14	0.31	0.35
Waterline	6.24	8.54	0.12	0.26	0.99	8.76	70.87	0.11	0.15	0.27	0.27
	6.25	8.26	0.11	0.26	0.92	8.48	68.58	0.11	0.15	0.26	0.24
	6.27	7.53	0.1	0.23	0.75	7.73	62.5	0.1	0.17	0.22	0.17
	6.29	6.9	0.09	0.21	0.6	7.08	57.28	0.08	0.19	0.18	0.11
	6.31	6.17	0.07	0.19	0.46	6.32	51.15	0.07	0.21	0.14	0.07
	6.33	5.43	0.06	0.17	0.34	5.55	44.91	0.06	0.25	0.11	0.04
	6.35	4.29	0.05	0.15	0.23	4.38	35.4	0.05	0.28	0.09	0.02
	6.37	3.69	0.04	0.13	0.15	3.76	30.4	0.04	0.36	0.06	0.01
	6.39	2.59	0.03	0.11	0.08	2.62	21.21	0.03	0.44	0.04	0.0
	6.42	1.06	0.04	0.09	0.04	1.08	8.75	0.04	0.36	0.06	0.0
	6.44	0.72	0.03	0.06	0.02	0.74	5.97	0.03	0.4	0.05	0.0
	6.46	0.53	0.02	0.04	0.01	0.54	4.38	0.02	0.6	0.02	0.0
	6.48	0.27	0.01	0.02	0.0	0.27	2.19	0.01	1.06	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) =	0.28	(cfs)
Calculated Flow (Qc) =	0.27	(cfs)
(Qm-Qc)/Qm * 100 =	0.31%	
Measured Waterline (WLm) =	6.25	(ft)
Calculated Waterline (WLc) =	6.24	(ft)
(WLm-WLc)/WLm * 100 =	0.14%	
Max Measured Depth (Dm) =	0.28	(ft)
Max Calculated Depth (Dc) =	0.26	(ft)
(Dm-Dc)/Dm * 100 =	5.78%	
Mean Velocity =	0.28	(ft/s)
Manning's n =	0.148	
0.4 * Qm =	0.11	(cfs)
2.5 * Qm =	0.69	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	5		
	2.2	5.35		
	2.9	5.55		
Bankfull	3.3	5.65		
	4.2	5.75		
	4.5	5.9		
Waterline	5	6.25	0	
	5.05	6.4	0.15	
	5.5	6.4	0.15	
	6	6.33	0.05	
	6.5	6.25	0	
	7	6.35	0.1	
	7.5	6.3	0.05	
	8	6.5	0.28	
	8.5	6.45	0.2	
	9	6.34	0.1	
	9.5	6.35	0.12	
	10	6.4	0.2	
	10.5	6.42	0.22	
	11	6.38	0.16	
	11.5	6.4	0.18	
	12	6.25	0	
	12.5	6.32	0.1	
	13	6.25	0.01	
Waterline	13.5	6.24	0	
	13.9	6.15		
	14.1	6		
	14.8	5.8		
Bankfull	15.3	5.6		
	16.1	5.25		

	16.5	4.95
	17.5	4.75

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.16	0.15	0.04	0.01	3.77
0.45	0.15	0.07	0.02	7.17
0.5	0.05	0.03	0.01	2.52
0.51	0	0	0	0
0.51	0.1	0.05	0.01	5.03
0.5	0.05	0.03	0.01	2.52
0.54	0.28	0.14	0.04	14.09
0.5	0.2	0.1	0.03	10.06
0.51	0.1	0.05	0.01	5.03
0.5	0.12	0.06	0.02	6.04
0.5	0.2	0.1	0.03	10.06
0.5	0.22	0.11	0.03	11.07
0.5	0.16	0.08	0.02	8.05
0.5	0.18	0.09	0.02	9.06
0.52	0	0	0	0
0.5	0.1	0.05	0.01	5.03
0.5	0.01	0.01	0	0.5
0.5	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

