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)

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 Red Creek, located in Water Division 6.

The Colorado Water Conservation Board (CWCB) currently holds an instream flow water right on the upper portion of Red Creek, starting at the headwaters and terminating at the Routt National Forest boundary. This water right is for 1.0 cubic feet per second, year round. This letter recommends appropriation of an additional instream flow water right for the lower portion of the creek, so that BLM lands along this portion of Red Creek will also benefit from instream flow protection.

Location and Land Status: Red Creek originates on Sand Mountain, approximately three miles southwest of Steamboat Lake State Park. This recommendation covers the portion of Red Creek that begins at the boundary of the Routt National Forest and extends downstream to the confluence with Willow Creek, a distance of approximately 5.7 miles. Of this mileage, the BLM manages 1.4 miles and private owners manage 4.3 miles.

Biological Summary: Red Creek is a cold-water, low gradient stream in rolling foothills below the Routt National Forest. The stream meanders through a valley floor that is approximately 200 feet wide. Red Creek has substrate ranging from gravels to small cobbles. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery. The creek also supports an active beaver community.

Fishery surveys revealed a self-sustaining native fishery which included mountain suckers, mottled sculpin, and speckled dace. White suckers, which are native to the Front Range, were also documented in the creek. Even though Red Creek is a small stream, the fish population survived the 2002-2003 drought, indicating that base flows are sufficient to support the trout

fishery through all types of climate conditions. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Red Creek is in good condition, and provides adequate cover, overhanging banks, and habitat diversity for the fish population. The riparian community is comprised mainly of willows and sedges and occupies the entire valley bottom.

R2Cross Analysis: The BLM collected the following R2Cross data from Red 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)
08/17/2011 #1	1.15 cfs	9.26 feet	1.30 cfs	2.01 cfs
08/17/2011 #2	0.98 cfs	15.59 feet	1.68 cfs	1.70 cfs
		Averages:	1.50 cfs	1.85 cfs

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

> 1.85 cubic feet per second is recommended for the snowmelt runoff period from April 1 through July 15. This recommendation is driven by the average depth criteria. Because of its small size and low flows during the base flow period, it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available.
>
> 0.7 cubic feet per second is recommended for the remainder of the year, from July 16 to March 31. This recommendation is driven by water availability, because insufficient water is available to meet two of three flow criteria at 1.5 cfs, as recommended by the R2Cross modeling effort. 0.7 cubic feet per second comes close to meeting the average velocity and wetted perimeter criteria, but provides an average depth of only 0.135 feet. This flow rate should prevent excessively high water temperatures during the late summer period, provide adequate pool habitat, and protect overwintering fish by preventing pools from freezing.

Water Availability: While there is no gage located on this creek, there is an abundance of gaging data in the larger Elk River watershed. Gage data that the CWCB could use for an analysis of comparable watersheds or for a basin apportionment analysis include the following U.S. Geological Survey (USGS) gages:

09241000 Elk River at Clark, CO
09244500 Elkhead Creek near Clark, CO
09240800 South Fork Elk River near Clark, CO

BLM recommends using the StreamStats package developed jointly between the USGS and the CWCB to develop a raw estimate of water availability. Historic diversions could be subtracted from streamflow estimates produced by the StreamStats package.

The BLM is aware of two significant water rights that could affect the water availability analysis for the proposed instream flow appropriation:

- Frye Ditches 1, 2, and 3, located upstream from the proposed instream flow reach, are decreed to divert a total of 7.5 cfs for irrigation purposes. During the period between 2001 and 2010, this ditch diverted an average 535 acre feet per year, primarily during the June through August period.

- The Steamboat Lake Water and Sanitation District holds a conditional storage right for Red Creek Reservoir for 1,030 acre feet for municipal, domestic, industrial, commercial, fish and wildlife, and recreation uses. In addition, the district holds a conditional water right to divert 3.0 cfs at the dam outlet. This water right was decreed 39 years ago, in 1973. If constructed, the reservoir would inundate a portion of the proposed instream flow reach.

In addition to the two major water rights described above, there are also numerous small water rights in the watershed on springs, wells, and on reservoirs less than 10 acre feet in storage capacity.

Relationship to Land Management Plans: Even though the BLM's ownership along the creek is limited, the BLM has elected to retain that land in public ownership because of its high riparian and recreation values. Lands owned by the BLM are easily accessed by major roads and provide additional recreation opportunities adjacent to Steamboat Lake State Park. In addition, the creek provides important lower elevation habitat for native fish species in an area where most of the land is privately owned. The BLM intends to continue management for riparian and fishery values, with emphasis on improving livestock use patterns to maintain and improve riparian conditions. 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 BLM's draft recommendation in February 2012. We thank both Colorado Parks and Wildlife and the CWCB for their cooperation in this effort.

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

Sincerely,

Leigh D. Espy
Deputy State Director
Resources and Fire

cc: Emily Spencer, Little Snake FO
Wendy Reynolds, Little Snake FO

DRAFT INSTREAM FLOW RECOMMENDATION

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

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Fishery surveys revealed a self-sustaining native fishery which included mountain suckers, mottled sculpin, and speckled dace. White suckers, which are native to the Front Range, were also documented in the creek. Even though Red Creek is a small stream, the fish population survived the 2002-2003 drought, indicating that base flows are sufficient to support the trout fishery through all types of climate conditions. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

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Sincerely,

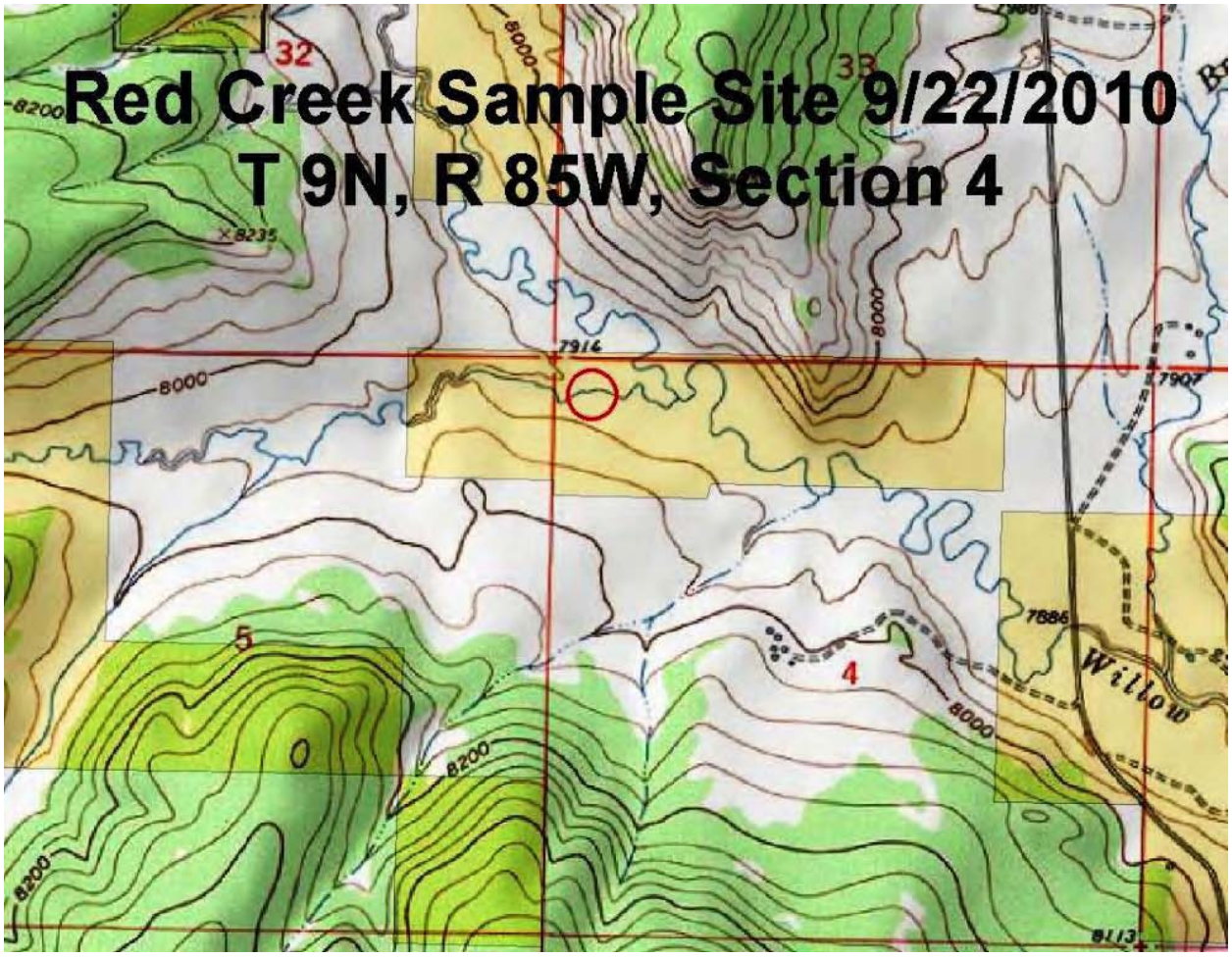
Leigh Espy
Deputy State Director
Resources and Fire

Cc: Emily Spencer, Little Snake FO
Wendy Reynolds, Little Snake FO

Little Snake Field Office Stream Surveys
September 2010

Red Creek - Water Code #21600

Red Creek, located south of Steamboat Lake State Park on BLM lands managed by the Little Snake Field Office was sampled on September 22, 2010. Red Creek is a tributary to Willow Creek, then the Elk River and then the Yampa River. Sampling was done in support of the instream flow program. Presence/Absence sampling was completed to determine fishery status and composition. Mountain suckers were abundant as well as Speckled dace, and White suckers. Sampling was conducted via one backpack electro-shocker and a 375 foot stream reach was sampled. Personnel present were Gregor Dekleva and Clay Ramey, BLM.



