United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7210
www.co.blm.gov

In Reply Refer To:
7250 (CO-930)

DEC 2 2 2014

Ms. Linda Bassi
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Dear Ms. Bassi:

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

Location and Land Status. Brush Creek originates approximately two miles east of Douglas Pass and flows into East Douglas Creek. This recommendation covers the stream reach beginning at headwaters and extends downstream to the confluence with East Douglas Creek. This stream reach covers a distance of approximately 4.5 miles. The BLM manages approximately 2.5 miles of this stream reach, while 2.0 miles are in private ownership.

Biological Summary. Brush Creek is a cold-water, moderate to high gradient stream in a narrow canyon. The stream cuts through alluvial deposits in a narrow valley and is not confined by bedrock in most locations. The stream generally has small substrate, consisting of sands and gravels. While riffle habitat is abundant, parts of the stream lack extensive pool habitat because of historic overgrazing and lack of woody vegetation.

Fisheries surveys have revealed a self-sustaining population of rainbow trout and cutthroat trout. Fish numbers are generally more abundant in the lower portions of the reach. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Brush Creek is comprised of grasses and sedges in some parts of the creek, while other portions are dominated by blue spruce and douglas fir. The riparian area is recovering from historic grazing practices. In portions of the reach with a conifer riparian community, cover and shading for the stream is good. Some portions of the creek with sedge and grass riparian community have good width-to-depth ratios, while other portions of the reach with sedge and grass community are open and wide, which limits usable fish habitat.

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

Cross Section Date	Discharge Rate	Top Width	Winter Flow Recommendation (meets 2 of 3 hydraulic criteria)	Summer Flow Recommendation (meets 3 of 3 hydraulic criteria)
07/29/2009 #1	0.73 cfs	4.24 feet	0.53 cfs	0.73 cfs
07/29/2009 #2	0.76 cfs	4.0 feet	0.47 cfs	0.57 cfs
		Averages:	0.50 cfs	0.65 cfs

The BLM's analysis of this data, coordinated with Colorado Parks and Wildlife (CPW), indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree.

> 0.65 cubic feet per second is recommended for the snowmelt runoff and high temperature period from April 1 through October 31. This recommendation is driven by the average depth criteria. This creek experiences consistently low flows during late summer and fall, so it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff and growing season flows are available. This flow rate is capable of maintaining pool habitat in the creek and preventing excessively water high temperatures.
>
> 0.50 cubic feet per second is recommended for the late fall and winter period from November1 to March 31. This recommendation is driven the average velocity criteria. This flow rate should provide sufficient flow to prevent pools from freezing and protect overwintering fish.

Water Availability. The BLM is not aware of any historic gage data within the East Douglas Creek watershed. The BLM does not recommend relying upon other gages that are within western Rio Blanco County because those gages measure watersheds with very different characteristics. For example, U.S. Geological Survey (USGS) Gage 09306380 (Douglas Creek at Rangely) is located at the bottom of the very large Douglas Creek watershed, of which Brush Creek is a part. However, this watershed contains many square miles of low elevation terrain with low runoff per unit of area. In contrast, Brush Creek is located at the top of Douglas Creek watershed, with high runoff per unit of area. Historic gages in the Piceance Creek watershed to the east, such as USGS Gage 09306175 (Black Sulphur Creek), measure large watersheds with characteristics similar to the large Douglas Creek watershed. Accordingly, the BLM recommends relying upon the StreamStats package developed jointly between the U.S. Geological Survey and the Colorado Water Conservation Board (CWCB) for the best flow estimates.

The BLM is not aware of any decreed water rights within the proposed instream flow reach.

Relationship to Land Management Plans. This stream reach is located within the BLM's "East Douglas Creek Area of Critical Environmental Concern." The BLM designated this area to protect important biologically diverse plant communities, riparian habitat, and cutthroat trout habitat. The BLM intends to continue management of this watershed for natural conditions and processes. Appropriation of an instream flow water right would assist the BLM in long-term management of riparian values and important fishery values.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with the BLM's draft recommendation in February 2014. We thank both CPW and the CWCB for their cooperation in this effort.

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

Sincerely,

Acting

Brian St. George
Deputy State Director
Resources and Fire Management

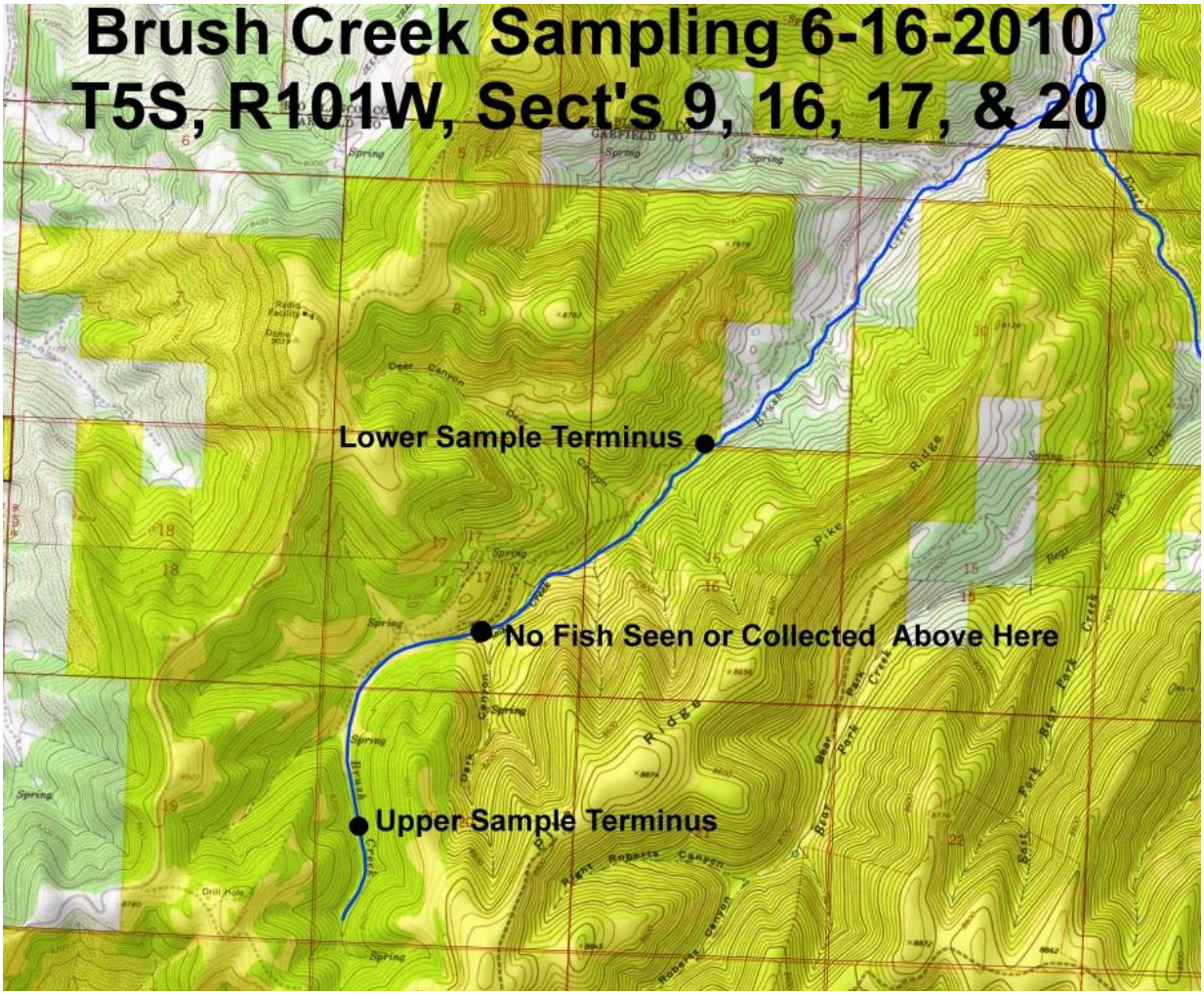
cc: Kent Walter, White River FO
Keith Sauter, White River FO
Ed Hollowed, White River FO
Joseph Meyer, Northwest District Office

White River Field Office Stream Surveys
June 2010

Brush Creek - Water Code #19299

Brush Creek, located on BLM lands administered by the White River Field Office, was sampled approximately two miles above the confluence with East Douglas Creek on June 16, 2010. Sampling was conducted to determine fishery status, determine the upper distribution of resident trout, and to analyze stream habitat complexity. The site was sampled with two crews using backpack electroshockers. Personnel present were Tom Fresques, Kristy Wallner, and Gregor Dekleva, BLM, and Frank Boyd Wright III, Colorado Division of Wildlife.