0	0	0	0	0
0	0	0	0	0

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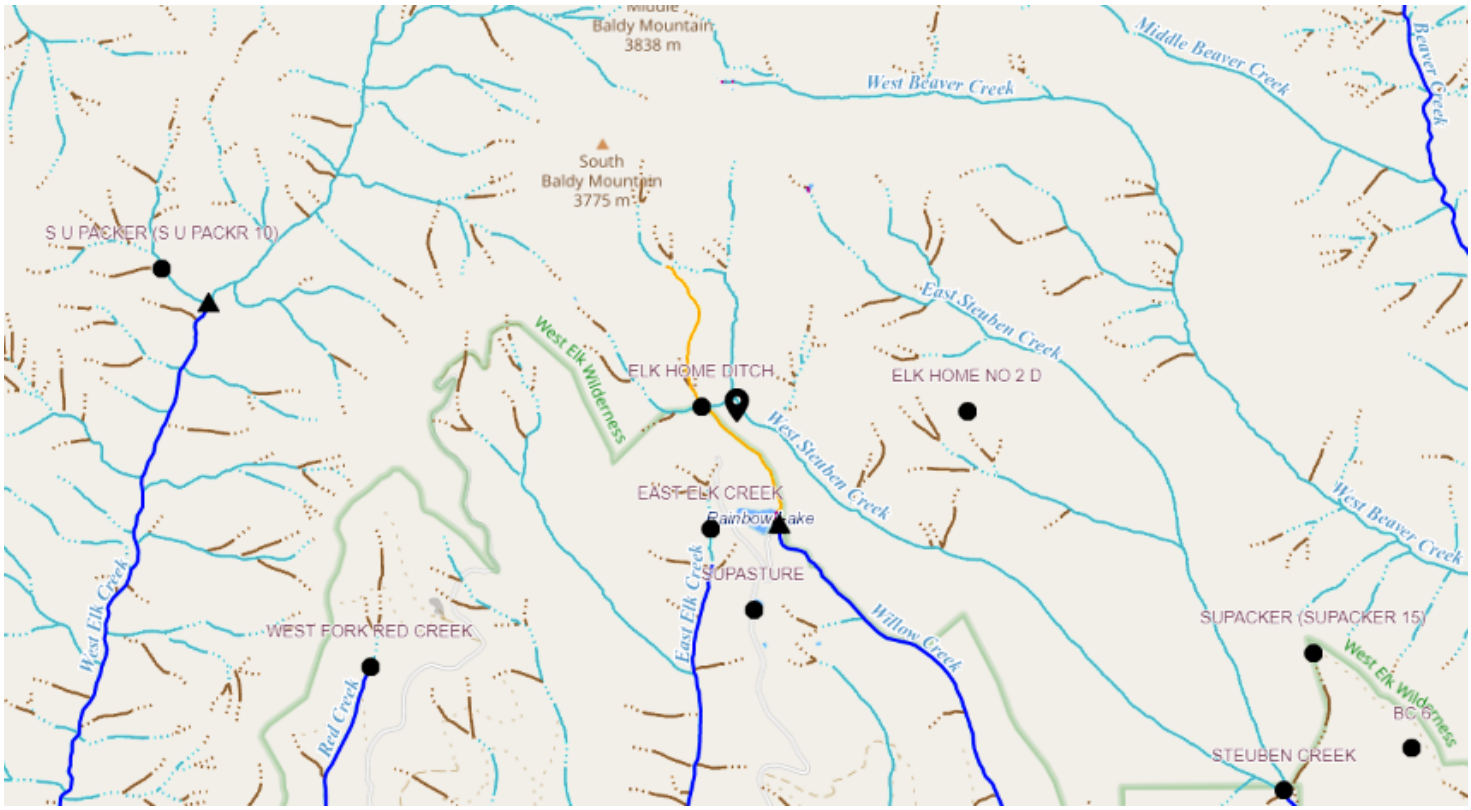
R2Cross RESULTS

Stream Name: West Stuben Creek
Stream Locations: Below EH 1 &2 Trib. Confluences
Fieldwork Date: 08/04/2021
Cross-section: 3
Observers: Birch & McDowell
Coordinate System: UTM Zone 13
X (easting): 310049
Y (northing): 4279529
Date Processed: 12/01/2022
Slope: 0.0264
Discharge: Entered Value: 0.47 (cfs)
Computation method: Ferguson VPE
a1: 6.5
a2: 2.5
R2Cross data filename: 3-R2Cross_West-Stueben_8_4_21 - corrected.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 17.29

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	2.08
Percent Wetted Perimeter (%)	50.0	0.27
Mean Velocity (ft/s)	1.0	3.23