Mountain Sucker

Red Creek

STREAM SURVEY FISH SAMPLING FORM

Water Red Creek **H_2O Code** 21600 **Date** 9/22/2010

Gear BPE **Effort** **Station #** 1 **Pass #** 1

Crew Dekleva, Ramey **Drainage** Yampa **Location** GPS

PASS	SPECIES	LENGTH	SPECIES	LENGTH	SPECIES	LENGTH	SPECIES	LENGTH
1	MOS	83	MOS	86	MOS	76		
1	MOS	68	MTS	79	MOS	52		
1	FHM	65	MOS	76	MOS	55		
1	MOS	97	MOS	75	MOS	60		
1	MOS	155	MOS	61	MOS	63		
1	MOS	78	WHS	84				
1	MOS	83	MOS	80				
1	MOS	84	MOS	85				
1	MOS	82	MOS	60	SPD COUNT:		78	
1	MOS	129	MOS	85				
1	MOS	54	MOS	70				
1	MOS	94	MOS	93				
1	MOS	84	MOS	67				
1	MOS	76	MOS	60				
1	MOS	79	MOS	77				
1	WHS	86	MOS	71				
1	MOS	72	WHS	82				
1	MOS	97	MOS	84				
1	MOS	93	MOS	68				
1	MOS	67	MOS	85				
1	MOS	93	MOS	60				
1	MOS	58	MOS	57				
1	MOS	82	MOS	77				
1	MTS	80	MOS	57				
1	MOS	80	MOS	67				

GPS LOCATION: 13t 338260 4514951

STREAM WIDTH: 11.6 AVG ft. SAMPLE REACH: 375 ft.

CONDUCTIVITY: ELECTROSHOCKER SETTINGS :

NOTES: Very productive with fish, filamentous algae present with an embedded bedrock bottom. Lots of young willows, grasses, sedges, banks about 75% stable, Beaver activity present, creating pools 3-4 feet deep. Many YOY SPD and MOS

Discussion. Red Creek contained a good mix of riffles, runs, pools and active beaver dams with small ponds. At the sample site, the stream contained a lot of filamentous algae on a bedrock bottom. The stream appeared to be a Rosgen C channel type. Riparian vegetation consisted of willows and sedges mainly, as well as a small grass component.

Native fish found in the stream were Mountain suckers, Mottled sculpin, and Speckled dace. Mountain suckers and Speckled dace were particularly abundant in a high densities. However White suckers, native to the front range of Colorado, were also present.

Recommendations:

- This stream would benefit from an instream flow recommendation. Periodically monitor to ensure that stream habitats remain in good condition.

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Red Creek					CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: Approx 1.25 miles upstream from confluence with Willow Creek					
DATE: 8-17-11	OBSERVERS: R. Smith, E. Spencer				
LEGAL DESCRIPTION	¼ SECTION: NE	SECTION: 6	TOWNSHIP: 9 (N)S	RANGE: 85 E(W)	PM: 6th
COUNTY: Routt	WATERSHED: Yampa	WATER DIVISION: 6	DOW WATER CODE: 21600		
MAP(S): USGS:			GPS Zone 13 334700		
USFS:				4515390	

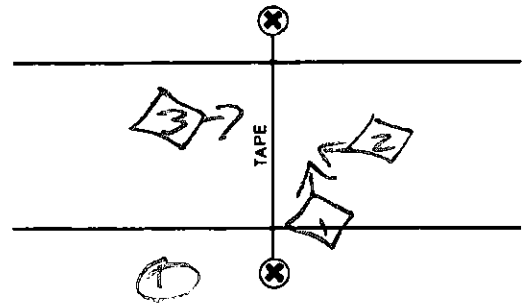
SUPPLEMENTAL DATA

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: 2 to 6 inch 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	7.55 / 7.53
② WS Upstream	7.0	7.46
③ WS Downstream	4.5	7.56
SLOPE	0.10 / 11.5 = .009	

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, stonefly

COMMENTS

Conductivity = 108
Salinity = .01
Temp = 20.90 C
pH = 8.07

Willow-rush-sedge riparian plus birch

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Red Creek	CROSS-SECTION NO: 1	DATE: 8-17-11	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: ____ ft	TIME: 3:10 pm

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.0		5.95								
G	2.8		6.35								
	3.8		7.20								
W	6.0		7.50								
	6.4		7.65	.15				1.18			
	6.7		7.75	.25				1.66			
	7.0		7.65	.15				1.69			
	7.3		7.80	.30				1.43			
	7.6		7.75	.25				1.49			
	7.9		7.75	.35				1.45			
	8.2		7.70	.20				1.38			
	8.5		7.65	.15				1.30			
	8.8		7.75	.25				1.69			
	9.1		7.80	.30				1.88			
	9.4		7.70	.20				0.84			
	9.7		7.60	.10				0.80			
W	10.2		7.50								
	11.8		7.47								
G	12.1		6.38								
LS	14.3		5.42								
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:	Red Creek
XS LOCATION:	1.25 m upstream fr conf w/ Willow Ck.
XS NUMBER:	1
DATE:	17-Aug-11
OBSERVERS:	R. Smith, E. Spencer
1/4 SEC:	NE
SECTION:	6
TWP:	9N
RANGE:	85W
PM:	Sixth
COUNTY:	Routt
WATERSHED:	Elk River
DIVISION:	6
DOW CODE:	21600
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:	0.008

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

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

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w/ Willow Ck.
XS NUMBER: 1

DATA POINTS= 20

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	0.00	5.95			0.00		0.00	0.00	0.0%
1	G	2.80	6.35			0.00		0.00	0.00	0.0%
		3.80	7.20			0.00		0.00	0.00	0.0%
	W	6.00	7.50	0.00	0.00	0.00		0.00	0.00	0.0%
		6.40	7.65	0.15	1.18	0.43	0.15	0.05	0.06	5.4%
		6.70	7.75	0.25	1.66	0.32	0.25	0.08	0.12	10.9%
		7.00	7.65	0.15	1.69	0.32	0.15	0.05	0.08	6.6%
		7.30	7.80	0.30	1.43	0.34	0.30	0.09	0.13	11.2%
		7.60	7.75	0.25	1.49	0.30	0.25	0.08	0.11	9.7%
		7.90	7.75	0.25	1.65	0.30	0.25	0.08	0.12	10.8%
		8.20	7.70	0.20	1.38	0.30	0.20	0.06	0.08	7.2%
		8.50	7.65	0.15	1.30	0.30	0.15	0.05	0.06	5.1%
		8.80	7.75	0.25	1.69	0.32	0.25	0.08	0.13	11.1%
		9.10	7.80	0.30	1.88	0.30	0.30	0.09	0.17	14.8%
		9.40	7.70	0.20	0.84	0.32	0.20	0.06	0.05	4.4%
		9.70	7.60	0.10	0.80	0.32	0.10	0.04	0.03	2.8%
	W	10.20	7.50	0.00	0.00	0.51		0.00	0.00	0.0%
		11.80	7.47			0.00		0.00	0.00	0.0%
1	G	12.10	6.38			0.00		0.00	0.00	0.0%
	LS	14.30	5.42			0.00		0.00	0.00	0.0%
	TOTALS ----------					4.37	0.3 (Max.)	0.78	1.15	100.0%