Rainbow trout, cutthroat trout, and apparent rainbow/cutthroat hybrids were collected. A population estimate was not completed.



Uppermost Sample Site

Middle Reach

Lower Reach

Rainbow trout

Rainbow trout

Old log drop structure?

Small waterfall – no fish seen or collected above here

Discussion:

Brush Creek was running clear and had a predominantly clean gravel substrate. The stream appears to be a Rosgen B channel type in the upper reaches and a B/A in the middle and lower reaches. The upper reach had reliable flow as a result of input from several tributary springs, but lacked good riparian habitat/stream shading, and larger deeper pools. Stream banks were dominated by dandelion and houndstongue with no woody species or desirable herbaceous species. The middle reach lacked woody species as well but had better herbaceous cover primarily sedges and rushes, although active bank erosion was evident and stream cover was still largely lacking. This reach had better flow and slightly better pool habitat. The lower reach was conifer dominated and had much better stream cover and shading. With increased flows, pools were deeper and more abundant. Large woody debris helped to create pools and slow stream velocities.

The upper reach apparently used to contain a rather large beaver pond complex although little evidence of these ponds exists. It appears that the ponds blew out some time ago and the stream appears to still be healing. It appears that some human constructed log drop structures were placed in the upper reach to create pool habitat. The majority of these have failed, but a few are still functioning. In the middle reach, it

appears that large woody material (spruce-fir trees) was placed into and adjacent to the creek to help slow stream velocities and reduce streambank erosion.

Fish were collected from the BLM/private land boundary upstream to a small waterfall. This waterfall does not appear to be a barrier to upstream movement but no fish were seen or collected above the site. Fish density near and at the upper sampling terminus was low. A total of 10 fish were seen or collected in approximately 800 feet of stream. This area is also close to the transition between the lower and middle reach. The middle reach provides substantially less cover and currently provides poor trout habitat. It is possible/likely that improvements in streamside vegetation and cover in the upper and middle reaches could improve and expand the upstream range of resident fish.

For the purposes of possible reclamation of the upper East Douglas Creek watershed, limited habitat complexity was noted on the portions of Brush Creek on BLM lands. The lack of beaver ponds could make chemical reclamation of this creek much easier and increase the likelihood of project success.

Recommendations:

- We assume that fish extend all the way down to the confluence with East Douglas Creek. We need to look at the creek on private lands and assess the habitat complexity of this lowest reach.

- Need to meet with private land owners in the Brush Creek watershed regarding potential reclamation and conversion of the creek back to a native cutthroat fishery.

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Brush Creek
XS LOCATION:	0.25 m u/s fr conf w/ E. Douglas Ck.
XS NUMBER:	1
DATE:	29-Jul-09
OBSERVERS:	R. Smith, P. Crowley
1/4 SEC:	SE
SECTION:	34
TWP:	4S
RANGE:	101W
PM:	Sixth
COUNTY:	Rio Blanco/Garfield
WATERSHED:	White River
DIVISION:	6
DOW CODE:	19299
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

*** NOTE ***
Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod

CHANNEL PROFILE DATA

SLOPE:	0.012

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....……..…….....DATE.....

STREAM NAME: Brush Creek
XS LOCATION: 0.25 m u/s fr conf w/ E. Douglas Ck.
XS NUMBER: 1

DATA POINTS= 18

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	2.00	5.09			0.00		0.00	0.00	0.0%
		3.00	5.62			0.00		0.00	0.00	0.0%
1	G	4.50	5.91			0.00		0.00	0.00	0.0%
	W	5.00	6.35	0.00	0.00	0.00		0.00	0.00	0.0%
		5.30	6.65	0.30	0.81	0.42	0.30	0.09	0.07	9.9%
		5.60	6.65	0.30	1.44	0.30	0.30	0.09	0.13	17.7%
		5.90	6.65	0.30	1.24	0.30	0.30	0.09	0.11	15.2%
		6.20	6.60	0.25	1.50	0.30	0.25	0.08	0.11	15.3%
		6.50	6.60	0.25	1.49	0.30	0.25	0.08	0.11	15.2%
		6.80	6.55	0.20	1.26	0.30	0.20	0.06	0.08	10.3%
		7.10	6.55	0.20	1.06	0.30	0.20	0.06	0.06	8.7%
		7.40	6.50	0.15	0.87	0.30	0.15	0.05	0.04	5.3%
		7.70	6.50	0.15	0.39	0.30	0.15	0.05	0.02	2.4%
		8.00	6.45	0.10	0.00	0.30	0.10	0.03	0.00	0.0%
	W	8.20	6.35			0.22		0.00	0.00	0.0%
1	G	8.90	5.78			0.00		0.00	0.00	0.0%
		11.80	5.56			0.00		0.00	0.00	0.0%
	LS	13.70	4.53			0.00		0.00	0.00	0.0%
	TOTALS ----------					3.36	0.3 (Max.)	0.66	0.73	100.0%

Manning's n = 0.0488
Hydraulic Radius= 0.19468418

STREAM NAME: Brush Creek
XS LOCATION: 0.25 m u/s fr conf w/ E. Douglas Ck.
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.66	0.66	0.0%
6.10	0.66	1.53	133.4%
6.12	0.66	1.45	121.9%
6.14	0.66	1.38	110.6%
6.16	0.66	1.31	99.3%
6.18	0.66	1.23	88.3%
6.20	0.66	1.16	77.3%
6.22	0.66	1.09	66.6%
6.24	0.66	1.02	55.9%
6.26	0.66	0.95	45.4%
6.28	0.66	0.88	35.1%
6.30	0.66	0.82	24.9%
6.31	0.66	0.78	19.8%
6.32	0.66	0.75	14.8%
6.33	0.66	0.72	9.8%
6.34	0.66	0.69	4.9%
6.35	0.66	0.66	0.0%
6.36	0.66	0.62	-4.9%
6.37	0.66	0.59	-9.7%
6.38	0.66	0.56	-14.5%
6.39	0.66	0.53	-19.2%
6.40	0.66	0.50	-23.9%
6.42	0.66	0.44	-33.1%
6.44	0.66	0.38	-42.1%
6.46	0.66	0.32	-50.9%
6.48	0.66	0.27	-59.4%
6.50	0.66	0.21	-67.4%
6.52	0.66	0.17	-74.0%
6.54	0.66	0.13	-80.3%
6.56	0.66	0.09	-85.6%
6.58	0.66	0.07	-90.1%
6.60	0.66	0.04	-94.1%

WATERLINE AT ZERO
AREA ERROR = 6.350

STREAM NAME: Brush Creek
XS LOCATION: 0.25 m u/s fr conf w/ E. Douglas Ck.
XS NUMBER: 1

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.91	4.24	0.54	0.74	2.29	4.73	100.0%	0.48	4.72	2.06
	5.95	4.15	0.51	0.70	2.12	4.60	97.4%	0.46	4.23	1.99
	6.00	4.03	0.48	0.65	1.92	4.45	94.1%	0.43	3.66	1.91
	6.05	3.91	0.44	0.60	1.72	4.29	90.8%	0.40	3.12	1.81
	6.10	3.79	0.40	0.55	1.53	4.14	87.6%	0.37	2.63	1.72
	6.15	3.67	0.37	0.50	1.34	3.98	84.3%	0.34	2.17	1.62
	6.20	3.55	0.33	0.45	1.16	3.83	81.0%	0.30	1.75	1.51
	6.25	3.44	0.29	0.40	0.99	3.67	77.7%	0.27	1.37	1.39
	6.30	3.32	0.25	0.35	0.82	3.52	74.4%	0.23	1.03	1.26
WL	6.35	3.20	0.20	0.30	0.65	3.36	71.2%	0.19	0.73	1.12
	6.40	3.05	0.16	0.25	0.50	3.18	67.3%	0.16	0.48	0.97
	6.45	2.90	0.12	0.20	0.35	3.00	63.4%	0.12	0.28	0.80
	6.50	2.25	0.09	0.15	0.21	2.32	49.2%	0.09	0.15	0.68
	6.55	1.60	0.07	0.10	0.11	1.65	34.9%	0.07	0.06	0.55
	6.60	0.95	0.04	0.05	0.04	0.97	20.6%	0.04	0.02	0.39

STREAM NAME: Brush Creek
XS LOCATION: 0.25 m u/s fr conf w/ E. Douglas Ck.
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.73	cfs
CALCULATED FLOW (Qc)=	0.73	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	6.35	ft
CALCULATED WATERLINE (WLc)=	6.35	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.30	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	1.12	ft/sec
MANNING'S N=	0.049	
SLOPE=	0.012	ft/ft
.4 * Qm =	0.3	cfs
2.5 * Qm=	1.8	cfs