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	2.98	17.29	0.93	1.28	16.05	17.84	100.0	0.9	0.04	5.3	85.08
	3.0	17.22	0.91	1.26	15.73	17.75	99.51	0.89	0.04	5.22	82.04
	3.05	17.01	0.87	1.21	14.87	17.51	98.2	0.85	0.04	4.99	74.2
	3.1	16.8	0.84	1.16	14.03	17.28	96.89	0.81	0.04	4.76	66.73
	3.15	16.65	0.79	1.11	13.19	17.1	95.85	0.77	0.05	4.5	59.43
	3.2	16.54	0.75	1.06	12.36	16.95	95.01	0.73	0.05	4.24	52.38
	3.25	16.39	0.7	1.01	11.54	16.77	94.01	0.69	0.05	3.97	45.82
	3.3	16.11	0.67	0.96	10.73	16.47	92.32	0.65	0.05	3.73	40.02
	3.35	15.83	0.63	0.91	9.93	16.16	90.63	0.61	0.05	3.49	34.61
	3.4	15.61	0.59	0.86	9.14	15.92	89.24	0.57	0.05	3.22	29.47
	3.45	15.4	0.54	0.81	8.37	15.68	87.94	0.53	0.05	2.95	24.69
	3.5	15.19	0.5	0.76	7.6	15.45	86.63	0.49	0.06	2.67	20.32
	3.55	14.99	0.46	0.71	6.85	15.22	85.33	0.45	0.06	2.39	16.38
	3.6	14.78	0.41	0.66	6.1	14.98	84.01	0.41	0.06	2.11	12.86
	3.65	14.51	0.37	0.61	5.37	14.7	82.43	0.37	0.07	1.83	9.82
	3.7	14.22	0.33	0.56	4.65	14.39	80.7	0.32	0.07	1.55	7.23
	3.75	13.93	0.28	0.51	3.95	14.08	78.96	0.28	0.08	1.28	5.06
	3.8	13.61	0.24	0.46	3.26	13.74	77.06	0.24	0.09	1.02	3.32
	3.85	13.12	0.2	0.41	2.59	13.25	74.27	0.2	0.11	0.77	2.01
	3.9	12.52	0.16	0.36	1.95	12.63	70.82	0.15	0.13	0.55	1.07
Waterline	3.95	11.43	0.12	0.31	1.35	11.52	64.61	0.12	0.16	0.37	0.5
	4.0	8.42	0.1	0.26	0.82	8.49	47.63	0.1	0.18	0.28	0.23
	4.05	5.07	0.1	0.21	0.49	5.12	28.71	0.1	0.18	0.28	0.14
	4.1	3.64	0.07	0.16	0.27	3.68	20.62	0.07	0.23	0.18	0.05
	4.15	2.09	0.06	0.11	0.12	2.11	11.81	0.06	0.28	0.13	0.02

	4.2	1.27	0.03	0.06	0.04	1.27	7.15	0.03	0.44	0.06	0.0
	4.25	0.34	0.01	0.01	0.0	0.34	1.92	0.01	1.52	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) =	0.47	(cfs)
Calculated Flow (Qc) =	0.48	(cfs)
(Qm-Qc)/Qm * 100 =	-2.74%	
Measured Waterline (WLm) =	3.98	(ft)
Calculated Waterline (WLc) =	3.95	(ft)
(WLm-WLc)/WLm * 100 =	0.66%	
Max Measured Depth (Dm) =	0.34	(ft)
Max Calculated Depth (Dc) =	0.31	(ft)
(Dm-Dc)/Dm * 100 =	8.46%	
Mean Velocity =	0.36	(ft/s)
Manning's n =	0.162	
a1	6.5	
a2	2.5	
0.4 * Qm =	0.19	(cfs)
2.5 * Qm =	1.18	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	0.86		
Bankfull	0.8	2.8		
	1.7	3.12		
	1.8	3.24		
	2.3	3.36		
	2.9	3.58		
	3.6	3.82		
Waterline	4.2	3.99		
	4.9	4.04	0.1	
	5.6	4.02	0.02	
	6.3	3.89	0	
	7	4	0.01	
	7.7	3.98	0.1	
	8.4	4.04	0.14	
	9.1	4.01	0.1	
	9.8	3.98	0.04	
	10.5	4	0.06	
	11.2	4.12	0.17	
	11.9	4.16	0.15	
	12.6	4.08	0.09	
	13.3	4.08	0.1	
	14	4.18	0.21	
	14.7	4.26	0.34	
	15.4	4.21	0.3	
Waterline	16.1	3.96		
	17.2	3.79		
	17.7	3.62		
	18.3	3.2		
Bankfull	18.6	2.98		
	20.4	2.9		