Manning's n = 0.0288
Hydraulic Radius= 0.17905344

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w/ Willow Ck.
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.78	0.78	0.0%
7.25	0.78	2.44	212.4%
7.27	0.78	2.29	192.9%
7.29	0.78	2.14	173.8%
7.31	0.78	2.00	155.1%
7.33	0.78	1.85	136.8%
7.35	0.78	1.71	118.9%
7.37	0.78	1.58	101.4%
7.39	0.78	1.44	84.2%
7.41	0.78	1.31	67.5%
7.43	0.78	1.18	51.1%
7.45	0.78	1.06	35.2%
7.46	0.78	1.00	27.3%
7.47	0.78	0.94	19.6%
7.48	0.78	0.88	12.3%
7.49	0.78	0.83	5.8%
7.50	0.78	0.78	0.0%
7.51	0.78	0.74	-5.3%
7.52	0.78	0.70	-10.5%
7.53	0.78	0.66	-15.7%
7.54	0.78	0.62	-20.7%
7.55	0.78	0.58	-25.6%
7.57	0.78	0.51	-35.2%
7.59	0.78	0.44	-44.3%
7.61	0.78	0.37	-53.1%
7.63	0.78	0.30	-61.6%
7.65	0.78	0.24	-69.8%
7.67	0.78	0.18	-77.3%
7.69	0.78	0.13	-83.9%
7.71	0.78	0.08	-89.4%
7.73	0.78	0.05	-93.8%
7.75	0.78	0.02	-97.3%

WATERLINE AT ZERO
AREA ERROR = 7.500

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w/ Willow 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	6.38	9.26	1.07	1.42	9.95	10.59	100.0%	0.94	44.01	4.42
	6.50	9.09	0.97	1.30	8.85	10.28	97.1%	0.86	36.91	4.17
	6.55	9.02	0.93	1.25	8.39	10.15	95.9%	0.83	34.11	4.06
	6.60	8.95	0.89	1.20	7.94	10.02	94.6%	0.79	31.39	3.95
	6.65	8.87	0.85	1.15	7.50	9.89	93.4%	0.76	28.76	3.83
	6.70	8.80	0.80	1.10	7.06	9.76	92.2%	0.72	26.22	3.71
	6.75	8.73	0.76	1.05	6.62	9.63	91.0%	0.69	23.77	3.59
	6.80	8.65	0.71	1.00	6.18	9.50	89.8%	0.65	21.42	3.46
	6.85	8.58	0.67	0.95	5.75	9.37	88.5%	0.61	19.16	3.33
	6.90	8.51	0.63	0.90	5.33	9.25	87.3%	0.58	17.01	3.19
	6.95	8.44	0.58	0.85	4.90	9.12	86.1%	0.54	14.95	3.05
	7.00	8.36	0.54	0.80	4.48	8.99	84.9%	0.50	13.00	2.90
	7.05	8.29	0.49	0.75	4.07	8.86	83.7%	0.46	11.16	2.74
	7.10	8.22	0.44	0.70	3.65	8.73	82.4%	0.42	9.43	2.58
	7.15	8.15	0.40	0.65	3.24	8.60	81.2%	0.38	7.81	2.41
	7.20	8.07	0.35	0.60	2.84	8.47	80.0%	0.34	6.32	2.22
	7.25	7.69	0.32	0.55	2.44	8.05	76.0%	0.30	5.09	2.08
	7.30	7.31	0.28	0.50	2.07	7.63	72.0%	0.27	4.00	1.93
	7.35	6.93	0.25	0.45	1.71	7.21	68.1%	0.24	3.03	1.77
	7.40	6.55	0.21	0.40	1.38	6.78	64.1%	0.20	2.19	1.59
	7.45	6.17	0.17	0.35	1.06	6.36	60.1%	0.17	1.47	1.39
WL	7.50	4.20	0.19	0.30	0.78	4.37	41.3%	0.18	1.15	1.46
	7.55	3.82	0.15	0.25	0.58	3.97	37.5%	0.15	0.75	1.28
	7.60	3.43	0.12	0.20	0.40	3.58	33.8%	0.11	0.43	1.07
	7.65	3.15	0.08	0.15	0.24	3.27	30.9%	0.07	0.19	0.80
	7.70	2.15	0.05	0.10	0.10	2.23	21.0%	0.05	0.06	0.60
	7.75	0.85	0.03	0.05	0.02	0.88	8.3%	0.02	0.01	0.39
	7.80	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w/ Willow Ck.
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.15	cfs
CALCULATED FLOW (Qc)=	1.15	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	7.50	ft
CALCULATED WATERLINE (WLc)=	7.50	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=	1.46	ft/sec
MANNING'S N=	0.029	
SLOPE=	0.008	ft/ft
.4 * Qm =	0.5	cfs
2.5 * Qm=	2.9	cfs

RECOMMENDED INSTREAM FLOW:
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FLOW (CFS)	PERIOD
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____________________	____________________
____________________	____________________
____________________	____________________