RECOMMENDED INSTREAM FLOW:
============================

FLOW (CFS)	PERIOD
___________________	___________________
___________________	___________________
___________________	___________________
___________________	___________________

RATIONALE FOR RECOMMENDATION:
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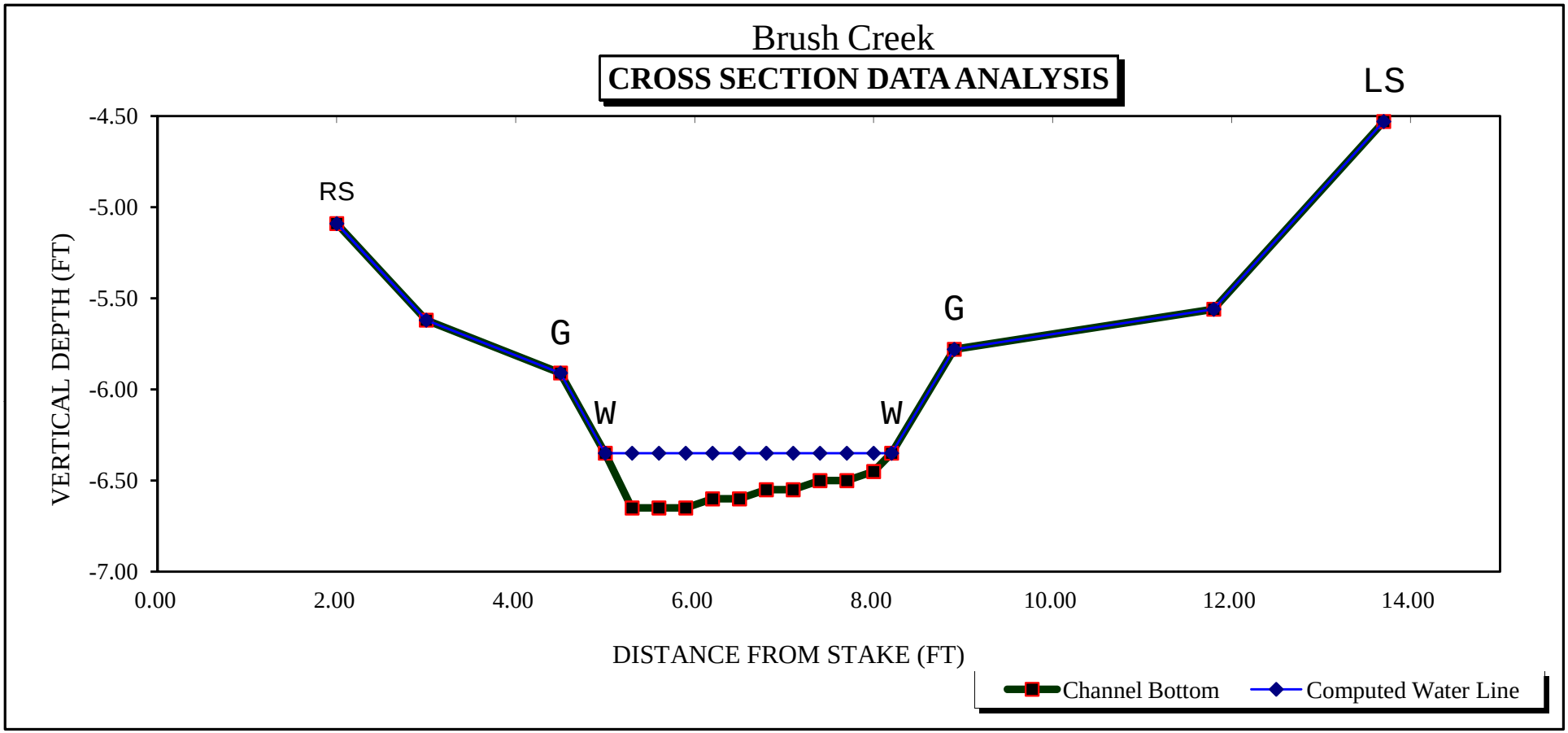
RECOMMENDATION BY: ………………...………..……............................... AGENCY..……………………….....……...…....……...... DATE:......…...…......……………

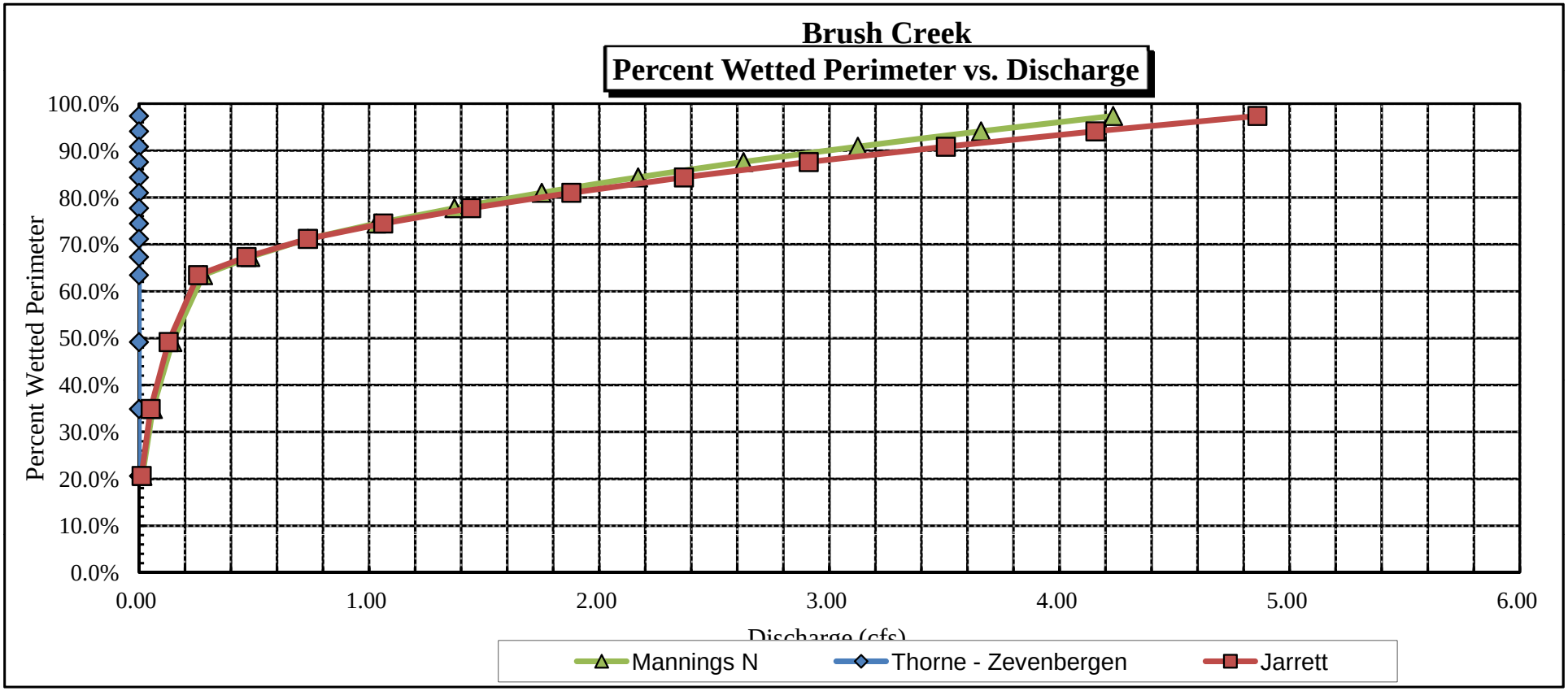
CWCB REVIEW BY: ..……………………….....……………………………………………...…............ DATE:.................…………….....