	22.8	1.56
	24.6	2.06

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.7	0.1	0.07	0.02	5.18
0.7	0.02	0.01	0	1.04
0.71	0	0	0	0
0.71	0.01	0.01	0	0.52
0.7	0.1	0.07	0.02	5.18
0.7	0.14	0.1	0.03	7.25
0.7	0.1	0.07	0.02	5.18
0.7	0.04	0.03	0.01	2.07
0.7	0.06	0.04	0.01	3.11
0.71	0.17	0.12	0.04	8.81
0.7	0.15	0.1	0.04	7.77
0.7	0.09	0.06	0.02	4.66
0.7	0.1	0.07	0.02	5.18
0.71	0.21	0.15	0.05	10.88
0.7	0.34	0.24	0.08	17.62
0.7	0.3	0.21	0.07	15.54
0.74	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

0	0	0	0	0
0	0	0	0	0

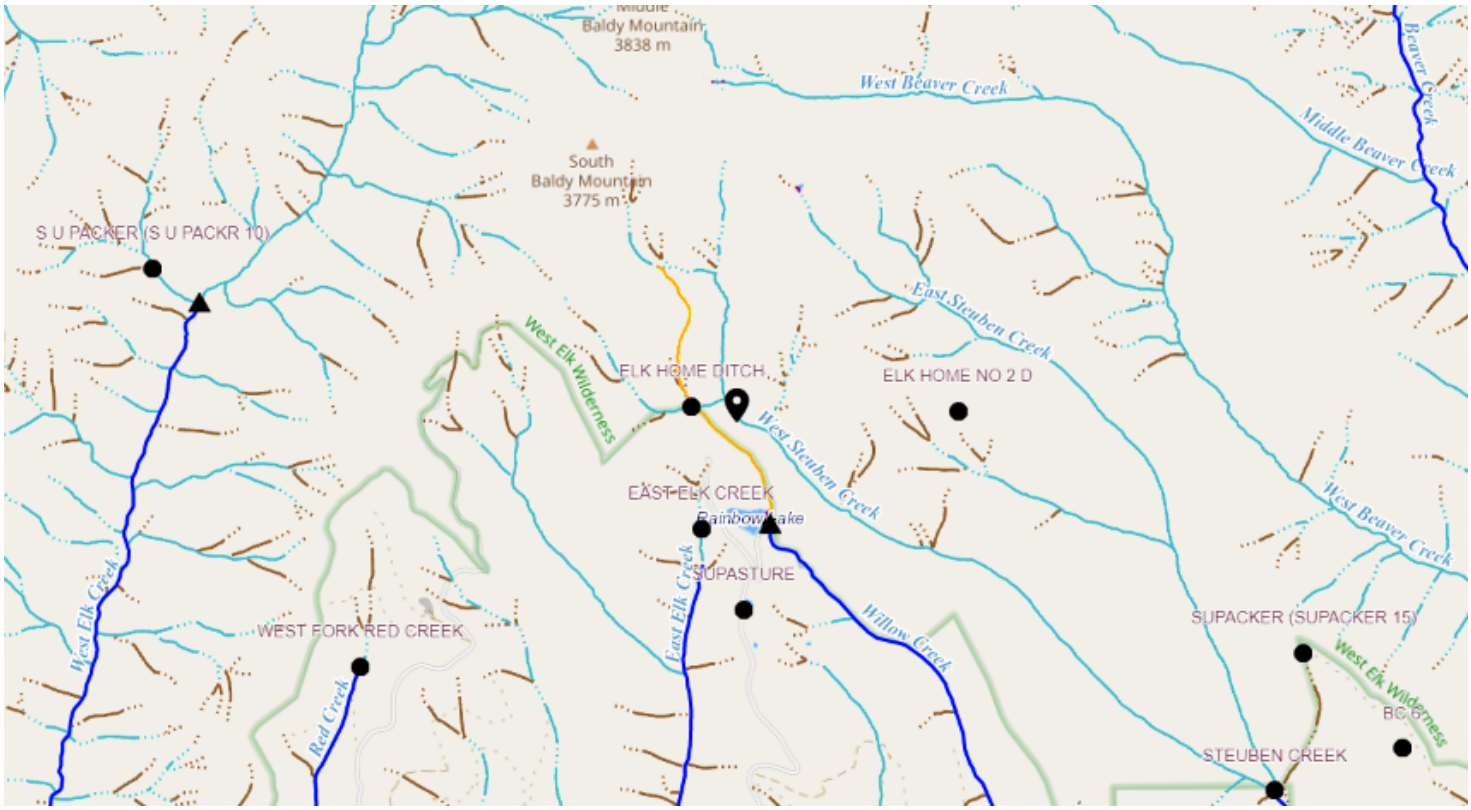
DISCLAIMER

"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: West Stuben Creek
Stream Locations: Below EH 1 &2 Trib. Confluences
Fieldwork Date: 08/04/2021
Cross-section: 4
Observers: Birch & McDowell
Coordinate System: UTM Zone 13
X (easting): 310062
Y (northing): 4279519
Date Processed: 12/01/2022
Slope: 0.054
Discharge: Entered Value: 0.47 (cfs)
Computation method: Ferguson VPE
a1: 6.5
a2: 2.5
R2Cross data filename: 4-R2Cross_West-Stueben_8_4_21.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 17.09

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.61
Percent Wetted Perimeter (%)	50.0	0.26
Mean Velocity (ft/s)	1.0	5.65

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	3.52	17.09	0.8	1.31	13.68	17.66	100.0	0.77	0.14	2.11	28.93
	3.57	16.71	0.77	1.26	12.85	17.27	97.77	0.74	0.14	1.99	25.63