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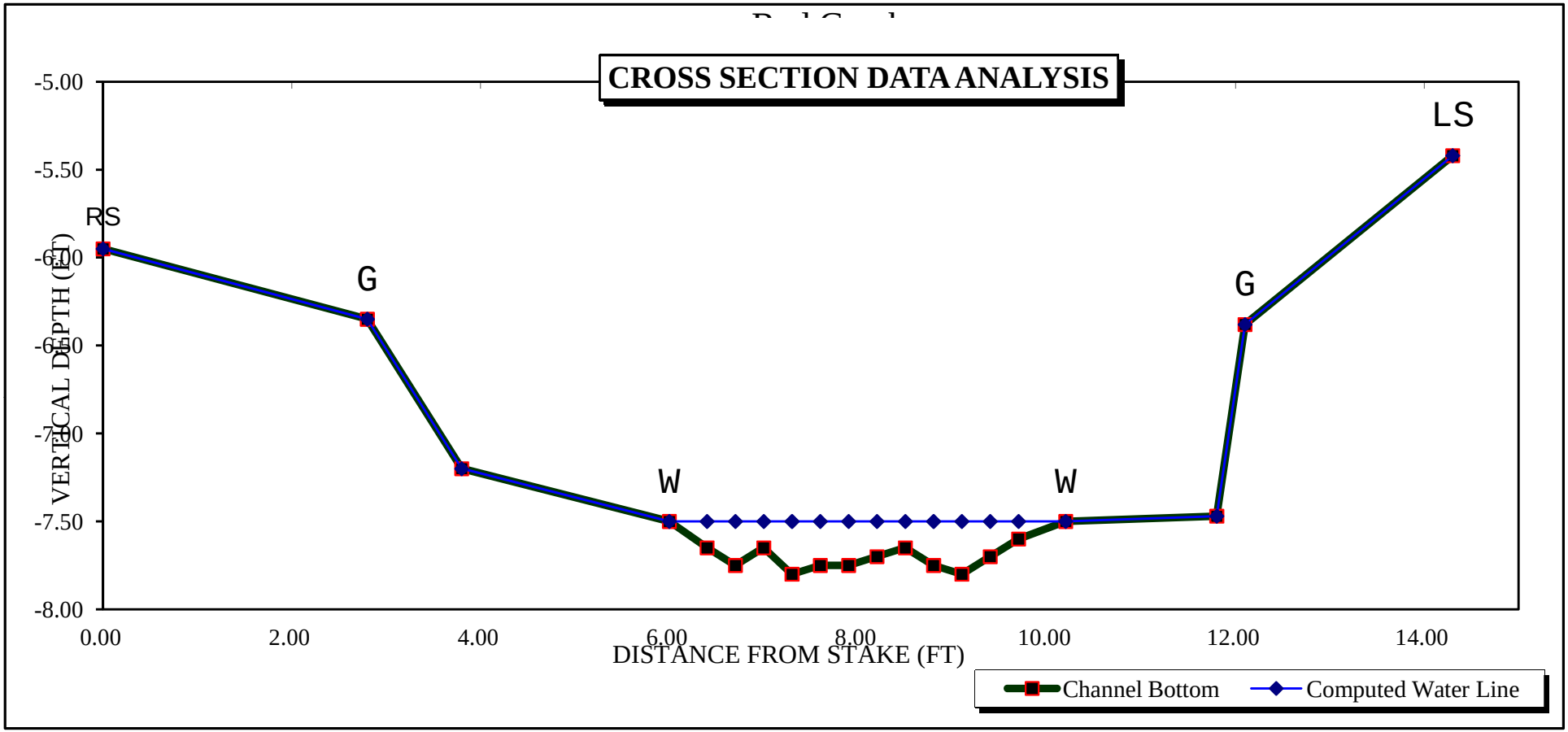
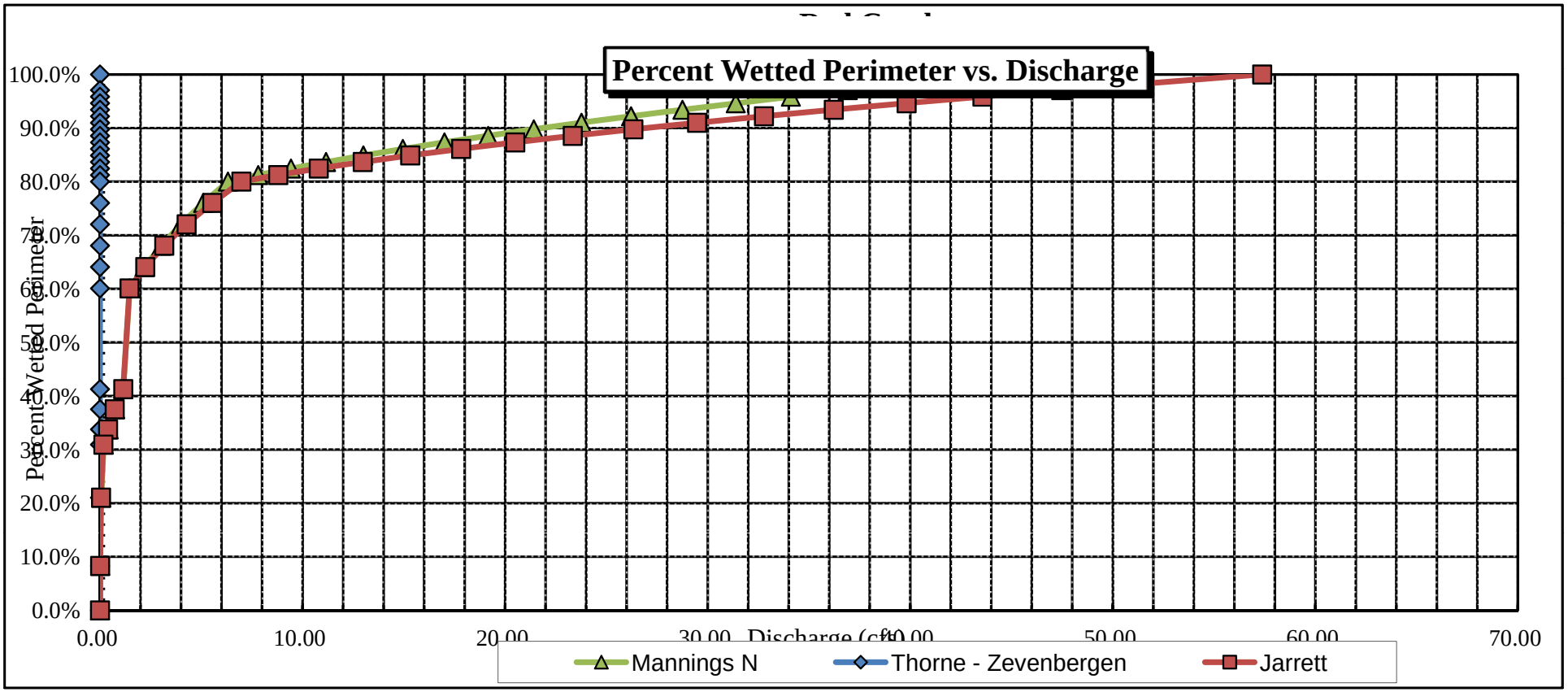
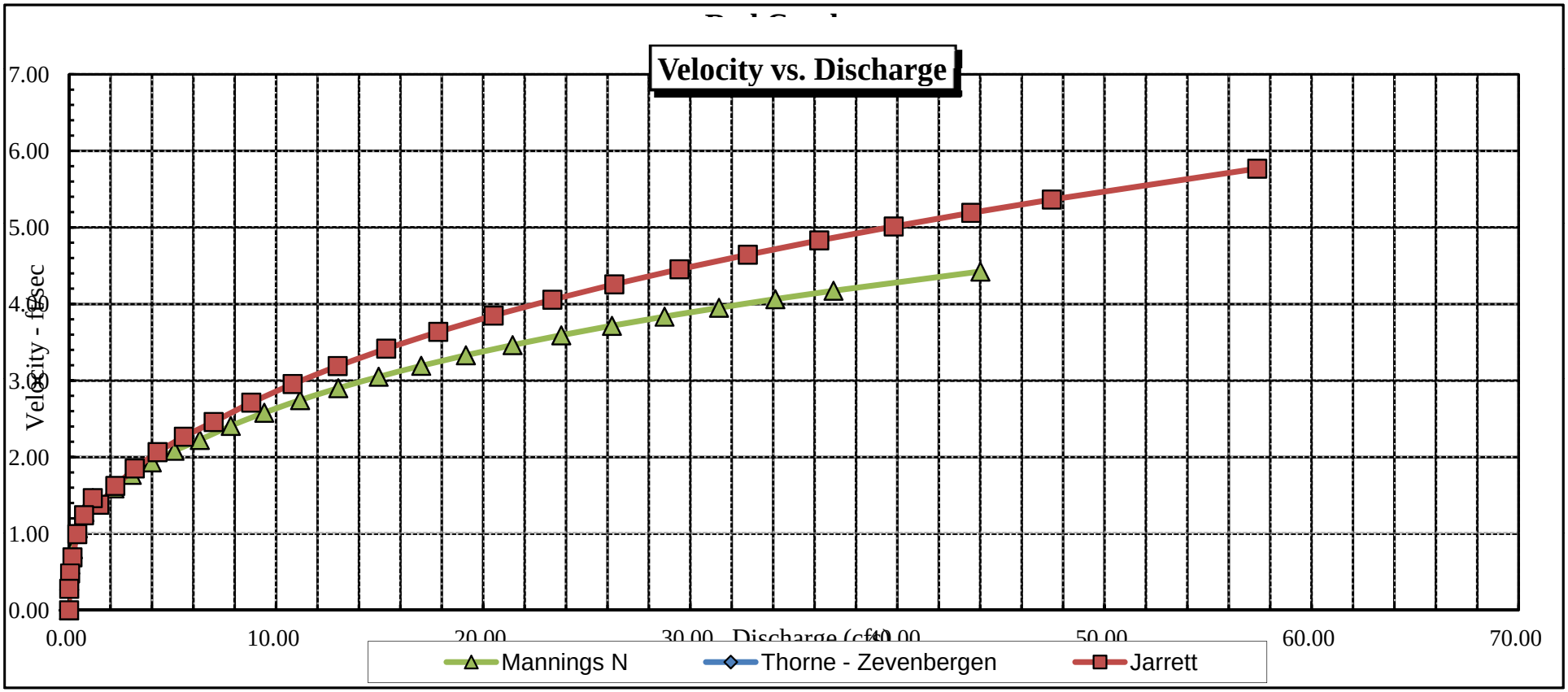
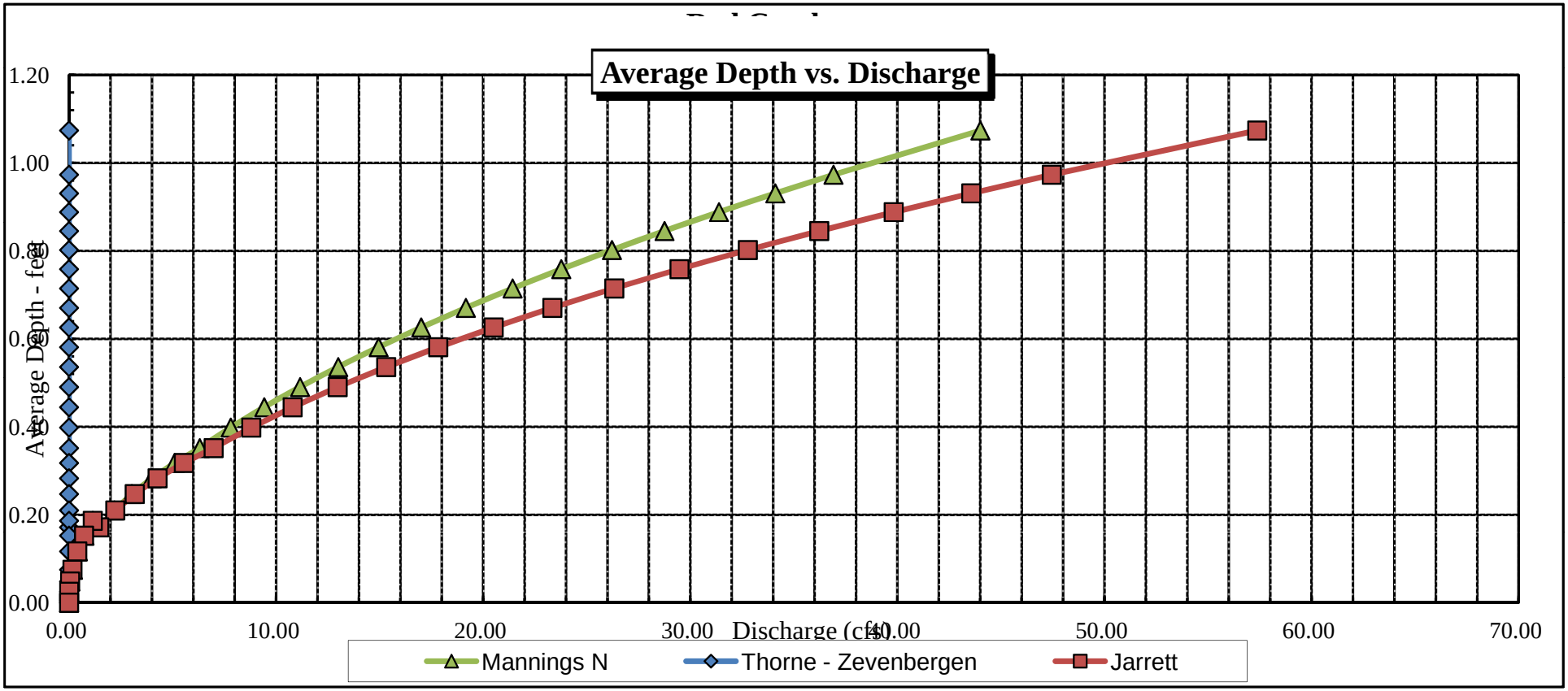
RECOMMENDATION BY: ……………………...………..……................................ AGENCY..…………………….....…….....…...……...... DATE:......…...…......……………