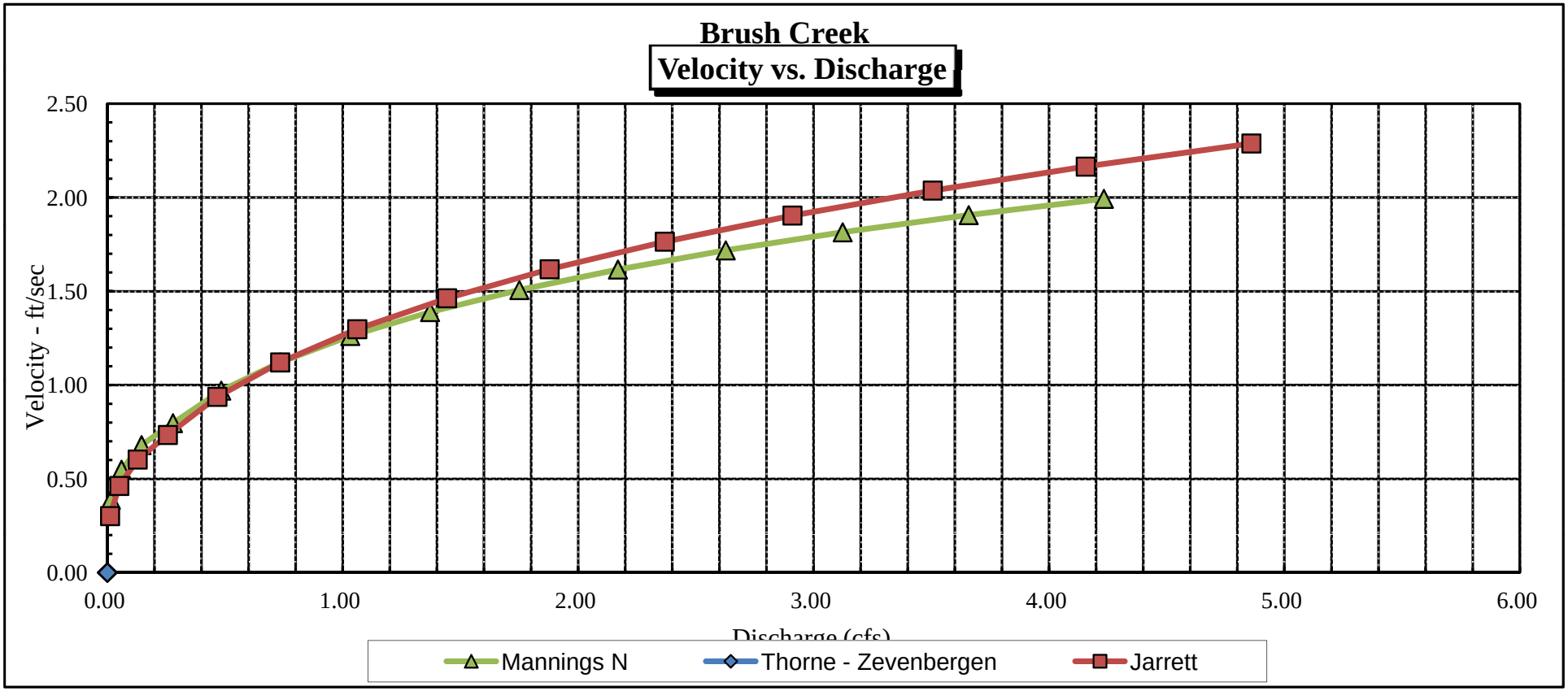
STREAM NAME: Brush Creek
XS LOCATION: 0.25 m u/s fr conf w/ E. Douglas Ck.
XS NUMBER: 1 Jarrett Variable Manning's n Correction Applied

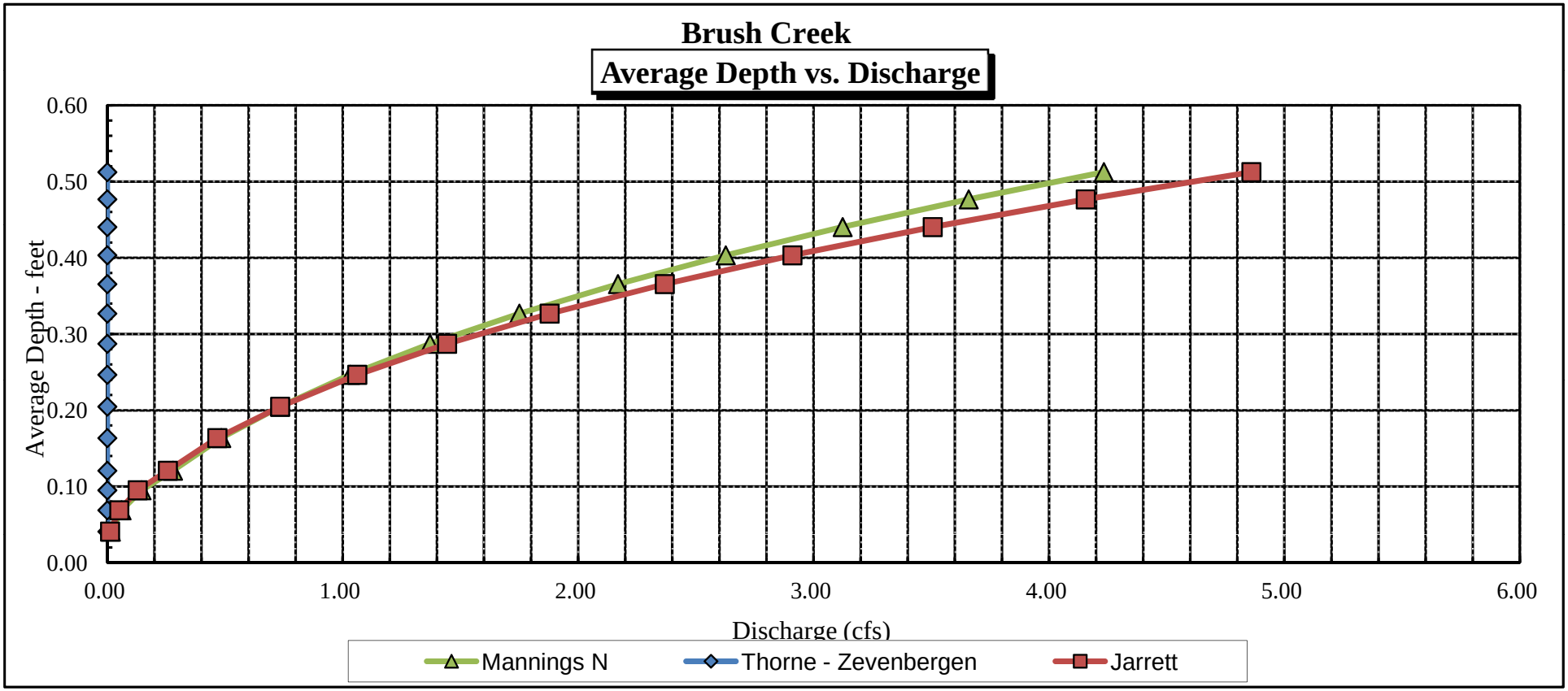
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

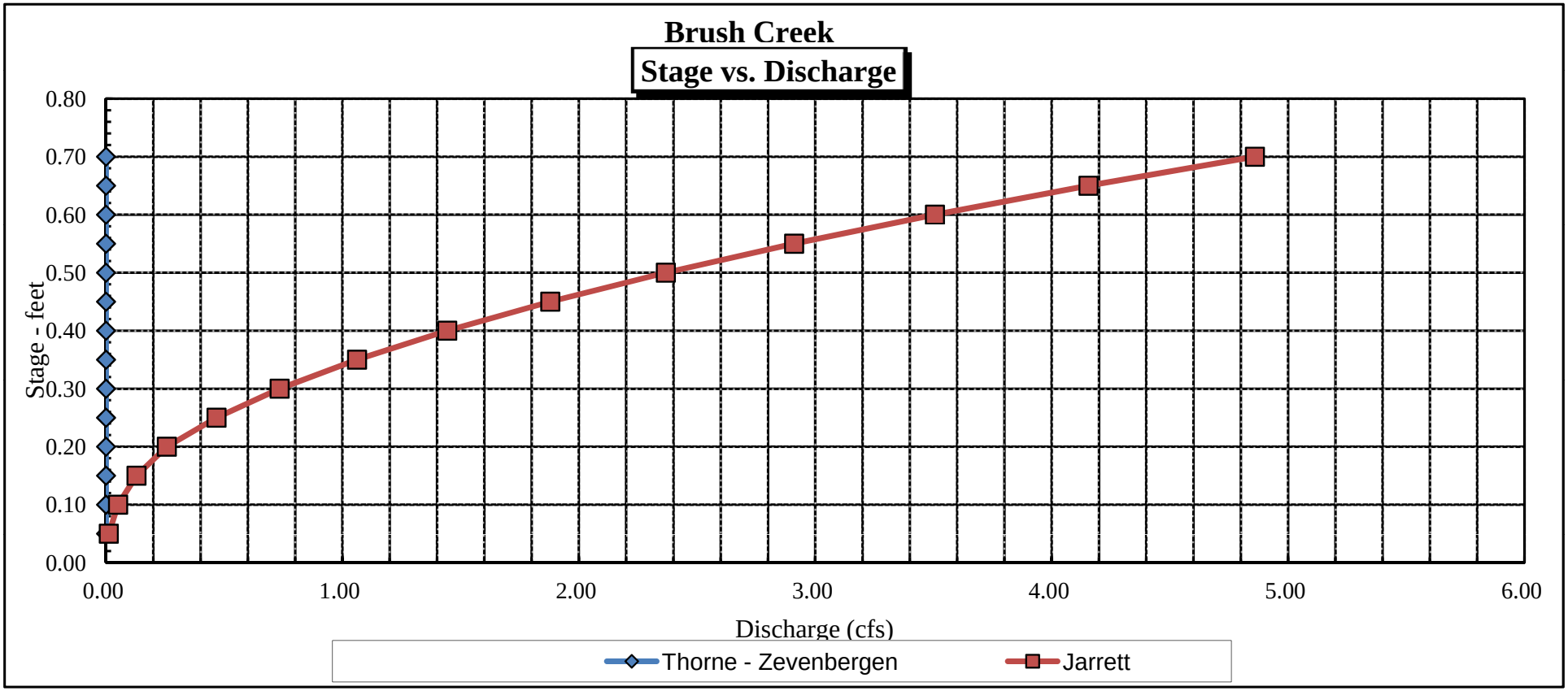
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.91	4.24	0.54	0.74	2.29	4.73	100.0%	0.48	5.46	2.38
	5.95	4.15	0.51	0.70	2.12	4.60	97.4%	0.46	4.86	2.29
	6.00	4.03	0.48	0.65	1.92	4.45	94.1%	0.43	4.16	2.16
	6.05	3.91	0.44	0.60	1.72	4.29	90.8%	0.40	3.51	2.04
	6.10	3.79	0.40	0.55	1.53	4.14	87.6%	0.37	2.91	1.90
	6.15	3.67	0.37	0.50	1.34	3.98	84.3%	0.34	2.37	1.76
	6.20	3.55	0.33	0.45	1.16	3.83	81.0%	0.30	1.88	1.62
	6.25	3.44	0.29	0.40	0.99	3.67	77.7%	0.27	1.44	1.46
	6.30	3.32	0.25	0.35	0.82	3.52	74.4%	0.23	1.06	1.30
WL	6.35	3.20	0.20	0.30	0.65	3.36	71.2%	0.19	0.73	1.12
	6.40	3.05	0.16	0.25	0.50	3.18	67.3%	0.16	0.47	0.94
	6.45	2.90	0.12	0.20	0.35	3.00	63.4%	0.12	0.26	0.73
	6.50	2.25	0.09	0.15	0.21	2.32	49.2%	0.09	0.13	0.60
	6.55	1.60	0.07	0.10	0.11	1.65	34.9%	0.07	0.05	0.46
	6.60	0.95	0.04	0.05	0.04	0.97	20.6%	0.04	0.01	0.30