	3.62	16.34	0.74	1.21	12.02	16.87	95.52	0.71	0.15	1.87	22.54
	3.67	15.63	0.72	1.16	11.22	16.16	91.49	0.69	0.15	1.81	20.26
	3.72	14.7	0.71	1.11	10.46	15.22	86.18	0.69	0.15	1.78	18.62
	3.77	14.47	0.67	1.06	9.73	14.97	84.74	0.65	0.16	1.64	15.99
	3.82	14.24	0.63	1.01	9.01	14.72	83.31	0.61	0.17	1.51	13.58
	3.87	14.01	0.59	0.96	8.31	14.46	81.88	0.57	0.17	1.37	11.41
	3.92	12.57	0.61	0.91	7.66	13.0	73.6	0.59	0.17	1.42	10.91
	3.97	12.33	0.57	0.86	7.04	12.74	72.11	0.55	0.18	1.3	9.13
	4.02	12.11	0.53	0.81	6.43	12.49	70.68	0.51	0.19	1.17	7.52
	4.07	11.9	0.49	0.76	5.83	12.25	69.34	0.48	0.2	1.04	6.07
	4.12	11.73	0.45	0.71	5.24	12.05	68.22	0.43	0.22	0.91	4.78
	4.17	11.56	0.4	0.66	4.65	11.85	67.1	0.39	0.24	0.79	3.66
	4.22	11.39	0.36	0.61	4.08	11.65	65.97	0.35	0.26	0.66	2.71
	4.27	11.23	0.31	0.56	3.51	11.46	64.85	0.31	0.29	0.55	1.92
	4.32	11.06	0.27	0.51	2.96	11.26	63.73	0.26	0.33	0.43	1.28
	4.37	10.87	0.22	0.46	2.41	11.03	62.47	0.22	0.38	0.33	0.79
Waterline	4.42	10.26	0.18	0.41	1.88	10.4	58.88	0.18	0.45	0.25	0.46
	4.47	8.86	0.16	0.36	1.39	8.97	50.76	0.16	0.5	0.2	0.27
	4.52	7.4	0.13	0.31	0.99	7.48	42.33	0.13	0.57	0.16	0.16
	4.57	5.15	0.13	0.26	0.68	5.2	29.46	0.13	0.58	0.15	0.11
	4.62	4.58	0.1	0.21	0.44	4.63	26.23	0.1	0.76	0.1	0.04
	4.67	3.48	0.07	0.16	0.23	3.51	19.89	0.07	1.02	0.06	0.01
	4.72	1.6	0.07	0.11	0.11	1.62	9.16	0.07	0.99	0.06	0.01