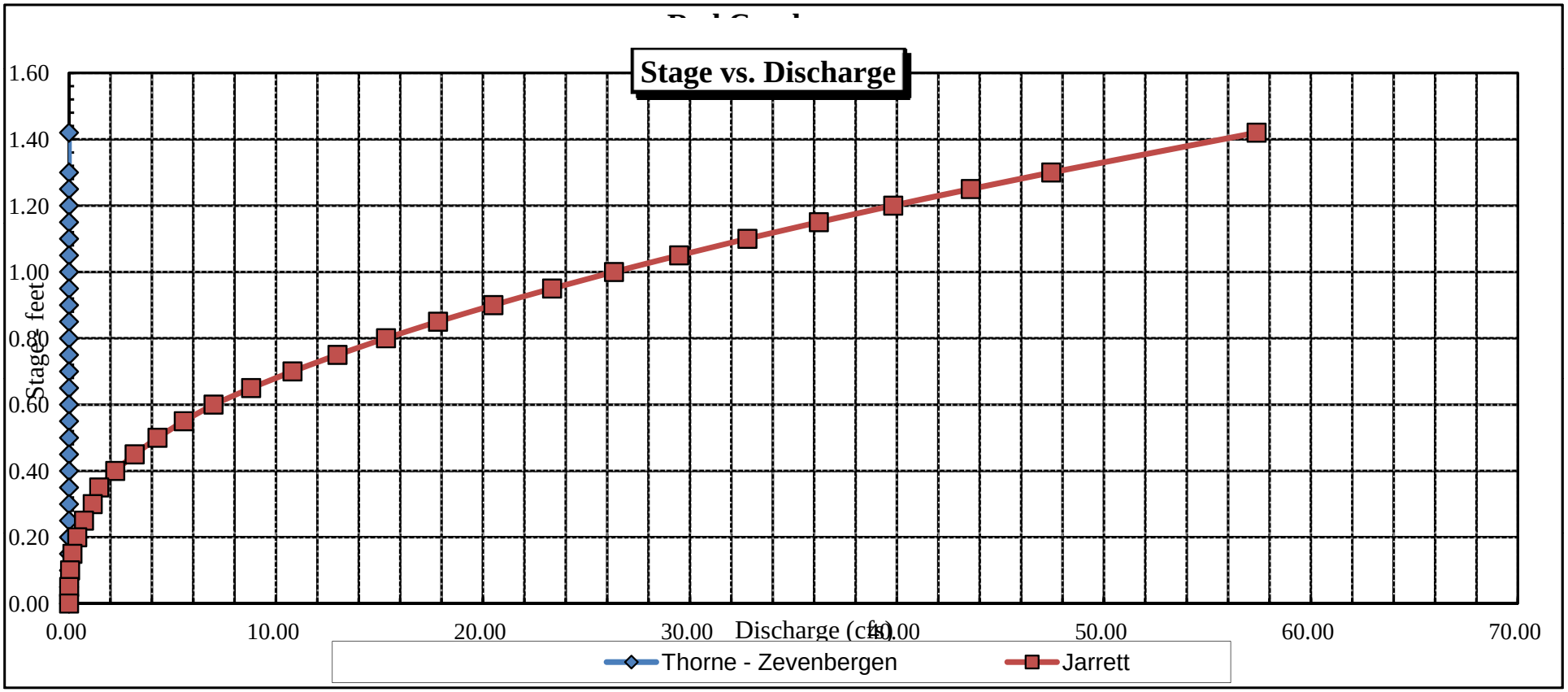
CWCB REVIEW BY: ..…………………………....………………………………………………...…............. DATE:.................…………….....


CROSS SECTION DATA ANALYSIS
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
-8.00
VERTICAL DEPTH (FT)
RS
G
W
W
G
LS
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


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
10.00
20.00
30.00
40.00
50.00
60.00
70.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
Velocity - ft/sec
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Stage, feet
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Red Creek						CROSS-SECTION NO.: 2	
CROSS-SECTION LOCATION: Approx 1.25 miles upstream from confluence with Willow Creek							
DATE: 8-17-11	OBSERVERS: R. Smith, E. Spencer						
LEGAL DESCRIPTION	¼ SECTION: NE	SECTION: 6	TOWNSHIP: 9 (N)/S	RANGE: 85 E/(W)	PM: 6th		
COUNTY: Routt	WATERSHED: Yampa		WATER DIVISION: 6		DOW WATER CODE: 21600		
MAP(S): USGS:				GPS Zone 13	334694		
USFS:					4515409		

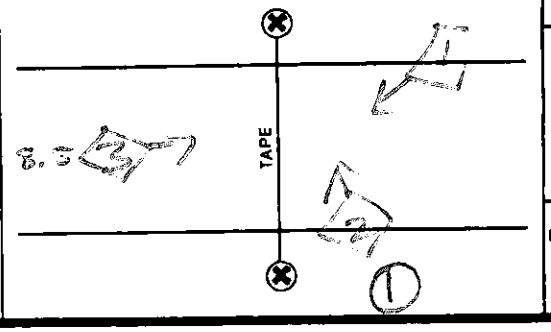
SUPPLEMENTAL DATA

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 4" cobbles	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(X) Tape @ Stake LB	0.0	surveyed
(X) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0 16.3	7.80/7.80
(2) WS Upstream	2.0	7.75
(3) WS Downstream	7.5	8.04
SLOPE	0.29/9.5 = .031	

SKETCH



LEGEND: Stake (X), 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, stonefly

COMMENTS

pH: 8.07
Cond: 108
Temp: 20.9° C
Salinity = .01

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Red Creek | CROSS-SECTION NO: 2 | DATE: 8-17-11 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: ____ ft | TIME: 3:40 pm

Features (Stake (S), Grassline (G), Waterline (W), Rock (R))	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.0		5.30								
G	3.7		6.90								
W	8.5		7.80	0				0			
	9.3		7.9	.10				0.49			
	9.7		7.9	.10				0.57			
	10.1		7.9	.10				0.68			
	10.5		8.0	.20				0.92			
	10.9		8.0	.20				0.95			
	11.3		8.0	.20				0.95			
	11.7		7.9	.10				0.78			
	12.1		8.1	.30				0.89			
	12.5		8.1	.30				0.87			
	12.9		8.05	.25				0.91			
	13.3		8.0	.20				0.88			
	13.7		8.0	.20				0.95			
	14.1		8.0	.20				0.93			
	14.5		7.85	.05				0			
	14.9		7.9	.10				0.91			
	15.3		7.9	.10				0.90			
	15.7		7.9	.10				0.75			
	16.1		7.9	.10				0.54			
W	16.3		7.80	0				0			
	18.5		7.40								
G	19.5		6.94								
LS	21.6		5.22								
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:	Red Creek
XS LOCATION:	1.25 m upstream fr conf w Willow Ck.
XS NUMBER:	2
DATE:	17-Aug-11
OBSERVERS:	R. Smith, E. Spencer
1/4 SEC:	NE
SECTION:	6
TWP:	9N
RANGE:	85W
PM:	6th
COUNTY:	Routt
WATERSHED:	Elk River
DIVISION:	6
DOW CODE:	21600
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