Brush Creek
CROSS SECTION DATA ANALYSIS
LS
RS
G
W
W
G
-4.50
-5.00
-5.50
-6.00
-6.50
-7.00
VERTICAL DEPTH (FT)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Brush Creek
Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Brush Creek
Velocity vs. Discharge
Velocity - ft/sec
2.50
2.00
1.50
1.00
0.50
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Brush Creek
Average Depth vs. Discharge
Average Depth - feet
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Brush Creek
Stage vs. Discharge
Stage - feet
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER
CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Brush Creek					CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: Approx. 1/4 mile upstream from conf. w/ East Douglas Creek					
DATE: 7-29-09	OBSERVERS: R. Smith, P. Crowley				
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 34	TOWNSHIP: 4 N/(S)	RANGE: 101 E/(W)	PM: 6th
COUNTY: Rio Blanco	WATERSHED: White River		WATER DIVISION: 6		DOW WATER CODE: 19299
MAP(S):	USGS: GPS 12 S 0696501				
	USFS: 6967 ft. 4391697				

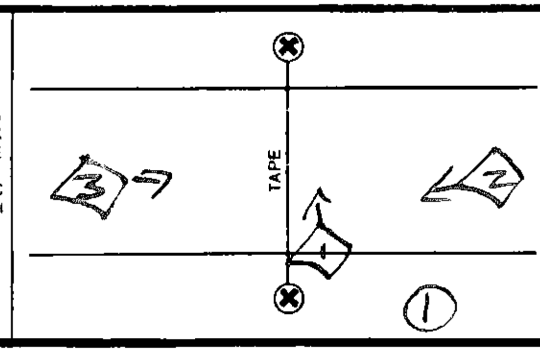
SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	6.35 / 6.35
(2) WS Upstream	8.8	6.28
(3) WS Downstream	15.5	6.58
SLOPE	.30 / 24.3 =	

SKETCH



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

AQUATIC SAMPLING SUMMARY

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

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

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

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

COMMENTS

Ph = 8.4
TDS = 800
Temp = 12°C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Brush Creek	CROSS-SECTION NO.: 1	DATE 7-28-09	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 9:45

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	2.0		5.09								
	3.0		5.62								
G	4.5		5.91								
W	5.0		6.35								
	5.3		6.65	.30				0.81			
	5.6		6.65	.30				1.44			
	5.9		6.65	.30				1.24			
	6.2		6.60	.25				1.50			
	6.5		6.60	.25				1.49			
	6.8		6.55	.20				1.26			
	7.1		6.55	.20				1.06			
	7.4		6.50	.15				0.57			
	7.7		6.50	.15				0.39			
	8.0		6.45	.10				0			
W	8.2		6.35								
G	8.9		5.78								
	11.8		5.56								
LS	13.7		4.53								
TOTALS:											

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

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Brush Creek
XS LOCATION:	Approx. 0.25 u/s fr conf. w/ East Douglas Ck.
XS NUMBER:	2
DATE:	29-Jul-09
OBSERVERS:	R. Smith, P. Crowley
1/4 SEC:	SE
SECTION:	34
TWP:	4S
RANGE:	101W
PM:	Sixth
COUNTY:	Rio Blanco/Garfield
WATERSHED:	White River
DIVISION:	6
DOW CODE:	19299
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

*** NOTE ***
Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod

CHANNEL PROFILE DATA

SLOPE:	0.014

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....……..…….....DATE.....

STREAM NAME: Brush Creek
XS LOCATION: Approx. 0.25 u/s fr conf. w/ East Douglas Ck.
XS NUMBER: 2

DATA POINTS= 16

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	2.00	4.65			0.00		0.00	0.00	0.0%
1	G	3.90	5.48			0.00		0.00	0.00	0.0%
	W	4.10	6.10	0.00	0.00	0.00		0.00	0.00	0.0%
		4.20	6.25	0.15	0.00	0.18	0.15	0.03	0.00	0.0%
		4.50	6.30	0.20	0.72	0.30	0.20	0.06	0.04	5.7%
		4.80	6.40	0.30	1.15	0.32	0.30	0.09	0.10	13.7%
		5.10	6.40	0.30	1.48	0.30	0.30	0.09	0.13	17.6%
		5.40	6.40	0.30	1.34	0.30	0.30	0.09	0.12	15.9%
		5.70	6.40	0.30	1.39	0.30	0.30	0.09	0.13	16.5%
		6.00	6.35	0.25	1.39	0.30	0.25	0.08	0.10	13.8%
		6.30	6.30	0.20	1.43	0.30	0.20	0.06	0.09	11.3%
		6.60	6.30	0.20	0.85	0.30	0.20	0.05	0.04	5.6%
	W	6.80	6.10	0.00	0.00	0.28		0.00	0.00	0.0%
		7.10	5.64			0.00		0.00	0.00	0.0%
1	G	8.50	5.36			0.00		0.00	0.00	0.0%
	LS	10.60	4.75			0.00		0.00	0.00	0.0%
	TOTALS ----------					2.89	0.3	0.64	0.76	100.0%
							(Max.)			