	4.77	1.16	0.04	0.06	0.04	1.17	6.61	0.04	1.73	0.02	0.0
	4.82	0.44	0.01	0.01	0.0	0.44	2.49	0.01	6.31	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) =	0.47	(cfs)
Calculated Flow (Qc) =	0.47	(cfs)
(Qm-Qc)/Qm * 100 =	0.56%	
Measured Waterline (WLm) =	4.48	(ft)
Calculated Waterline (WLc) =	4.42	(ft)
(WLm-WLc)/WLm * 100 =	1.35%	
Max Measured Depth (Dm) =	0.45	(ft)
Max Calculated Depth (Dc) =	0.41	(ft)
(Dm-Dc)/Dm * 100 =	8.77%	
Mean Velocity =	0.25	(ft/s)
Manning's n =	0.442	
a1	6.5	
a2	2.5	
0.4 * Qm =	0.19	(cfs)
2.5 * Qm =	1.18	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	2.74		
Bankfull	1	3.52		
	2.2	3.72		
	2.7	3.88		
	3.9	3.88		
	4.5	4.06		
	5.2	4.36		
Waterline	5.8	4.48		
	6	4.55	0.06	
	6.5	4.55	0.07	
	7	4.64	0.16	
	7.5	4.68	0.21	
	8	4.7	0.3	
	8.5	4.7	0.3	
	9	4.64	0.27	
	9.5	4.71	0.34	
	10	4.83	0.45	
	10.5	4.81	0.43	
	11	4.76	0.4	
	11.5	4.61	0.22	
	12	4.53	0.13	
	12.5	4.56	0.18	
	13	4.4	0	
	13.5	4.44	0.04	
	14	4.48	0.07	
	14.5	4.46	0.05	
	15	4.52	0.04	
	15.5	4.54	0.05	
Waterline	16	4.48		
	16.5	3.99		

	16.9	3.72
	17.9	3.64
	18.2	3.45
Bankfull	19.7	3.44
	20.9	3.24
	22	2.8

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.21	0.06	0.02	0.01	1.12
0.5	0.07	0.04	0.01	1.87
0.51	0.16	0.08	0.02	4.26
0.5	0.21	0.1	0.03	5.6
0.5	0.3	0.15	0.04	8
0.5	0.3	0.15	0.04	8
0.5	0.27	0.14	0.03	7.2
0.5	0.34	0.17	0.04	9.06
0.51	0.45	0.23	0.06	11.99
0.5	0.43	0.21	0.05	11.46
0.5	0.4	0.2	0.05	10.66
0.52	0.22	0.11	0.03	5.86
0.51	0.13	0.07	0.02	3.46
0.5	0.18	0.09	0.02	4.8
0.52	0	0	0	0
0.5	0.04	0.02	0.01	1.07
0.5	0.07	0.04	0.01	1.87
0.5	0.05	0.03	0.01	1.33
0.5	0.04	0.02	0.01	1.07
0.5	0.05	0.03	0.01	1.33
0.5	0	0	0	0
0	0	0	0	0

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	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.

PEBBLE COUNT

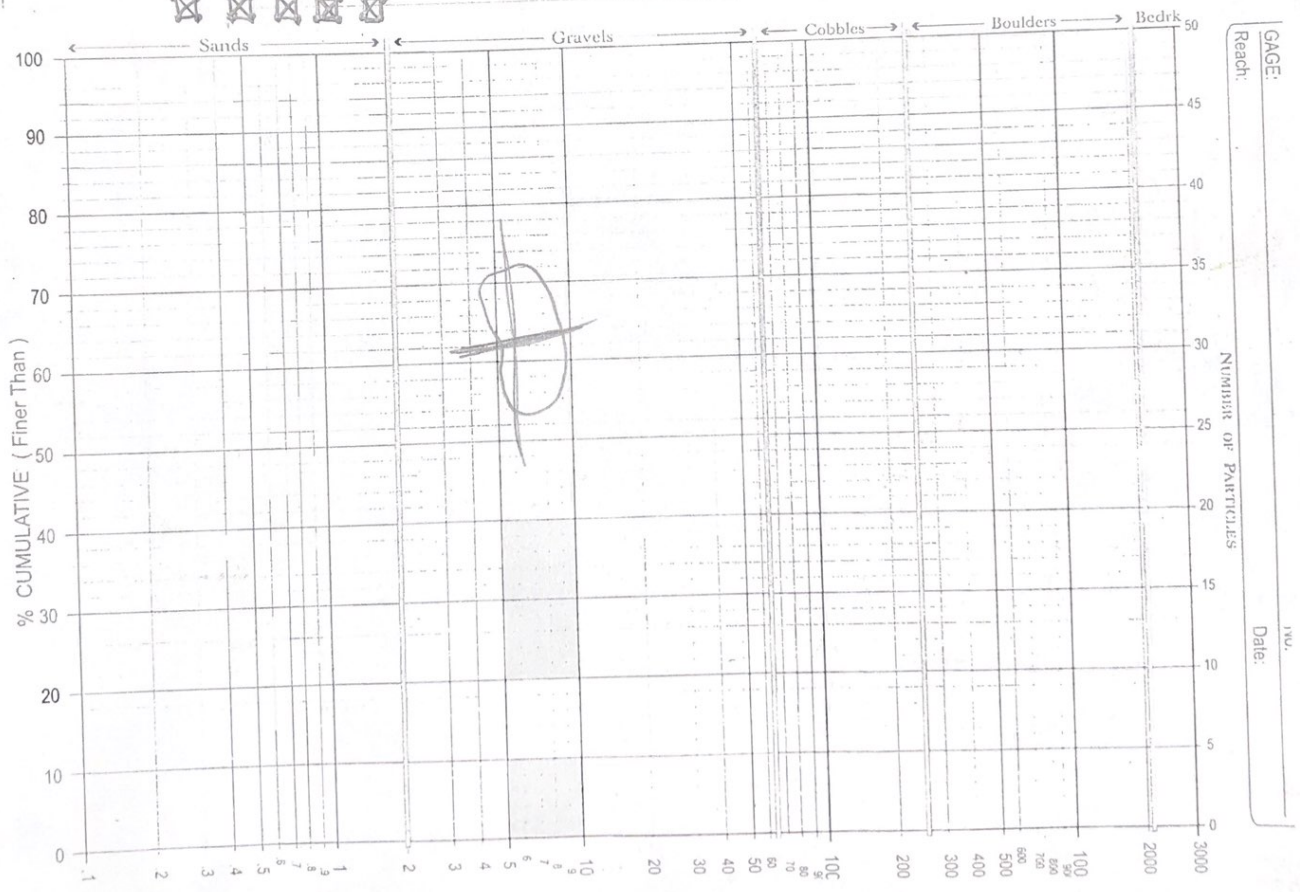
Site: West Steuben
Party: Birch / McDowell