		*** NOTE ***
		Leave TAPE WT and TENSION
		at defaults for data collected
TAPE WT:	0.0106	with a survey level and rod
TENSION:	99999	

CHANNEL PROFILE DATA

SLOPE:	0.031

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

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

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w Willow Ck.
XS NUMBER: 2

DATA POINTS= 25

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	0.00	5.30			0.00		0.00	0.00	0.0%
1	G	3.70	6.90			0.00		0.00	0.00	0.0%
	W	8.50	7.80	0.00	0.00	0.00		0.00	0.00	0.0%
		9.30	7.90	0.10	0.49	0.81	0.10	0.06	0.03	3.0%
		9.70	7.90	0.10	0.57	0.40	0.10	0.04	0.02	2.3%
		10.10	7.90	0.10	0.68	0.40	0.10	0.04	0.03	2.8%
		10.50	8.00	0.20	0.92	0.41	0.20	0.08	0.07	7.5%
		10.90	8.00	0.20	0.95	0.40	0.20	0.08	0.08	7.8%
		11.30	8.00	0.20	0.95	0.40	0.20	0.08	0.08	7.8%
		11.70	7.90	0.10	0.78	0.41	0.10	0.04	0.03	3.2%
		12.10	8.10	0.30	0.89	0.45	0.30	0.12	0.11	10.9%
		12.50	8.10	0.30	0.87	0.40	0.30	0.12	0.10	10.7%
		12.90	8.05	0.25	0.91	0.40	0.25	0.10	0.09	9.3%
		13.30	8.00	0.20	0.88	0.40	0.20	0.08	0.07	7.2%
		13.70	8.00	0.20	0.95	0.40	0.20	0.08	0.08	7.8%
		14.10	8.00	0.20	0.93	0.40	0.20	0.08	0.07	7.6%
		14.50	7.85	0.05	0.00	0.43	0.05	0.02	0.00	0.0%
		14.90	7.90	0.10	0.91	0.40	0.10	0.04	0.04	3.7%
		15.30	7.90	0.10	0.90	0.40	0.10	0.04	0.04	3.7%
		15.70	7.90	0.10	0.75	0.40	0.10	0.04	0.03	3.1%
		16.10	7.90	0.10	0.54	0.40	0.10	0.03	0.02	1.7%
	W	16.30	7.80	0.00	0.00	0.22		0.00	0.00	0.0%
		18.50	7.40			0.00		0.00	0.00	0.0%
1	G	19.50	6.94			0.00		0.00	0.00	0.0%
	LS	21.60	5.22			0.00		0.00	0.00	0.0%
	TOTALS ----------					7.94	0.3 (Max.)	1.17	0.98	100.0%

Manning's n = 0.0873
Hydraulic Radius= 0.14738846

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w Willow Ck.
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.17	1.17	0.0%
7.55	1.17	3.46	195.6%
7.57	1.17	3.25	177.8%
7.59	1.17	3.05	160.4%
7.61	1.17	2.85	143.4%
7.63	1.17	2.65	126.7%
7.65	1.17	2.46	110.4%
7.67	1.17	2.28	94.5%
7.69	1.17	2.09	78.9%
7.71	1.17	1.92	63.8%
7.73	1.17	1.74	48.9%
7.75	1.17	1.57	34.5%
7.76	1.17	1.49	27.4%
7.77	1.17	1.41	20.4%
7.78	1.17	1.33	13.5%
7.79	1.17	1.25	6.7%
7.80	1.17	1.17	0.0%
7.81	1.17	1.09	-6.6%
7.82	1.17	1.02	-13.2%
7.83	1.17	0.94	-19.6%
7.84	1.17	0.87	-26.0%
7.85	1.17	0.79	-32.3%
7.87	1.17	0.65	-44.4%
7.89	1.17	0.52	-55.8%
7.91	1.17	0.41	-64.8%
7.93	1.17	0.33	-71.7%
7.95	1.17	0.26	-78.1%
7.97	1.17	0.19	-84.1%
7.99	1.17	0.12	-89.7%
8.01	1.17	0.08	-93.5%
8.03	1.17	0.05	-95.5%
8.05	1.17	0.03	-97.2%

WATERLINE AT ZERO
AREA ERROR = 7.800

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w Willow 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	6.94	15.59	0.74	1.16	11.53	15.94	100.0%	0.72	27.84	2.41
	6.95	15.51	0.73	1.15	11.38	15.86	99.5%	0.72	27.30	2.40
	7.00	15.14	0.70	1.10	10.61	15.47	97.1%	0.69	24.72	2.33
	7.05	14.76	0.67	1.05	9.86	15.08	94.6%	0.65	22.26	2.26
	7.10	14.39	0.63	1.00	9.13	14.69	92.2%	0.62	19.93	2.18
	7.15	14.01	0.60	0.95	8.42	14.30	89.7%	0.59	17.73	2.11
	7.20	13.63	0.57	0.90	7.73	13.91	87.2%	0.56	15.66	2.03
	7.25	13.26	0.53	0.85	7.06	13.52	84.8%	0.52	13.72	1.94
	7.30	12.88	0.50	0.80	6.41	13.13	82.3%	0.49	11.90	1.86
	7.35	12.51	0.46	0.75	5.77	12.74	79.9%	0.45	10.20	1.77
	7.40	12.13	0.43	0.70	5.16	12.34	77.4%	0.42	8.63	1.67
	7.45	11.59	0.39	0.65	4.56	11.79	74.0%	0.39	7.26	1.59
	7.50	11.05	0.36	0.60	4.00	11.24	70.5%	0.36	6.01	1.50
	7.55	10.51	0.33	0.55	3.46	10.69	67.1%	0.32	4.88	1.41
	7.60	9.97	0.30	0.50	2.95	10.14	63.6%	0.29	3.87	1.31
	7.65	9.42	0.26	0.45	2.46	9.59	60.2%	0.26	2.98	1.21
	7.70	8.88	0.23	0.40	2.00	9.04	56.7%	0.22	2.20	1.10
	7.75	8.34	0.19	0.35	1.57	8.49	53.3%	0.19	1.53	0.97
WL	7.80	7.80	0.15	0.30	1.17	7.94	49.8%	0.15	0.98	0.84
	7.85	7.30	0.11	0.25	0.79	7.42	46.6%	0.11	0.53	0.67
	7.90	4.27	0.11	0.20	0.45	4.36	27.4%	0.10	0.30	0.66
	7.95	3.63	0.07	0.15	0.26	3.70	23.2%	0.07	0.13	0.50
	8.00	1.40	0.06	0.10	0.09	1.43	9.0%	0.06	0.04	0.47
	8.05	0.90	0.04	0.05	0.03	0.91	5.7%	0.04	0.01	0.32
	8.10	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Red Creek
XS LOCATION: 1.25 m upstream fr conf w Willow Ck.
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.98	cfs
CALCULATED FLOW (Qc)=	0.98	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	7.80	ft
CALCULATED WATERLINE (WLc)=	7.80	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=	0.84	ft/sec
MANNING'S N=	0.087	
SLOPE=	0.031	ft/ft
.4 * Qm =	0.4	cfs
2.5 * Qm=	2.4	cfs

RECOMMENDED INSTREAM FLOW:
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FLOW (CFS)	PERIOD
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____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