Manning's n = 0.0536
Hydraulic Radius= 0.21958927

STREAM NAME: Brush Creek
XS LOCATION: Approx. 0.25 u/s fr conf. w/ East Douglas Ck.
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.64	0.64	0.0%
5.85	0.64	1.34	111.1%
5.87	0.64	1.28	101.9%
5.89	0.64	1.22	92.7%
5.91	0.64	1.17	83.6%
5.93	0.64	1.11	74.5%
5.95	0.64	1.05	65.5%
5.97	0.64	0.99	56.6%
5.99	0.64	0.94	47.7%
6.01	0.64	0.88	38.9%
6.03	0.64	0.83	30.1%
6.05	0.64	0.77	21.5%
6.06	0.64	0.74	17.1%
6.07	0.64	0.72	12.8%
6.08	0.64	0.69	8.5%
6.09	0.64	0.66	4.3%
6.10	0.64	0.64	0.0%
6.11	0.64	0.61	-4.2%
6.12	0.64	0.58	-8.5%
6.13	0.64	0.55	-12.6%
6.14	0.64	0.53	-16.8%
6.15	0.64	0.50	-20.9%
6.17	0.64	0.45	-29.1%
6.19	0.64	0.40	-37.2%
6.21	0.64	0.35	-45.2%
6.23	0.64	0.30	-53.1%
6.25	0.64	0.25	-60.8%
6.27	0.64	0.20	-68.3%
6.29	0.64	0.16	-75.4%
6.31	0.64	0.12	-81.5%
6.33	0.64	0.09	-86.6%
6.35	0.64	0.06	-91.1%

WATERLINE AT ZERO
AREA ERROR = 6.100

STREAM NAME: Brush Creek
XS LOCATION: Approx. 0.25 u/s fr conf. w/ East Douglas Ck.
XS NUMBER: 2 Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.48	4.00	0.64	0.92	2.55	4.91	100.0%	0.52	5.41	2.12
	5.50	3.89	0.64	0.90	2.47	4.79	97.5%	0.52	5.22	2.11
	5.55	3.63	0.63	0.85	2.29	4.48	91.2%	0.51	4.79	2.09
	5.60	3.36	0.63	0.80	2.11	4.17	85.0%	0.51	4.40	2.08
	5.65	3.14	0.62	0.75	1.95	3.90	79.5%	0.50	4.02	2.06
	5.70	3.09	0.58	0.70	1.79	3.79	77.2%	0.47	3.57	1.99
	5.75	3.04	0.54	0.65	1.64	3.68	74.9%	0.45	3.14	1.91
	5.80	2.99	0.50	0.60	1.49	3.57	72.6%	0.42	2.73	1.83
	5.85	2.94	0.46	0.55	1.34	3.45	70.3%	0.39	2.34	1.75
	5.90	2.89	0.41	0.50	1.19	3.34	68.1%	0.36	1.97	1.65
	5.95	2.85	0.37	0.45	1.05	3.23	65.8%	0.33	1.63	1.55
	6.00	2.80	0.33	0.40	0.91	3.12	63.5%	0.29	1.31	1.44
	6.05	2.75	0.28	0.35	0.77	3.00	61.2%	0.26	1.02	1.33
WL	6.10	2.70	0.24	0.30	0.63	2.89	58.9%	0.22	0.76	1.19
	6.15	2.62	0.19	0.25	0.50	2.76	56.3%	0.18	0.53	1.05
	6.20	2.53	0.15	0.20	0.37	2.63	53.6%	0.14	0.33	0.89
	6.25	2.45	0.10	0.15	0.25	2.50	50.9%	0.10	0.18	0.70
	6.30	1.80	0.08	0.10	0.14	1.82	37.2%	0.07	0.08	0.58
	6.35	1.35	0.04	0.05	0.06	1.36	27.8%	0.04	0.02	0.39
	6.40	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Brush Creek
XS LOCATION: Approx. 0.25 u/s fr conf. w/ East Douglas Ck.
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.76	cfs
CALCULATED FLOW (Qc)=	0.76	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	6.10	ft
CALCULATED WATERLINE (WLc)=	6.10	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.30	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	1.19	ft/sec
MANNING'S N=	0.054	
SLOPE=	0.014	ft/ft
.4 * Qm =	0.3	cfs
2.5 * Qm=	1.9	cfs

RECOMMENDED INSTREAM FLOW:
=============================

FLOW (CFS)	PERIOD
___________	________
___________	________
___________	________
___________	________

RATIONALE FOR RECOMMENDATION:
=============================

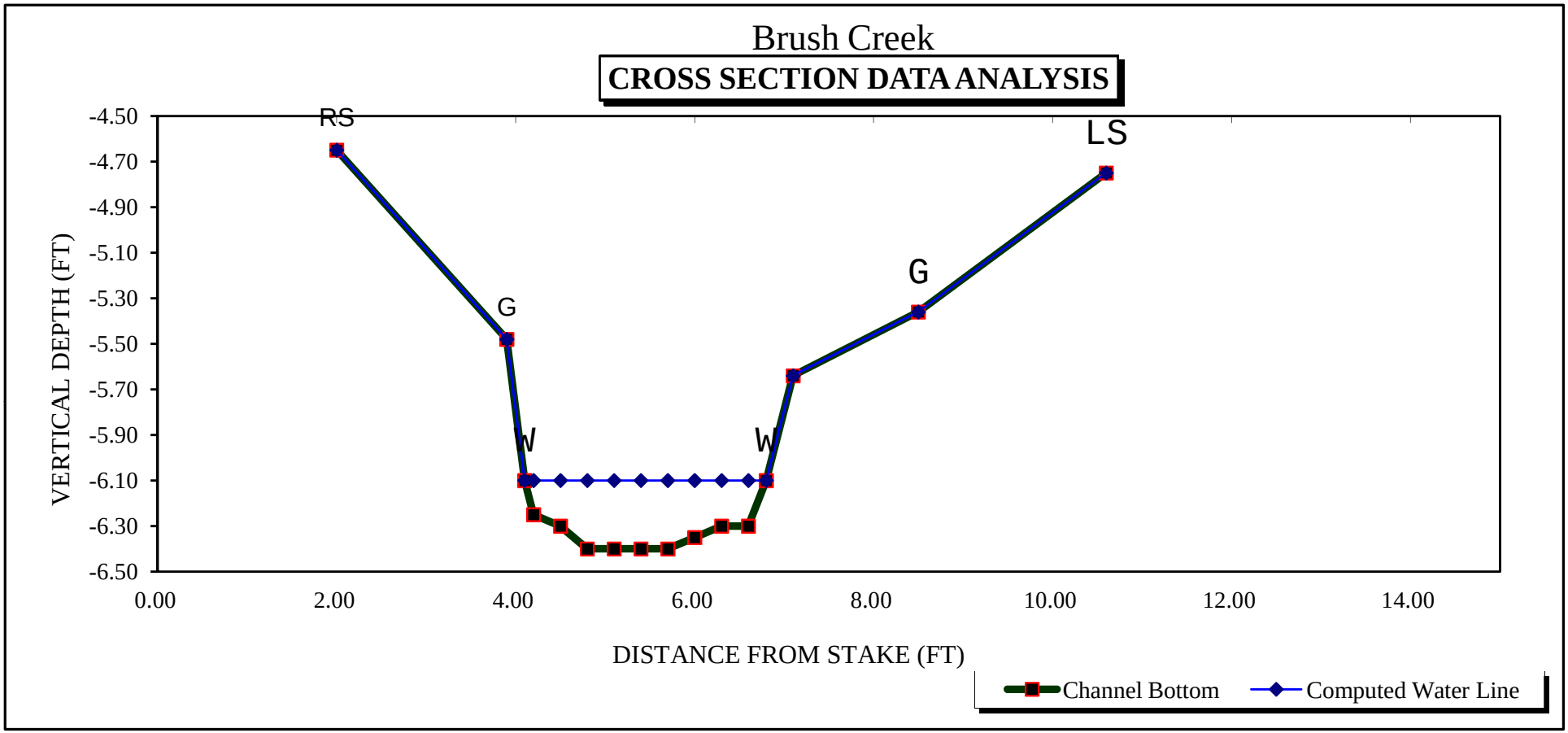
RECOMMENDATION BY: ……………………...……….....…................................ AGENCY...………………………......……...…...……....... DATE:.......….....…......……………