Reach: Below EH 132 confluences
Date: 8/4/21

Inches	PARTICLE	Millimeters		PARTICLE COUNT 1	2	3	TOT #	ITEM %	% CUM
	Silt / Clay	< .062	SAC	Riffle 2	Riffle 2	→	combined due to similarity of riffle substrate.		
	Very Fine	.062 - .125	SAND						
	Fine	.125 - .25							
	Medium	.25 - .50							
	Coarse	.50 - 1.0							
.04 - .08	Very Coarse	1.0 - 2							
.08 - .16	Very Fine	2 - 4	GRAVEL						
.16 - .22	Fine	4 - 5.7							
.22 - .31	Fine	5.7 - 8		2			2		
.31 - .44	Medium	8 - 11.3		3	5		8		
.44 - .63	Medium	11.3 - 16		3	2		5		
.63 - .89	Coarse	16 - 22.6		6	2		8		
.89 - 1.26	Coarse	22.6 - 32		9	7		16		
1.26 - 1.77	Very Coarse	32 - 45		10	4		14		
1.77 - 2.5	Very Coarse	45 - 64		8	3		11		
2.5 - 3.5	Small	64 - 90	COBBLE	6	3		9		
3.5 - 5.0	Small	90 - 128		3	8		11		
5.0 - 7.1	Large	128 - 180		1	7		8		
7.1 - 10.1	Large	180 - 256			2		2		
10.1 - 14.3	Small	256 - 362	BOULDER		5		5		
14.3 - 20	Small	362 - 512		1			1		
20 - 40	Medium	512 - 1024			1		1		
40 - 80	Large-Vry Large	1024 - 2048			1		1		
	Bedrock		BEDROCK						
						TOTALS →			

PEBBLE COUNT
Reach:
Date:

PEBBLE COUNT
Reach:
Date:



Length/Frequency

Water **46137** **Steuben Creek, West**

Station **GU2750** **NNE of Rainbow Lake**

Date **8/31/2011**

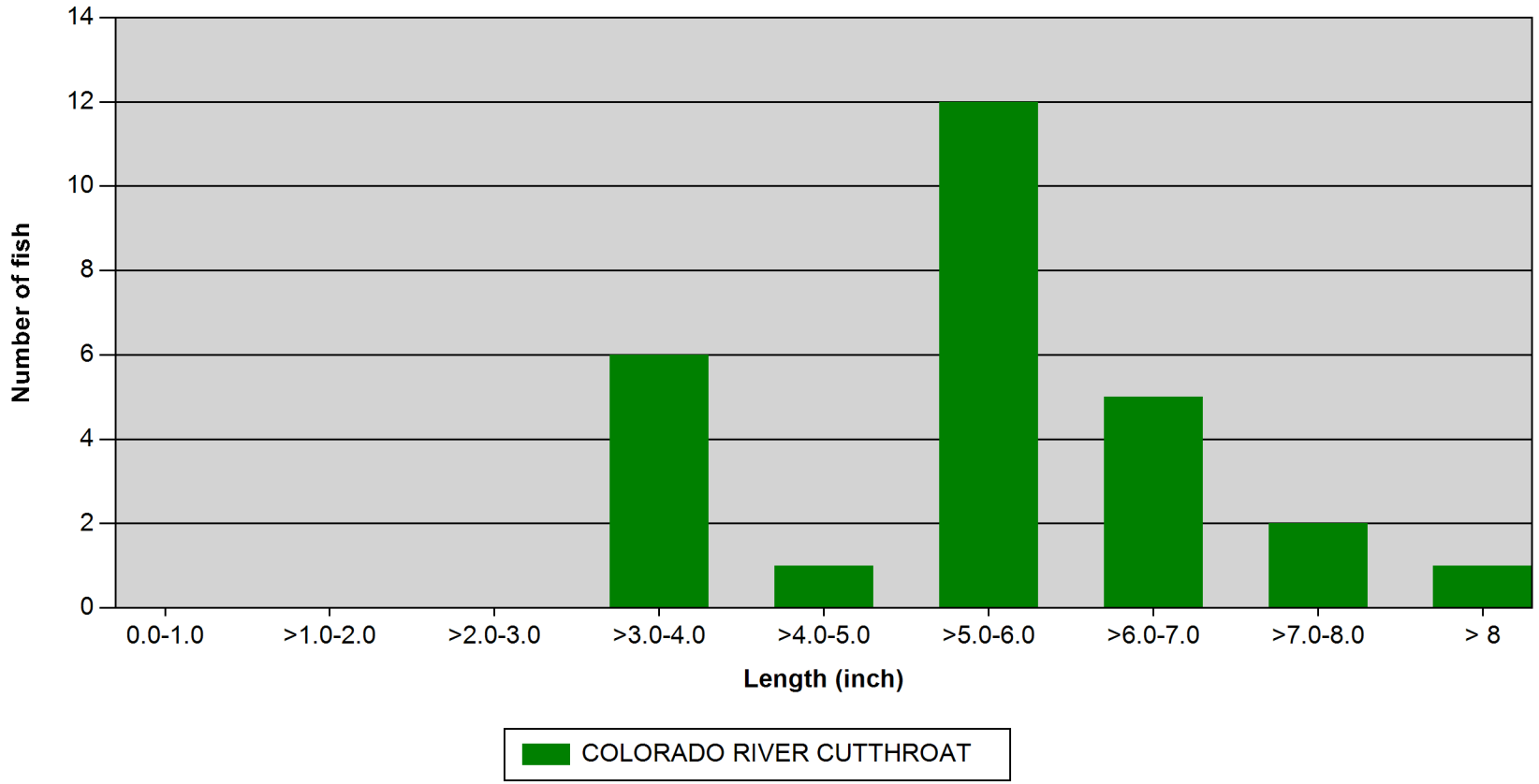
Drainage **Gunnison River**

UtmX **310425** UtmY **4279245** Elevation **3226 m**

Length **91 m** Width **4.27 m** Area **0.04 Ha**

Surveyors **Brauch, BonDurant, Dennison**

Gear **NOT LISTED** Effort Metric **PASS** Protocol **TWO-PASS REMOVAL**



West Steuben Creek Bird's Eye View, Fish Habitat Overview

West Steuben Creek Cross Section 1 (Pictured without Transect Tape), Looking Upstream from Left Bank & Flow Measurement Transect (Pictured with Transect Tape)

West Steuben Creek Cross Section 1, Looking Upstream

West Steuben Creek Cross Section 1, Close Up Looking Upstream

West Steuben Creek Cross Section 2, Looking Downstream

West Steuben Creek Cross Section 3, Looking Upstream

West Steuben Creek Cross Section 3, Looking Downstream

West Steuben Creek Cross Section 3, Looking Across Cross Section from Right Bank

West Steuben Creek Cross Section 4, Looking Upstream from Right Bank

West Steuben Creek Cross Section 4, Looking Downstream

West Steuben Creek Cross Section 4, Looking Downstream from Right Bank

West Steuben Creek Overview

West Steuben Creek Fish Habitat Overview

West Steuben Creek Large Woody Debris in Channel

West Steuben Creek, High Gradient Pocket Pool Fish Habitat

West Steuben Creek Bedrock Control Features and Large Pools

West Steuben Creek, Bedrock Run

West Steuben Creek Fish Habitat, Instream and Riparian Cover