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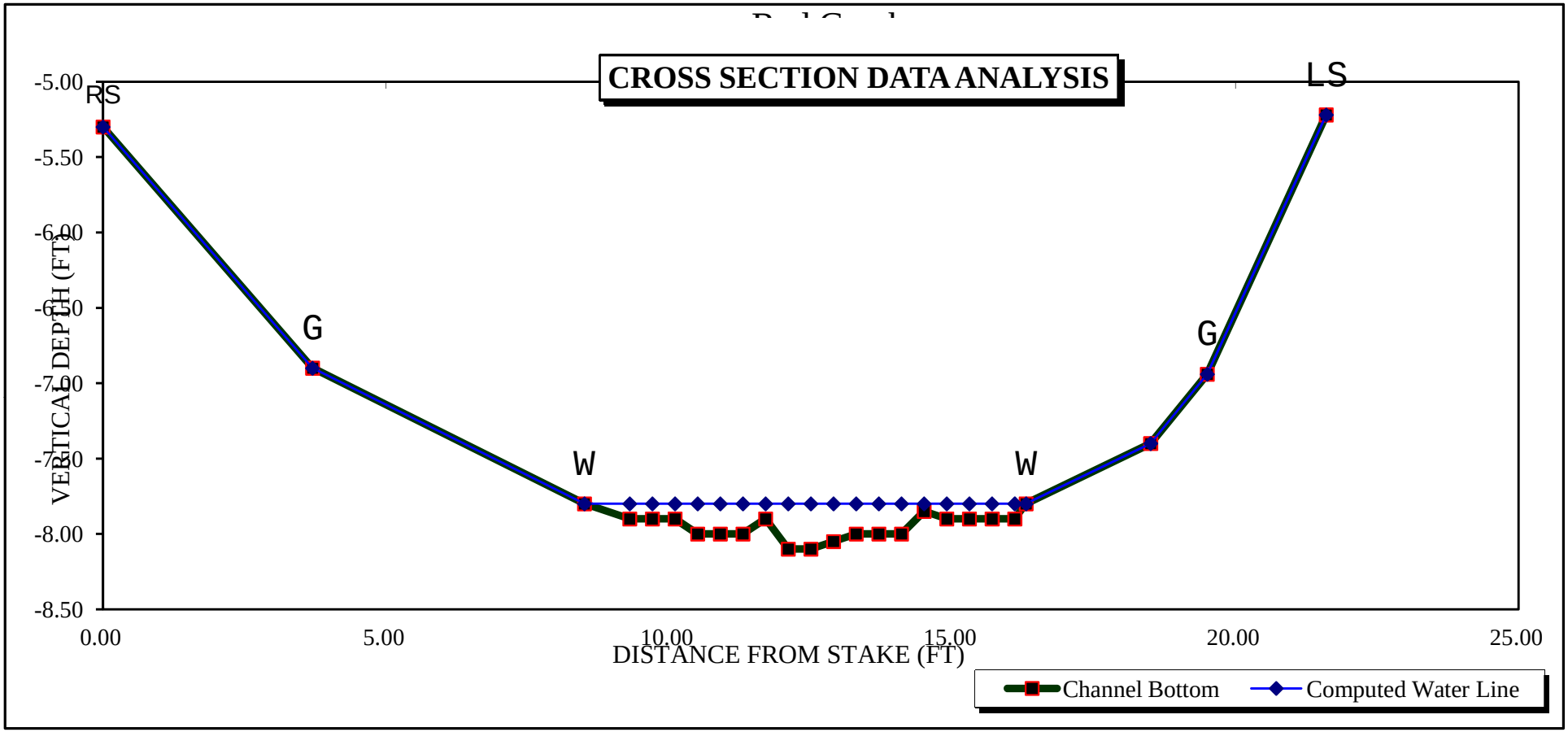
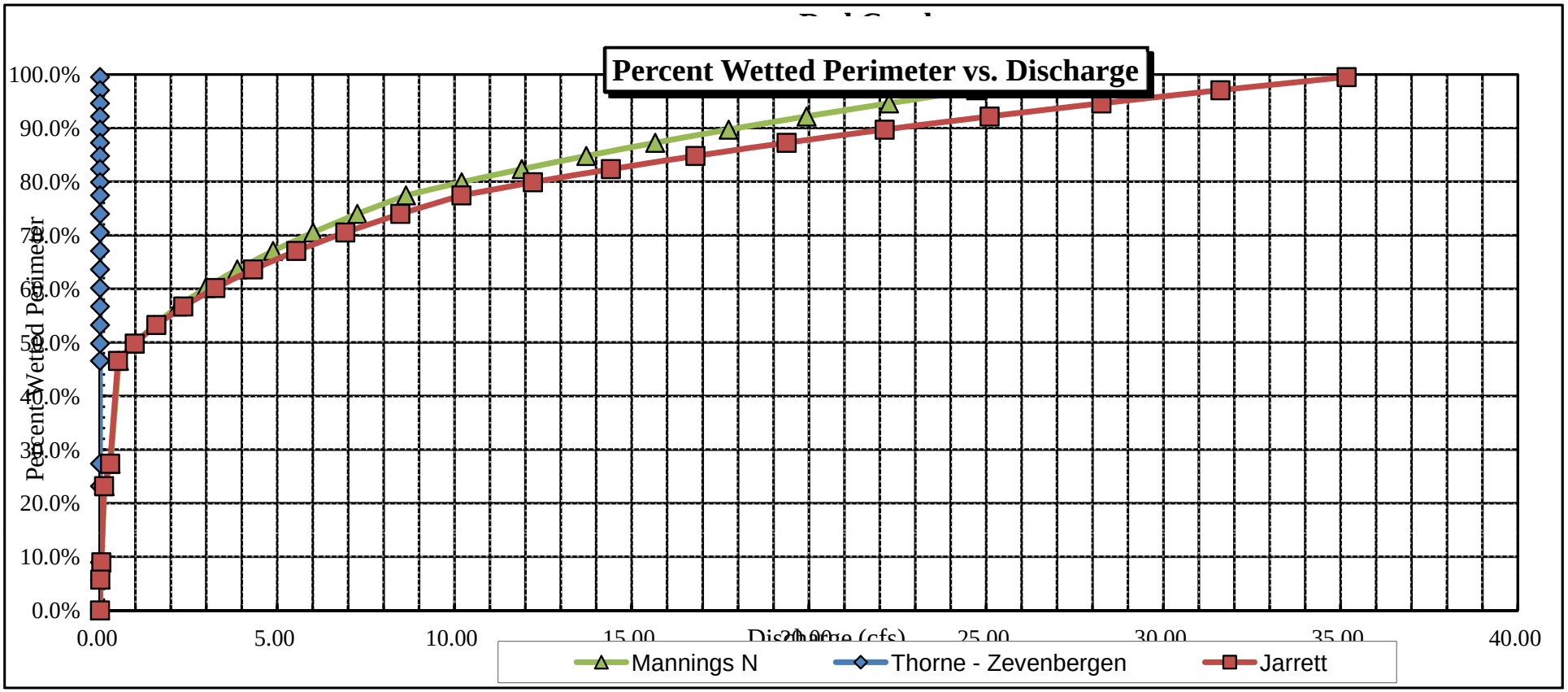
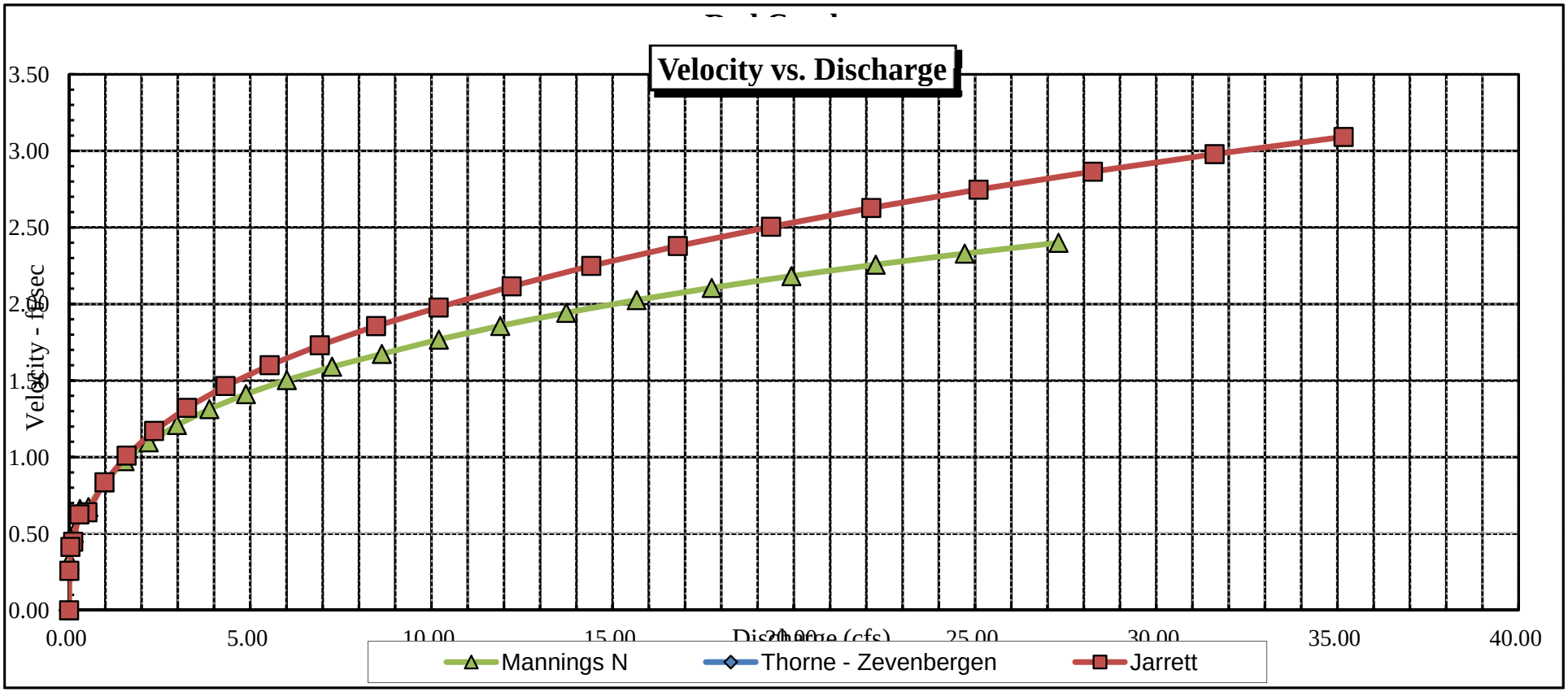
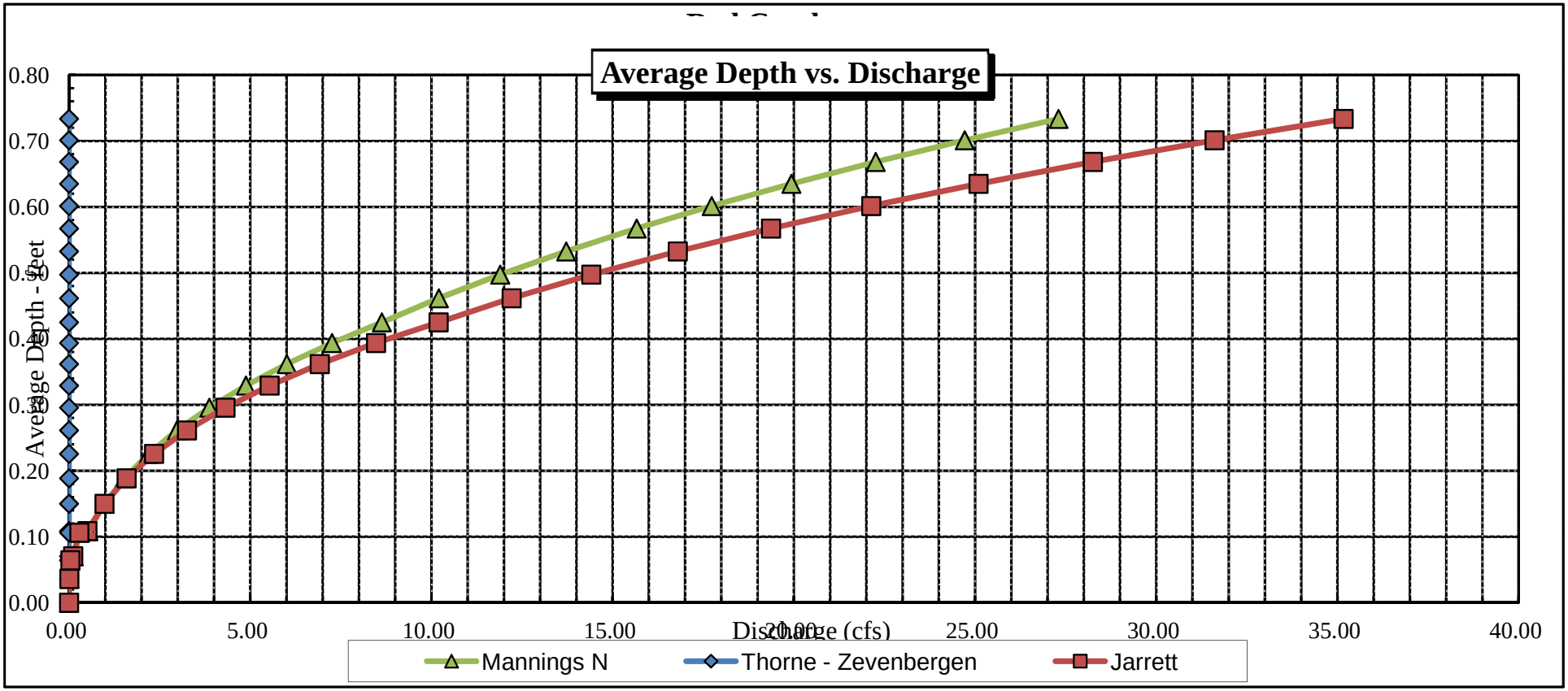
RECOMMENDATION BY: ………………...……...……................................ AGENCY...……………………......…....…...…...…....... DATE:......…...…......……………