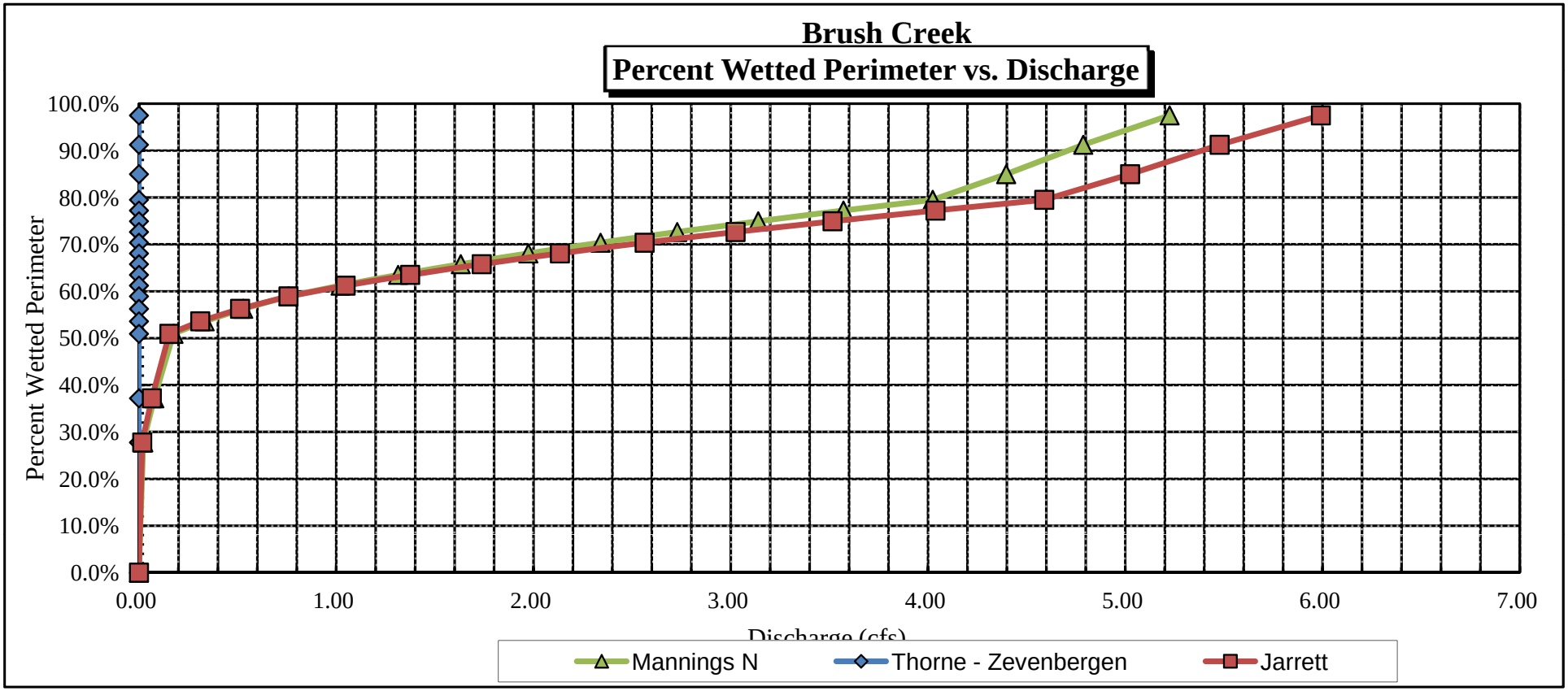
CWCB REVIEW BY: ..……………………………......……………………………………………………..…............. DATE:.................……………....…

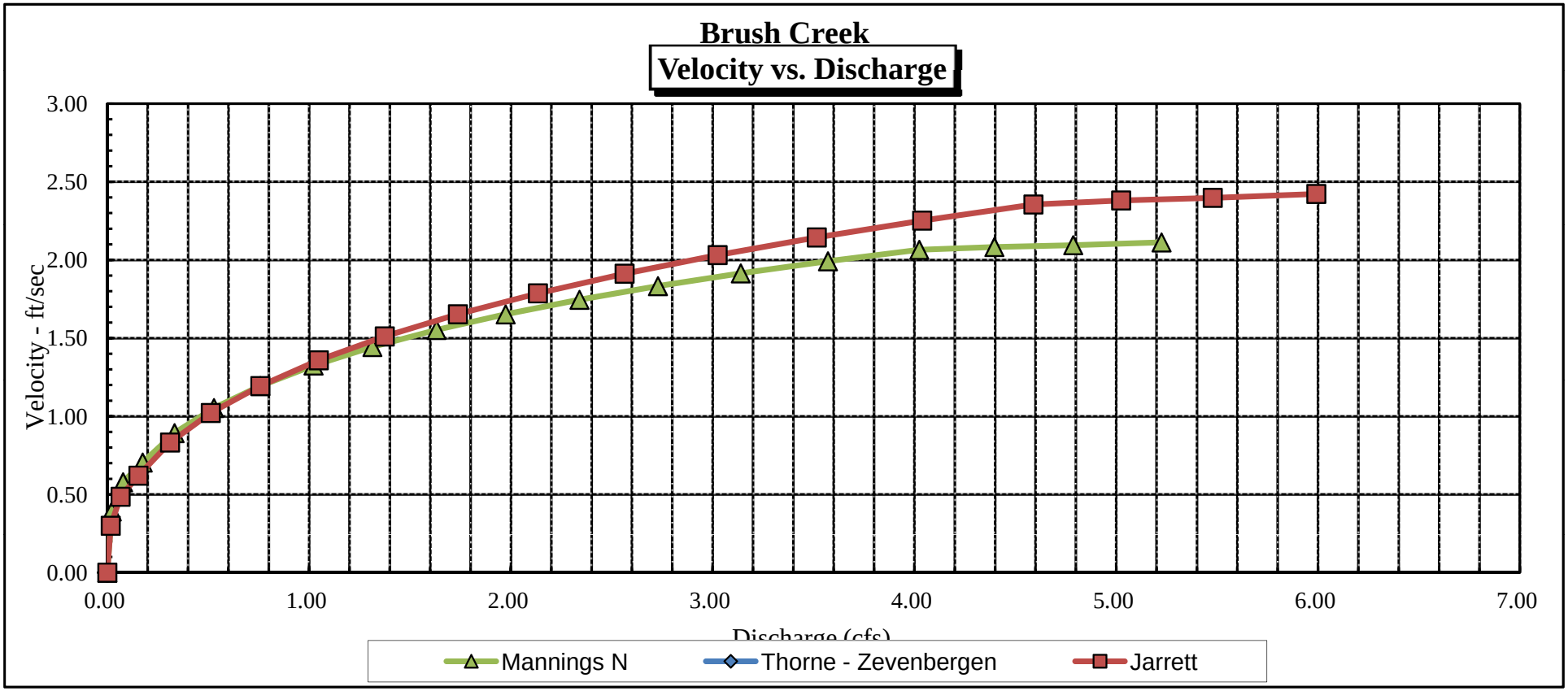
STREAM NAME: Brush Creek
XS LOCATION: Approx. 0.25 u/s fr conf. w/ East Douglas Ck.
XS NUMBER: 2 Jarrett Variable Manning's n Correction Applied

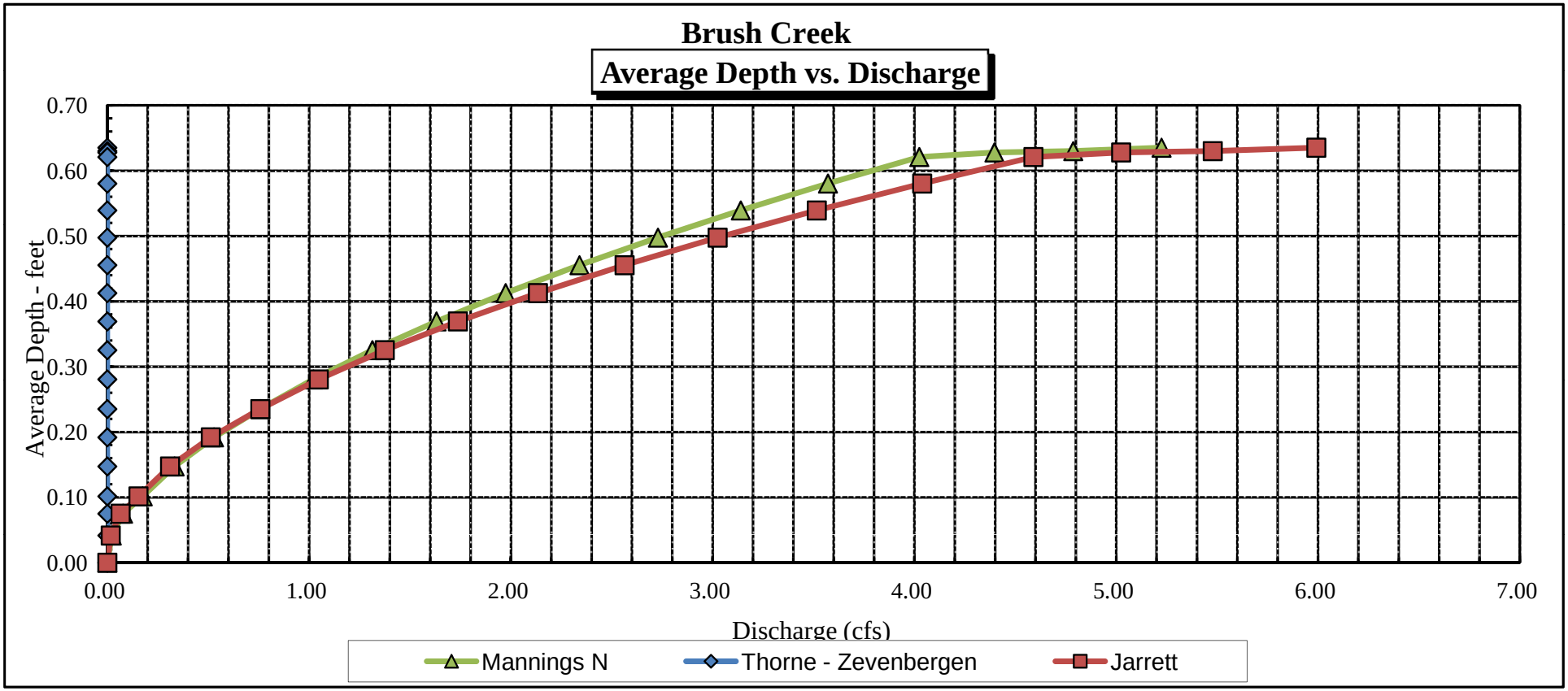
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

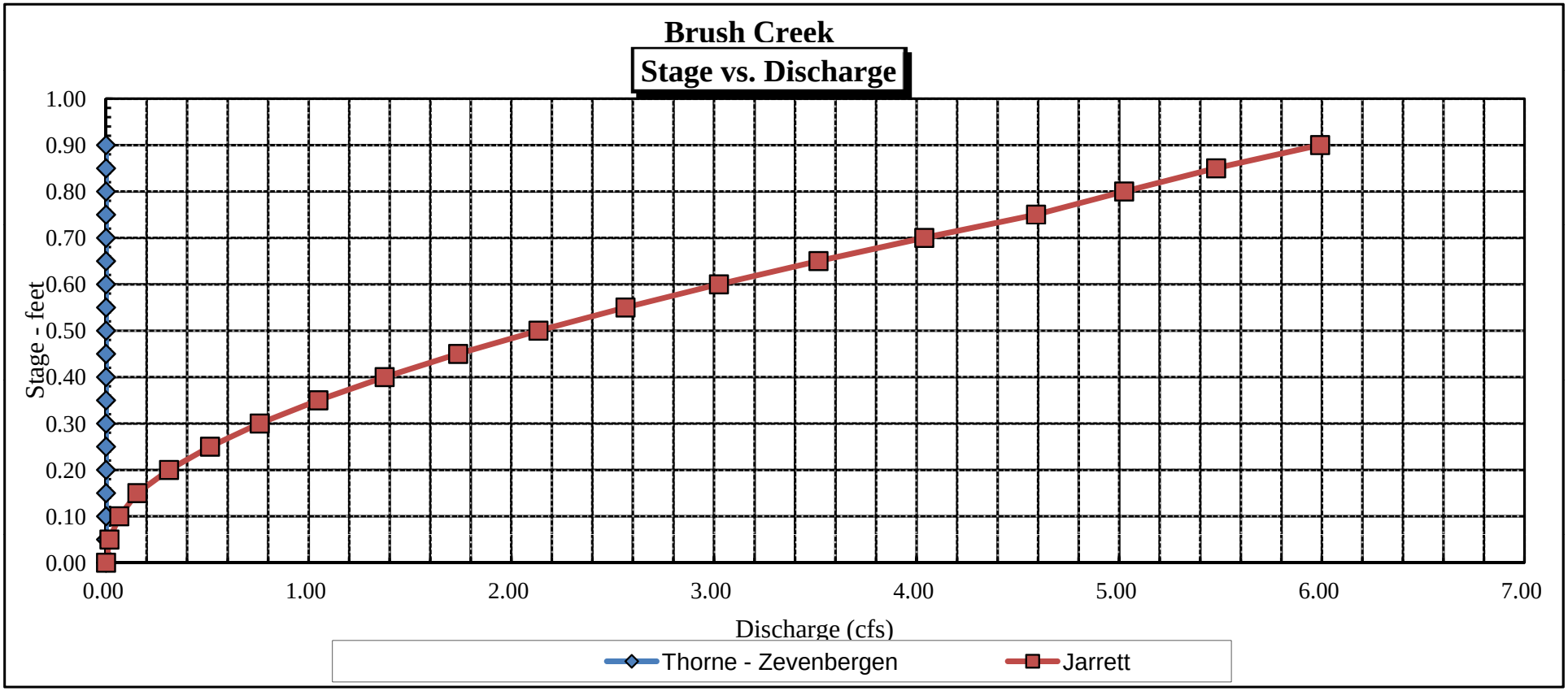
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.48	4.00	0.64	0.92	2.55	4.91	100.0%	0.52	6.21	2.43
	5.50	3.89	0.64	0.90	2.47	4.79	97.5%	0.52	5.99	2.42
	5.55	3.63	0.63	0.85	2.29	4.48	91.2%	0.51	5.48	2.40
	5.60	3.36	0.63	0.80	2.11	4.17	85.0%	0.51	5.02	2.38
	5.65	3.14	0.62	0.75	1.95	3.90	79.5%	0.50	4.59	2.36
	5.70	3.09	0.58	0.70	1.79	3.79	77.2%	0.47	4.04	2.25
	5.75	3.04	0.54	0.65	1.64	3.68	74.9%	0.45	3.52	2.14
	5.80	2.99	0.50	0.60	1.49	3.57	72.6%	0.42	3.02	2.03
	5.85	2.94	0.46	0.55	1.34	3.45	70.3%	0.39	2.56	1.91
	5.90	2.89	0.41	0.50	1.19	3.34	68.1%	0.36	2.13	1.79
	5.95	2.85	0.37	0.45	1.05	3.23	65.8%	0.33	1.74	1.65
	6.00	2.80	0.33	0.40	0.91	3.12	63.5%	0.29	1.37	1.51
	6.05	2.75	0.28	0.35	0.77	3.00	61.2%	0.26	1.05	1.36
WL	6.10	2.70	0.24	0.30	0.63	2.89	58.9%	0.22	0.76	1.19
	6.15	2.62	0.19	0.25	0.50	2.76	56.3%	0.18	0.51	1.02
	6.20	2.53	0.15	0.20	0.37	2.63	53.6%	0.14	0.31	0.83
	6.25	2.45	0.10	0.15	0.25	2.50	50.9%	0.10	0.15	0.62
	6.30	1.80	0.08	0.10	0.14	1.82	37.2%	0.07	0.07	0.49
	6.35	1.35	0.04	0.05	0.06	1.36	27.8%	0.04	0.02	0.30
	6.40	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!


Brush Creek
CROSS SECTION DATA ANALYSIS
RS
G
W
W
G
LS
-4.50
-4.70
-4.90
-5.10
-5.30
-5.50
-5.70
-5.90
-6.10
-6.30
-6.50
VERTICAL DEPTH (FT)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Brush Creek
Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Brush Creek
Velocity vs. Discharge
Velocity - ft/sec
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Brush Creek
Average Depth vs. Discharge
Average Depth - feet
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Brush Creek
Stage vs. Discharge
Stage - feet
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Brush Creek						CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: Approx. 1/4 mile upstream from conf. w/ East Douglas Creek						
DATE: 7-29-09	OBSERVERS: R. Smith, P. Crowley					
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 34	TOWNSHIP: 4 N/S	RANGE: 101 E/W	PM: 6th	
COUNTY: Rio Blanco	WATERSHED: White River	WATER DIVISION: 6	DOW WATER CODE: 19299			
MAP(S): USGS:						
USFS:						

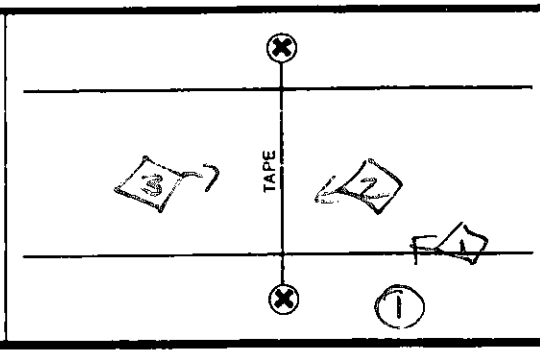
SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	6.10 / 6.10
② WS Upstream	7.0	6.06
③ WS Downstream	8.0	6.21
SLOPE	0.21 / 15.0 = .014	

SKETCH



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

pH= 8.4
TDS= 800
Temp= 12°C

Excellent riparian & morphology condition.

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Brush Creek | CROSS-SECTION NO.: 2 | DATE: 7-29-09 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 10:10 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 (ft^2)	Discharge (cfs)
RS	2.0		4.65								
G	3.9		5.48								
W	4.1		6.10								
	4.2		6.25	.15				0			
	4.5		6.30	.20				0.72			
	4.8		6.40	.30				1.15			
	5.1		6.40	.30				1.48			
	5.4		6.40	.30				1.32			
	5.7		6.40	.30				1.39			
	6.0		6.35	.25				1.39			
	6.3		6.30	.20				1.43			
	6.6		6.30	.20				0.85			
W	6.8		6.10								
	7.1		5.64								
G	8.5		5.36								
LS	10.6		4.75								
TOTALS:											

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