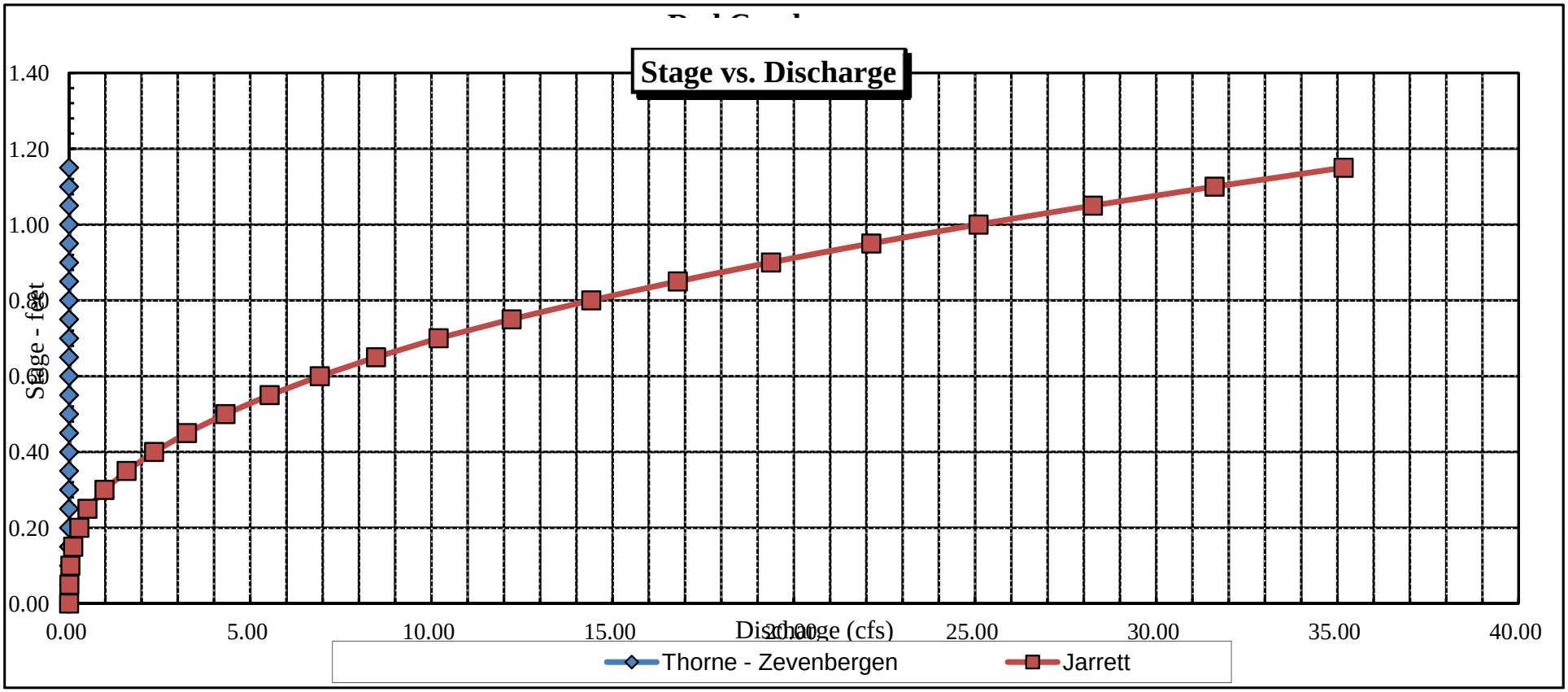
CWCB REVIEW BY: ..…………………………....…………………………………………………...…............. DATE:..................…………….....


CROSS SECTION DATA ANALYSIS
RS
G
W
W
G
LS
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
-8.00
-8.50
VERTICAL DEPTH (FT)
0.00
5.00
10.00
15.00
20.00
25.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


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
5.00
10.00
15.00
25.00
30.00
35.00
40.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
Velocity - ft/sec
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Stage - feet
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett