United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7093
www.blm.gov/co

TAKE PRIDE IN AMERICA

JAN 11 2012

RECEIVED
JAN 12
Colorado Water Conservation Board

In Reply Refer To:
7250 (CO-932)

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 instream flow water rights on Brewery Creek, located in Water Division 3.

Relationship to Land Management Plans. Instream flow protection on this creek is important to the BLM because the BLM and multiple other partners have worked to address acid mine drainage impacts from historic mines in the Kerber Creek watershed. Although very little mining activity occurred within the Brewery Creek watershed, flows contributed by the watershed to Kerber Creek are critical for diluting heavy metals and maintaining Ph levels in Kerber Creek. Brewery Creek itself supports fish populations and riparian habitat that is relatively undisturbed by historic mining activities, a very important resource within the Kerber Creek watershed.

Location and Land Status. Brewery Creek is tributary to Kerber Creek approximately 14.5 miles west of Villa Grove. The total stream length is 4.29 miles. This recommendation covers the stream reach beginning at the U.S. Forest Service boundary within Section 35, T47N, R7E and extending downstream to the confluence with Kerber Creek, a distance of approximately 1.83 miles. Approximately 11.4 % (0.18 river miles) of this stream reach is managed by the BLM and the remainder is in private ownership.

Biological Summary. Brewery Creek is considered to be a cold-water stream in an alpine environment, starting at 11,920 feet and ending at the confluence with Kerber Creek at 9,200 feet. Brewery Creek is a moderate gradient stream (1.2 % average slope), has well developed and functional floodplains, and several active beaver dams. Brewery Creek is one of the few perennial streams in the Bonanza Mining District that has not been impacted by mining activities.

Fish surveys show that Elkhorn Gulch supports a naturally reproducing brook trout population. Macroinvertebrate surveys have revealed various species of mayfly, stonefly, and caddisfly.

The riparian community is comprised primarily of willow, alder, aspen, and sedge species, with coyote willow and alder being the most dominant shrubs. The healthy riparian community has resulted in normal width-to-depth ratios, sinuosity and bank stability.

R2Cross Analysis. The BLM collected the following R2Cross data from Brewery 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)
10/07/2010 #2	1.44 cfs	9.69 feet	1.34 cfs	2.10 cfs
10/07/2010 #1	1.59 cfs	15.69 feet	1.89 cfs	3.59 cfs
		Averages:	1.62 cfs	2.85 cfs

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

> 2.85 cubic feet per second is recommended for the snowmelt runoff period, from April 1 through July 31. This recommendation is driven by the average velocity criteria. This section of the creek has very limited riffle habitat available for spawning, so it is important that as much usable habitat as possible is available.
>
> 2.10 cubic feet per second is recommended for the late summer and fall period, from August 1 through November 15. Although the R2Cross model suggests a higher flow rate for this time period, the BLM has reduced its recommendation for this period based on water availability. This flow rate will meet the average depth and wetted perimeter criteria, and will provide an average velocity in riffles of at least 0.85 feet per second.
>
> 1.60 cubic feet per second is recommended during the winter period from Nov. 16 to March 31. This recommendation is driven by the average depth criteria and average velocity criteria. This flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

Water Availability. For water availability analysis, the BLM recommends using the StreamStats package available from the U.S. Geological Survey. This analytic procedure is particularly suited for small, high elevation watersheds where significant snowpack produces a large amount of runoff per acre. The BLM does not recommend using a basin apportionment procedures based upon gages lower in the watershed. A basin apportionment procedure assumes that every acre within the watershed produces the same amount of runoff, rather than considering the unusually high amount of runoff from snowfall in small, high altitude watersheds.

The BLM is not aware of any decreed water rights that operate within the recommended stream reach. The Colorado Water Conservation Board (CWCB) should be aware that the U.S. Forest Service holds a reserved water right on the creek. The reserved water right terminates at the Forest Service boundary, just above the subject stream reach.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2011. We thank both the 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: Andrew Archuleta, Saguache Field Office
Mark Uppendahl, Colorado Parks and Wildlife

DRAFT INSTREAM FLOW RECOMMENDATION

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

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>
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Water Availability. For water availability analysis, BLM recommends analysis of U.S. Geological Survey stream gage 08224500, (Kerber Creek above Little Kerber Creek near Villa Grove, CO). This gage has a long period of record between 1923 and 2007, providing an excellent indication of raw water availability. When utilizing this gage, it should be understood that the gage may have been affected by icing during the winter, and may be influenced by irrigation operations in the vicinity of the gage. To estimate water availability for Brewery Creek, a basin apportionment procedure can be used.

BLM is not aware of any decreed water rights that operate within the recommended stream reach. The CWCB should be aware that the U.S. Forest Service holds a reserved water right on the creek. The reserved water right terminates at the Forest Service boundary, just above the subject stream reach.

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Sincerely,

Leigh Espy
Deputy State Director
Resources and Fire

Cc: Andrew Archuleta, Saguache Field Office
Steve Sanchez, Saguache Field Office

San Luis Valley Field Office Stream Surveys
November 2011

Elkhorn Gulch and Brewery Creek are located approximately 10 miles northwest of the town of Villa Grove and one half mile south of the mining town of Bonanza, Colorado in Saguache County. The creeks are located on lands managed by the Bureau of Land Management, San Luis Valley Field Office, the Rio Grande National Forest, Saguache Ranger District, as well as private land owners on Brewery Creek. These creeks are tributaries to Kerber Creek which flows into San Luis Creek. An attempt by Colorado Parks and Wildlife and the BLM at sampling these creeks to determine fishery status and composition occurred on November 17th, 2011. This attempt was unsuccessful due to the early onset of ice cover and snow cover which made the creek inaccessable for sampling equipment. Both creeks were flowing at this time period but were not sampled. Previous sampling history will be described for each creek in the separate sections of this document. A map of the general area is included below.

Brewery Creek and Elkhorn Gulch, tributaries to Kerber Creek

Elkhorn Gulch – Water Code # 40016/40844 (depending on report)

Elkhorn Gulch is a small high gradient (11.5%) stream that drains the northwest slope of Elkhorn Peak. The stream is spring-fed with some contribution from run-off waters. The lower terminus is at the confluence of Kerber Creek (T46N R7E, S36) and the upper terminus or head water is the spring (T47 R8E S20). The stream flows through 0.25 miles of BLM and 2.25 miles of USFS managed lands. The elevation rises from 9280 ft to 10,700 ft. The fishery value is considered average with a stream length of 2.5 miles and width of 1-4 feet. In the 1980 stream assessment, the flow was below normal at a flow rate of 2 cubic feet per second. At the time, Kerber Creek did not contain aquatic invertebrates or fish at the confluence of Elkhorn Gulch as was considered a dead stream. The average stream temperature was between 46 degrees Farenheit in September/ October and 70 degrees in August and pH was 7.6.

Numerous beaver ponds and dense riparian vegetation make this stream a poor candidate for reclamation to re-introduce Rio Grande cutthroat trout. The Rio Grande cutthroat trout (native species) is considered extirpated. Elkhorn Gulch is managed by Colorado Parks and Wildlife as a brook trout fishery. This stream would be very difficult for fish toxicants to adequately remove non-native fish due to stream morphology and success would be unlikely.

Historic mining in the Kerber Creek basin has polluted Kerber Creek with heavy metals and has provided an intermittent barrier to fish movement into Elkhorn Gulch. No fish stocking records are found so brook trout likely came to Elkhorn Gulch from Kerber Creek during periods when Kerber Creek had low metal content and could sustain a fishery. There are sufficient overwinter pools, undercut banks, and stream flow to sustain a fishery year-round in Elkhorn Gulch. In addition, the creek hasexcellent riparian habitat condition to provide shade, a food source, and cover habitat, as well as lower heavy metal content from mining sources.

Recent reclamation of the mining tailings within and adjacent to Kerber Creek, riparian vegetation enhancement, and improvement of stream morphology through sediment structures and pool development should improve Kerber Creek and the associated fishery. This reclamation has the potential to provide a sustainable fishery in all creeks that drain into Kerber Creek that have fishery value and overwinter habitat.

Stream surveys on Elkhorn Gulch occurred in 1980 and again in 1999 with a backpack electroshocker using two pass removal. Electrofishing data in 1980 revealed that 19 Brook Trout and two Rio Grande cutthroat trout were sampled in a distance of 120 feet from the confluence with Kerber Creek. The 1999 sampling effort revealed a naturally reproducing population of brook trout with a biomass of 69 lb/acre and density of 449 fish/mile. At this time, Rio Grande cutthroat trout were not collected or observed. Brook trout were observed inhabiting beaver ponds throughout the drainage. A presence/ absence survey occurred by the BLM July 27th, 2011. This survey looked at two areas of

open water and six brook trout were captured, most age classes were present (juvenile to adult). At this time, the stream had sufficient flow to support a fishery and the fish habitat and riparian condition was considered good.

Station 1, 2 Pass Removal, August 7th, 1980

Species	Length (inches)	Number of Fish	Total Weight (grams)
BKT	3	1	
BKT	6	1	
BKT	7	1	
BKT	8	1	
RGCT	8	1	
RGCT	9	1	
RGCT	10	1	Unknown

Comments: Electofishing for 900 ft. length at 9280 ft in elevation. In addition, on August 13th 1980 sampling occurred with a flyrod and spinning rod. Beaver ponds were sampled with five man hours and six fish caught, two Rio Grande cutthroat trout and four brook trout.

Station 1, 2 Pass Removal, September 17th, 1980

Species	Length (inches)	Number of Fish	Total Weight (grams)
BKT	2	7	
BKT	3	11	
BKT	7	1	
RGCT	4	1	
RGCT	5	1	
			194

Comments: Electrofishing for 120 ft. at 9280 ft. in elevation. Fish biomass was 100% gamefish at 51.5 lbs/acre.

Station 1, 2 Pass Removel, June 29th, 1999

Relative Abundance and Catch Per Unit Effort

Species	Number	Weight (lb)	Biomass/Acre	Number/ Mile	Density #/acre	Density Confidence Interval
BKT	19	1.58	69.45	449.2	926.4	314.1

Mean, Minimum, and Maximum Values for Lengths and Weights

Species	Number	Mean Length (inches)	Mean Weight (lbs)	Minimum Length (inches)	Minimum Weight (lbs)	Maximum Length (inches)	Maximum Weight (lbs)
BKT	19	5.8	0.08	3.9	0.02	9.4	0.28

Comments: Length of sampling area was 256 feet. Stream width was 4 ft.

Length of Fish Sampled

Species	Length (inches)	Number of Fish
BKT	4	4
BKT	5	4
BKT	6	6
BKT	7	2
BKT	8	2
BKT	9	1

Recommendations:

- Periodically monitor the creek to determine fish status and monitor habitat conditions.
- Sample further upstream to confirm upper distribution of fish. If no fish are present, evaluate habitat quality, stream temperatures, and low flow rates.
- This stream would benefit from an instream flow recommendation to protect the existing brook trout fishery and to help protect flows for spawning by brook trout.

Elkhorn Gulch Overview

Elkhorn Gulch With Large/ Coarse Woody Debris

Elkhorn Gulch Near Confluence With Kerber Creek

Elkhorn Gulch Showing Stream Meander and Habitat

Elkhorn Gulch Habitat and Old Beaver Dam Structure

Brewery Creek – Water Code # 38554

Brewery Creek is a minor high gradient stream (12.8%) located south of Slaughterhouse Creek and west of Kerber Creek. The stream is spring-fed with some contribution from spring run-off waters. The lower terminus is at the confluence of Slaughterhouse Creek (T47N R7E, S35) and the upper terminus or head waters of the stream is narrow and spring-fed (T47 R7E S29). The elevation rises from 9400 ft to 11,840 ft. Ownership is mixed and includes less than ¼ mile of BLM, private land for 1.3 miles, and USFS for 2.2 miles. The fishery value is considered excellent with a stream length of 3.6 miles and width of 2.5 to 5 feet. The average stream temperature was 58 degrees Farenheit on September 15th, 1980 and pH was 8.5, and flow rate was 0.8 cubic feet per second.

Historic mining in the Kerber Creek basin has polluted Kerber Creek Creek with heavy metals and has provided a possible barrier to fish movement into Slaughterhouse Creek and consequently Brewery Creek. Recent reclamation of the mining tailings within and adjacent to Kerber Creek, riparian vegetation enhancement, and improvement of stream morphology through sediment structures, channel restructuring, and pool development should improve Kerber Creek and the associated fishery. This reclamation has the potential to provide a sustainable fishery in all creeks that drain into Kerber Creek that have fishery value and overwinter habitat. No fish stocking records are found for Brewery Creek, so brook trout likely moved from Kerber Creek to Slaughterhouse Creek and up the Brewery Creek drainage during intermittent periods when Kerber Creek has a fishery (likely from private stocking or movement of fish originating from San Luis Creek).

The official stream survey occurred in 1980 with a backpack electroshocker using 2 pass removal. Electrofishing data reveals that 31 brook trout were sampled in a distance of 130 feet from the confluence with Slaughterhouse Creek. A presence/absence fish survey was conducted by the BLM in 2008 (UTMs: 4237203; 399374) where 4 brook trout were captured (7cm in length to 12 cm in length) and shows longevity and sustainability in the fishery as a naturally reproducing population. In addition, BLM personnel walked the length of the creek on public lands on October 7, 2010, and verified the presence of brook throughout the portion of the stream on public lands.

Station 1, 2 Pass Removal, September 15th 1980

Species	**Length (inches)**	**Number of Fish**	**Total Weight (grams)**
BKT	3	4	
BKT	4	11	
BKT	5	13	
BKT	7	3	
			703 grams

Limiting factors for reclamation to a native fishery include steep gradient and numerous beaver ponds, and short stream length for reclamation purposes.

Recommendations:

- Periodically monitor the creek to determine fish status and monitor habitat conditions.
- Sample further upstream to confirm upper distribution of fish. If no fish are present, evaluate habitat quality, stream temperatures, and low flow rates.
- This stream would benefit from an instream flow recommendation to protect the existing brook trout fishery and to help protect flows for spawning by brook trout.

Overview of Brewery Creek Riparian Area Upstream View

Overview of Brewery Creek Riparian Area Downstream View, Impacts of Beaver Dams

Riparian Survey Downstream of Brewery Guard Station (on BLM Managed Lands)

Riparian Survey on Brewery Creek Downstream of Beaver Dam in 2011

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Brewery Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: at Brewery Creek Guard Station						
DATE: 10-7-10	OBSERVERS: R. Smith, S. Sanchez					
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 35	TOWNSHIP: 47 (N)S	RANGE: 7 (E)W	PM: NM	
COUNTY: Saguache	WATERSHED: Closed Basin	WATER DIVISION: 3	DOW WATER CODE: 38554			
MAP(S): USGS:			GPS 397980			
USFS:			4238388			

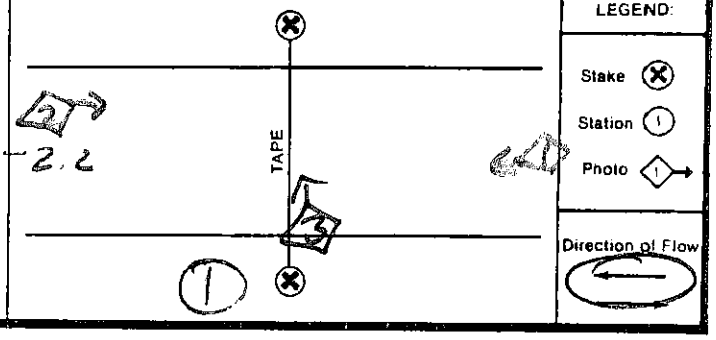
SUPPLEMENTAL DATA

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 6" 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 13.8	7.75 / 7.76
(2) WS Upstream	18.0	7.55
(3) WS Downstream	35.0	8.06
SLOPE	0.51 / 53.0 = .01	

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: 7.37 Cond = 760 Temp = 10.8 °C DO = 8.9%

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Brewery Creek | CROSS-SECTION NO.: 1 | DATE: 10-7-10 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 12:40 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 Obser-vation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.0		5.94								
G	2.0		6.73								
W	2.2		7.75								
	2.5		7.95		.2			.24			
	3		7.95		.2			.14			
	3.5		7.95		.2			.23			
	4		7.95		.2			.34			
	4.5		8.00		.25			.10			
	5		8.00		.25			.62			
	5.5		8.00		.25			.34			
	6		7.95		.2			.9			
	6.5		7.95		.2			1.57			
	7		7.95		.2			.82			
	7.5		7.95		.2			1.16			
	8		7.95		.2			1.28			
	8.5		7.90		.15			.59			
	9		7.90		.15			.66			
	9.5		7.90		.15			.95			
	10		7.95		.20			1.45			
	10.5		7.95		.20			1.12			
	11		8.00		.25			1.24			
	11.5		7.95		.20			.71			
	12		7.90		.15			.71			
	12.5		7.90		.15			.66			
	13.0		7.85		.10			.45			
	13.5		7.85		.10			.45			
W	13.8		7.75		ϕ			ϕ			
G	17.7		6.78								
LS	22.0		5.95								
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:	Brewery Creek
XS LOCATION:	at Brewery Creek Guard Station
XS NUMBER:	1
DATE:	7-Oct-10
OBSERVERS:	R. Smith, S. Sanchez
1/4 SEC:	NW
SECTION:	35
TWP:	47N
RANGE:	7W
PM:	NM
COUNTY:	Saguache
WATERSHED:	Closed Basin
DIVISION:	3
DOW CODE:	38554
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:	0.01

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

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

STREAM NAME: Brewery Creek
XS LOCATION: at Brewery Creek Guard Station
XS NUMBER: 1

DATA POINTS= 29

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	5.94			0.00		0.00	0.00	0.0%
1	G	2.00	6.73			0.00		0.00	0.00	0.0%
	W	2.20	7.75	0.00	0.00	0.00		0.00	0.00	0.0%
		2.50	7.95	0.20	0.24	0.36	0.20	0.08	0.02	1.2%
		3.00	7.95	0.20	0.14	0.50	0.20	0.10	0.01	0.9%
		3.50	7.95	0.20	0.23	0.50	0.20	0.10	0.02	1.4%
		4.00	7.95	0.20	0.34	0.50	0.20	0.10	0.03	2.1%
		4.50	8.00	0.25	0.10	0.50	0.25	0.13	0.01	0.8%
		5.00	8.00	0.25	0.62	0.50	0.25	0.13	0.08	4.9%
		5.50	8.00	0.25	0.34	0.50	0.25	0.13	0.04	2.7%
		6.00	7.95	0.20	0.90	0.50	0.20	0.10	0.09	5.7%
		6.50	7.95	0.20	1.57	0.50	0.20	0.10	0.16	9.9%
		7.00	7.95	0.20	0.82	0.50	0.20	0.10	0.08	5.2%
		7.50	7.95	0.20	1.16	0.50	0.20	0.10	0.12	7.3%
		8.00	7.95	0.20	1.28	0.50	0.20	0.10	0.13	8.1%
		8.50	7.90	0.15	0.59	0.50	0.15	0.08	0.04	2.8%
		9.00	7.90	0.15	0.66	0.50	0.15	0.08	0.05	3.1%
		9.50	7.90	0.15	0.95	0.50	0.15	0.08	0.07	4.5%
		10.00	7.95	0.20	1.45	0.50	0.20	0.10	0.15	9.1%
		10.50	7.95	0.20	1.12	0.50	0.20	0.10	0.11	7.1%
		11.00	8.00	0.25	1.24	0.50	0.25	0.13	0.16	9.8%
		11.50	7.95	0.20	0.71	0.50	0.20	0.10	0.07	4.5%
		12.00	7.90	0.15	0.71	0.50	0.15	0.08	0.05	3.4%
		12.50	7.90	0.15	0.66	0.50	0.15	0.08	0.05	3.1%
		13.00	7.85	0.10	0.45	0.50	0.10	0.05	0.02	1.4%
		13.50	7.85	0.10	0.45	0.50	0.10	0.04	0.02	1.1%
	W	13.80	7.75	0.00	0.00	0.32		0.00	0.00	0.0%
1	G	17.70	6.78			0.00		0.00	0.00	0.0%
	LS	22.00	5.95			0.00		0.00	0.00	0.0%
	TOTALS ----------					11.70	0.25 (Max.)	2.15	1.59	100.0%

Manning's n = 0.0648
Hydraulic Radius= 0.18338454

STREAM NAME: Brewery Creek
XS LOCATION: at Brewery Creek Guard Station
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	2.15	2.15	0.0%
7.50	2.15	5.18	141.3%
7.52	2.15	4.92	129.6%
7.54	2.15	4.67	117.9%
7.56	2.15	4.43	106.3%
7.58	2.15	4.18	94.8%
7.60	2.15	3.93	83.3%
7.62	2.15	3.69	72.0%
7.64	2.15	3.45	60.7%
7.66	2.15	3.21	49.5%
7.68	2.15	2.97	38.3%
7.70	2.15	2.73	27.3%
7.71	2.15	2.61	21.8%
7.72	2.15	2.49	16.3%
7.73	2.15	2.38	10.9%
7.74	2.15	2.26	5.4%
7.75	2.15	2.15	0.0%
7.76	2.15	2.03	-5.4%
7.77	2.15	1.91	-10.8%
7.78	2.15	1.80	-16.1%
7.79	2.15	1.68	-21.5%
7.80	2.15	1.57	-26.8%
7.82	2.15	1.34	-37.3%
7.84	2.15	1.12	-47.8%
7.86	2.15	0.90	-58.0%
7.88	2.15	0.69	-67.7%
7.90	2.15	0.49	-77.2%
7.92	2.15	0.32	-84.9%
7.94	2.15	0.17	-92.0%
7.96	2.15	0.07	-96.6%
7.98	2.15	0.03	-98.7%
8.00	2.15	0.00	-100.0%

WATERLINE AT ZERO
AREA ERROR = 7.750

STREAM NAME: Brewery Creek
XS LOCATION: at Brewery Creek Guard Station
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	6.78	15.69	0.98	1.22	15.38	16.70	100.0%	0.92	33.37	2.17
	6.80	15.61	0.97	1.20	15.07	16.60	99.4%	0.91	32.38	2.15
	6.85	15.40	0.93	1.15	14.29	16.34	97.8%	0.87	29.96	2.10
	6.90	15.18	0.89	1.10	13.53	16.08	96.3%	0.84	27.63	2.04
	6.95	14.97	0.85	1.05	12.77	15.83	94.7%	0.81	25.38	1.99
	7.00	14.76	0.81	1.00	12.03	15.57	93.2%	0.77	23.22	1.93
	7.05	14.55	0.78	0.95	11.30	15.31	91.7%	0.74	21.15	1.87
	7.10	14.34	0.74	0.90	10.58	15.05	90.1%	0.70	19.16	1.81
	7.15	14.13	0.70	0.85	9.86	14.79	88.6%	0.67	17.26	1.75
	7.20	13.92	0.66	0.80	9.16	14.54	87.0%	0.63	15.44	1.69
	7.25	13.71	0.62	0.75	8.47	14.28	85.5%	0.59	13.71	1.62
	7.30	13.50	0.58	0.70	7.79	14.02	83.9%	0.56	12.07	1.55
	7.35	13.29	0.54	0.65	7.12	13.76	82.4%	0.52	10.52	1.48
	7.40	13.08	0.49	0.60	6.46	13.50	80.8%	0.48	9.06	1.40
	7.45	12.87	0.45	0.55	5.81	13.25	79.3%	0.44	7.70	1.32
	7.50	12.65	0.41	0.50	5.18	12.99	77.7%	0.40	6.43	1.24
	7.55	12.44	0.37	0.45	4.55	12.73	76.2%	0.36	5.25	1.15
	7.60	12.23	0.32	0.40	3.93	12.47	74.7%	0.32	4.18	1.06
	7.65	12.02	0.28	0.35	3.33	12.21	73.1%	0.27	3.20	0.96
	7.70	11.81	0.23	0.30	2.73	11.95	71.6%	0.23	2.34	0.86
WL	7.75	11.60	0.18	0.25	2.14	11.70	70.0%	0.18	1.59	0.74
	7.80	11.37	0.14	0.20	1.57	11.45	68.5%	0.14	0.96	0.61
	7.85	10.65	0.09	0.15	1.01	10.70	64.1%	0.09	0.48	0.47
	7.90	8.58	0.06	0.10	0.49	8.61	51.5%	0.06	0.17	0.34
	7.95	3.00	0.03	0.05	0.10	3.01	18.0%	0.03	0.02	0.24
	8.00	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Brewery Creek
XS LOCATION: at Brewery Creek Guard Station
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.59	cfs
CALCULATED FLOW (Qc)=	1.59	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	7.75	ft
CALCULATED WATERLINE (WLc)=	7.75	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.25	ft
MAX CALCULATED DEPTH (Dc)=	0.25	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	0.74	ft/sec
MANNING'S N=	0.065	
SLOPE=	0.01	ft/ft
.4 * Qm =	0.6	cfs
2.5 * Qm=	4.0	cfs

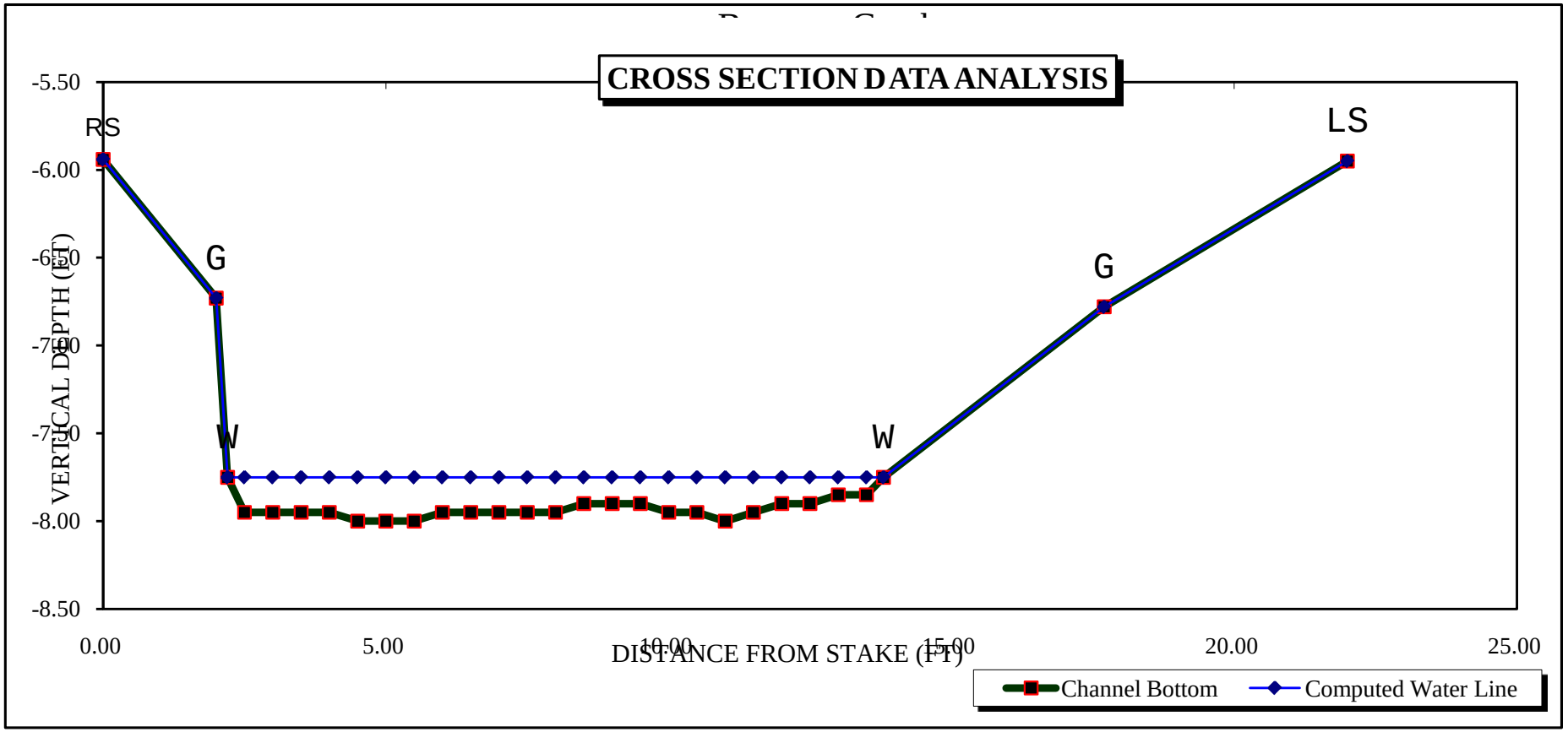
RECOMMENDED INSTREAM FLOW:
=============================

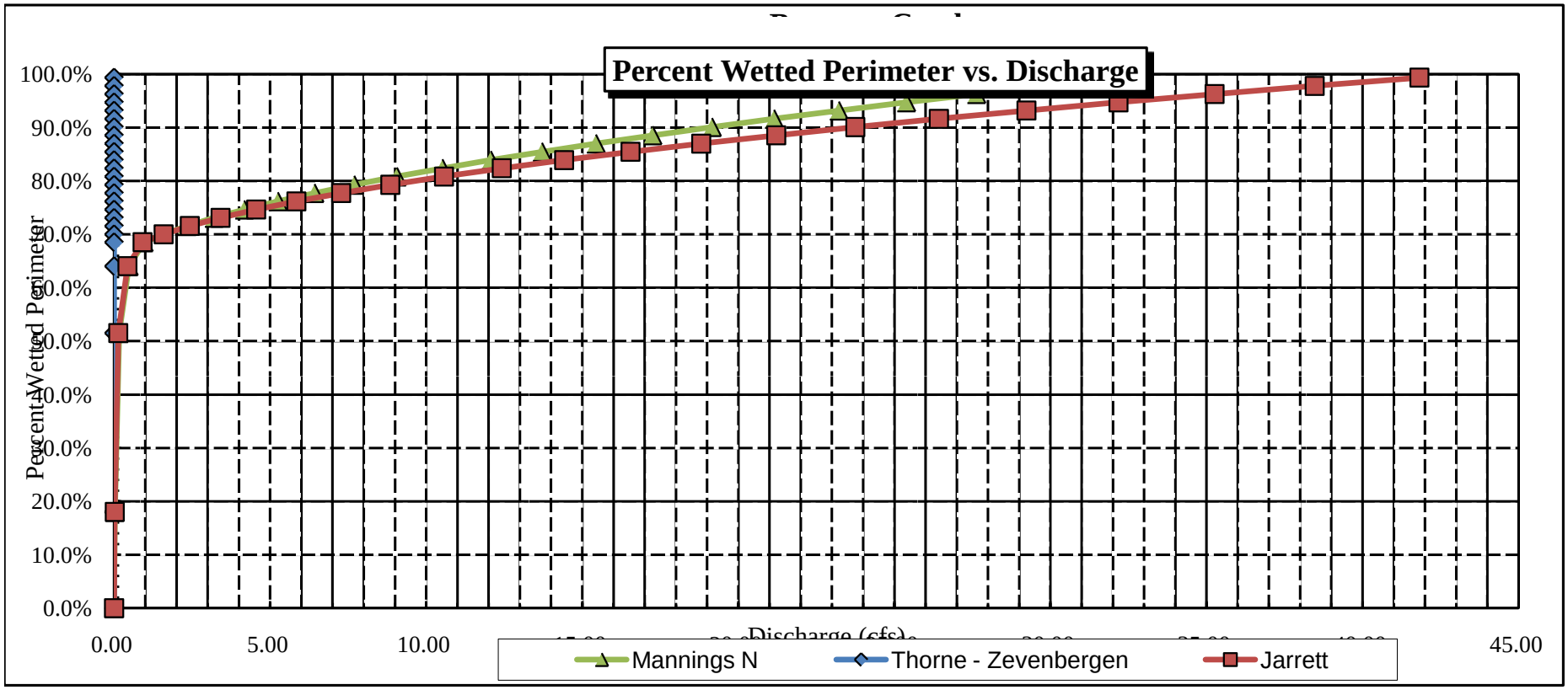
FLOW (CFS)	PERIOD
===========	========
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

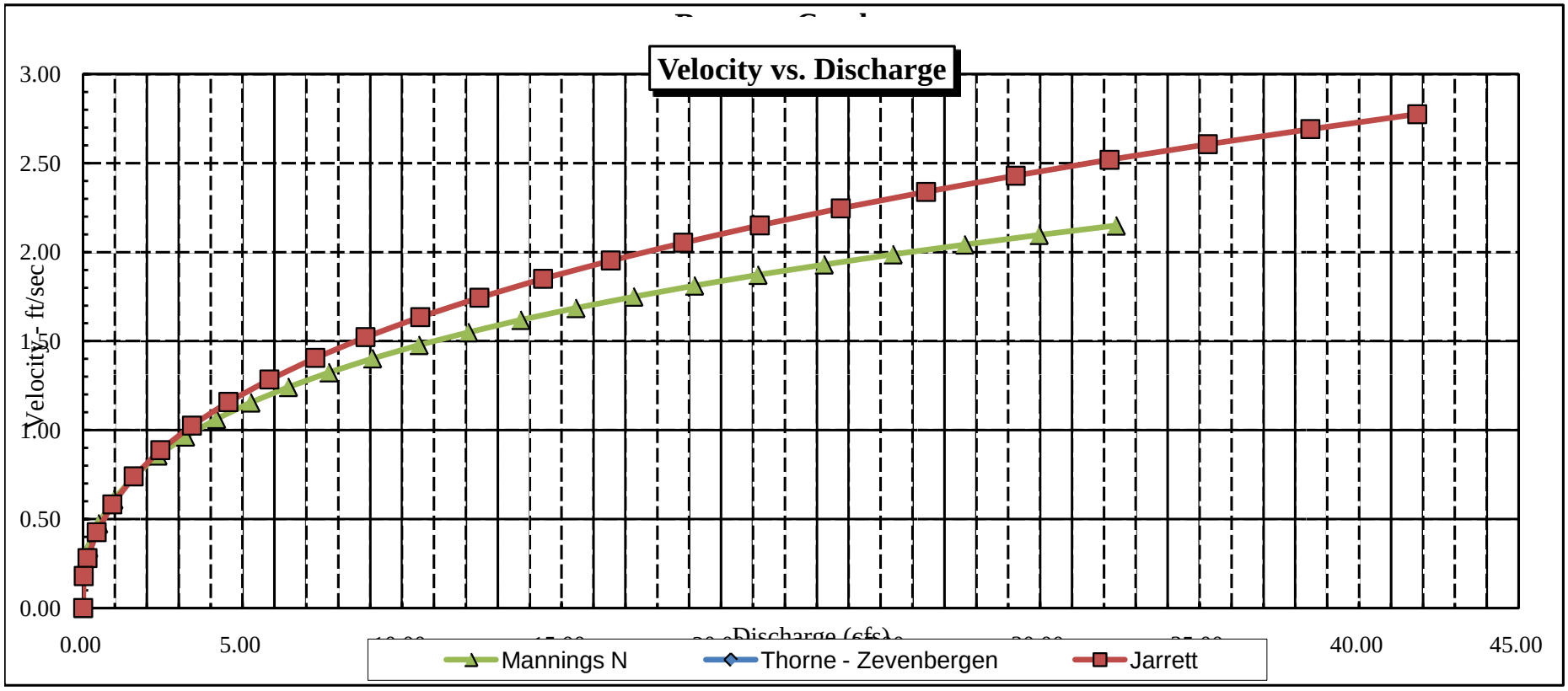
RATIONALE FOR RECOMMENDATION:
=============================

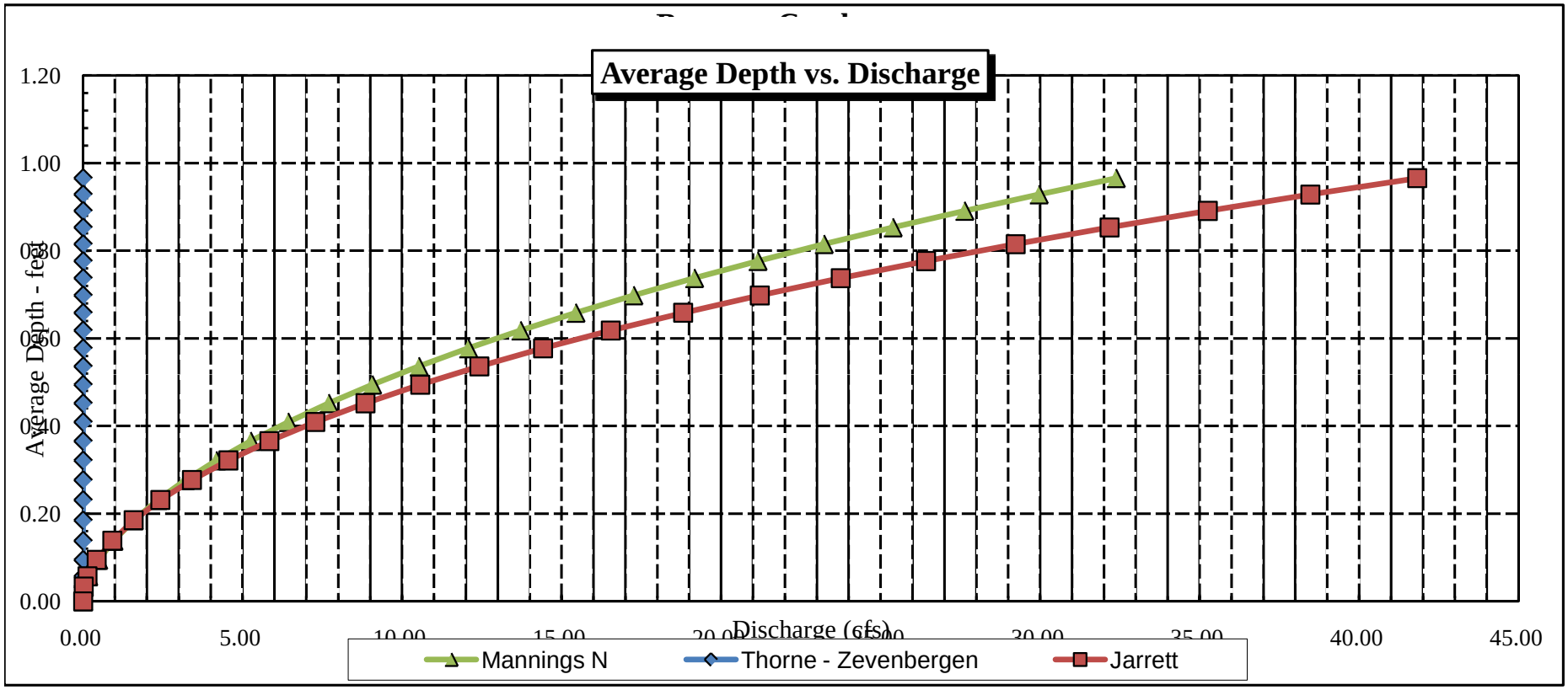
RECOMMENDATION BY: ……………………...………..……............................... AGENCY..………………………......……...…....……....... DATE:......…...…......……………

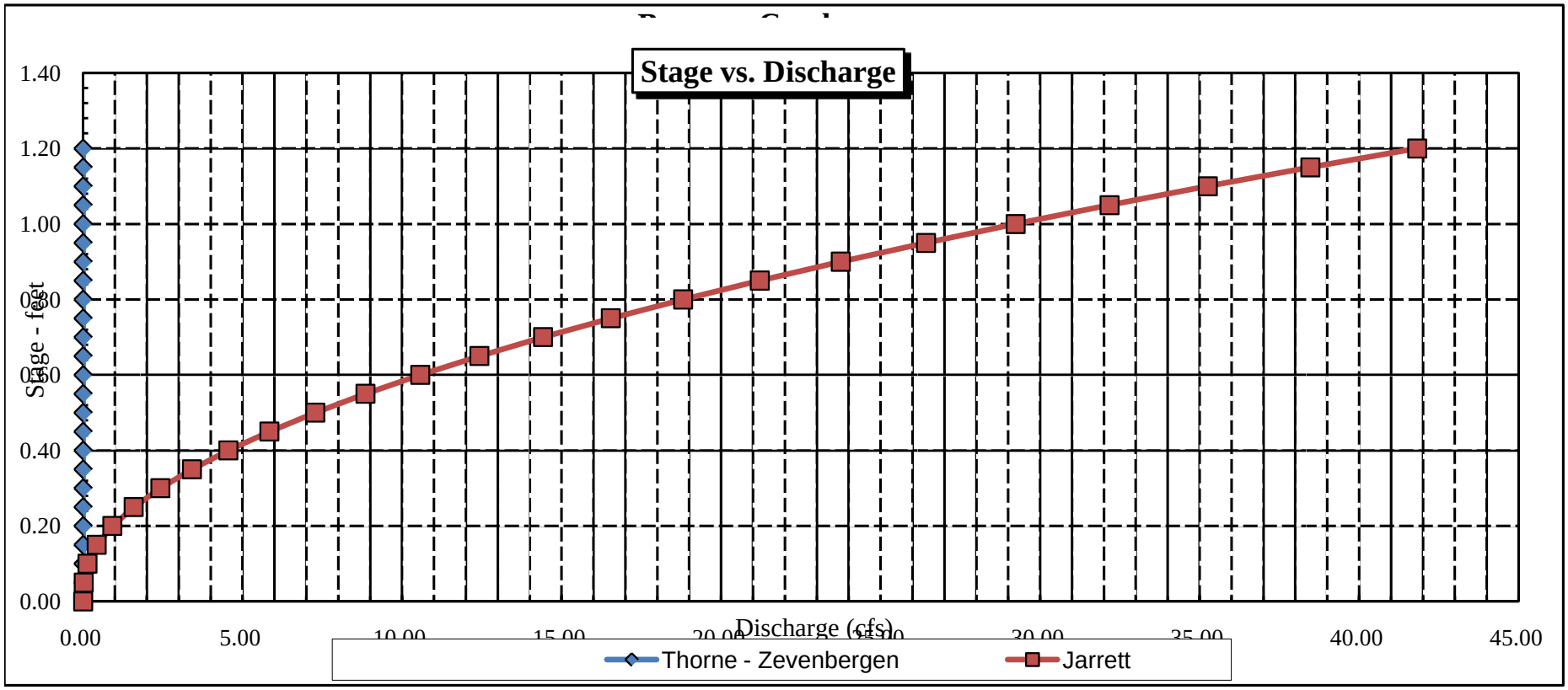
CWCB REVIEW BY: ..……………………………....…………………………………………………….....................................…............. DATE:.................…………….....


CROSS SECTION DATA ANALYSIS
RS
G
W
W
G
LS
-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
45.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Velocity - ft/sec
0.00
5.00
40.00
45.00
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
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
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
40.00
45.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Brewery Creek						CROSS-SECTION NO.: 2	
CROSS-SECTION LOCATION: at Brewery Creek guard station							
DATE: 10-7-10	OBSERVERS: R. Smith, S. Sanchez						
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 35	TOWNSHIP: 47 N/S	RANGE: 7 E/W	PM: NM		
COUNTY: Saguache	WATERSHED: Closed Basin	WATER DIVISION: 3	DOW WATER CODE: 38554				
MAP(S): USGS:							
USFS:							

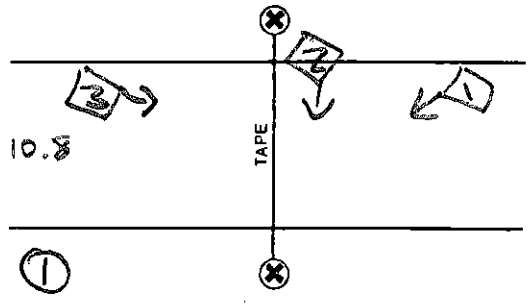
SUPPLEMENTAL DATA

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: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" 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	1.9	5.40 / 5.45
② WS Upstream	21.3		4.90
③ WS Downstream	22.5		6.34
SLOPE	1.44/43.8 = .033		

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

pH: 7.37 Cond = 760 Temp: 10.8°C DO: 18.9%

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Brewery Creek | CROSS-SECTION NO.: 2 | DATE: 10-7-10 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 1:30 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)
LS	0.0		3.82								
G	1.3		4.63								
W	1.9		5.40								
	2.5		5.70	.3				1.61			
	3		5.60	.2				0.94			
	3.5		5.55	.15				1.01			
	4		5.45	.05				1.68			
	4.5		5.50	.10				1.77			
	5		5.55	.15				1.45			
	5.5		5.50	.10				1.66			
	6		5.50	.10				1.66			
	6.5		5.50	.10				0.52			
	7		5.50	.10				.40			
	7.5		5.60	.15				.92			
	8		5.50	.05				ø			
	8.5		5.65	.20				0.76			
	9		5.90	.35				1.42			
	9.5		5.75	.30				0.44			
	10		5.75	.30				0.62			
	10.5		5.55	.10				ø			
W	10.8		5.45								
G	11.0		4.60								
RS	13.6		3.70								
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:	Brewery Creek
XS LOCATION:	At Brewery Creek Guard Station
XS NUMBER:	2
DATE:	7-Oct-10
OBSERVERS:	R. Smith, S. Sanchez
1/4 SEC:	NW
SECTION:	35
TWP:	47N
RANGE:	7E
PM:	New Mexico
COUNTY:	Saguache
WATERSHED:	Closed Basin
DIVISION:	3
DOW CODE:	38554
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:	0.033

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

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

STREAM NAME: Brewery Creek
XS LOCATION: At Brewery Creek Guard Station
XS NUMBER: 2

DATA POINTS= 23

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	0.00	3.82			0.00		0.00	0.00	0.0%
1	G	1.30	4.63			0.00		0.00	0.00	0.0%
	W	1.90	5.40	0.00	0.00	0.00		0.00	0.00	0.0%
		2.50	5.70	0.30	1.61	0.67	0.30	0.17	0.27	18.5%
		3.00	5.60	0.20	0.94	0.51	0.20	0.10	0.09	6.5%
		3.50	5.55	0.15	1.01	0.50	0.15	0.08	0.08	5.3%
		4.00	5.45	0.05	1.68	0.51	0.05	0.03	0.04	2.9%
		4.50	5.50	0.10	1.77	0.50	0.10	0.05	0.09	6.1%
		5.00	5.55	0.15	1.45	0.50	0.15	0.08	0.11	7.6%
		5.50	5.50	0.10	1.66	0.50	0.10	0.05	0.08	5.8%
		6.00	5.50	0.10	1.66	0.50	0.10	0.05	0.08	5.8%
		6.50	5.50	0.10	0.52	0.50	0.10	0.05	0.03	1.8%
		7.00	5.50	0.10	0.40	0.50	0.10	0.05	0.02	1.4%
		7.50	5.60	0.15	0.92	0.51	0.15	0.08	0.07	4.8%
		8.00	5.50	0.05	0.00	0.51	0.05	0.03	0.00	0.0%
		8.50	5.65	0.20	0.76	0.52	0.20	0.10	0.08	5.3%
		9.00	5.80	0.35	1.42	0.52	0.35	0.18	0.25	17.3%
		9.50	5.75	0.30	0.44	0.50	0.30	0.15	0.07	4.6%
		10.00	5.75	0.30	0.62	0.50	0.30	0.15	0.09	6.5%
		10.50	5.55	0.10	0.00	0.54	0.10	0.04	0.00	0.0%
	W	10.80	5.45	0.00	0.00	0.32		0.00	0.00	0.0%
1	G	11.00	4.60			0.00		0.00	0.00	0.0%
	RS	13.60	3.70			0.00		0.00	0.00	0.0%
	TOTALS ----------					9.12	0.35	1.41	1.44	100.0%
							(Max.)			

Manning's n = 0.0757
Hydraulic Radius= 0.15402878

STREAM NAME: Brewery Creek
XS LOCATION: At Brewery Creek Guard Station
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.41	1.36	-3.2%
5.18	1.41	3.61	157.2%
5.20	1.41	3.43	144.2%
5.22	1.41	3.25	131.2%
5.24	1.41	3.07	118.3%
5.26	1.41	2.89	105.4%
5.28	1.41	2.70	92.5%
5.30	1.41	2.52	79.7%
5.32	1.41	2.34	66.8%
5.34	1.41	2.16	54.0%
5.36	1.41	1.98	41.3%
5.38	1.41	1.81	28.5%
5.39	1.41	1.72	22.2%
5.40	1.41	1.63	15.8%
5.41	1.41	1.54	9.5%
5.42	1.41	1.45	3.2%
5.43	1.41	1.36	-3.2%
5.44	1.41	1.27	-9.4%
5.45	1.41	1.18	-15.7%
5.46	1.41	1.10	-22.0%
5.47	1.41	1.01	-28.1%
5.48	1.41	0.93	-34.1%
5.50	1.41	0.76	-45.6%
5.52	1.41	0.64	-54.8%
5.54	1.41	0.53	-62.2%
5.56	1.41	0.44	-68.4%
5.58	1.41	0.37	-73.7%
5.60	1.41	0.31	-78.2%
5.62	1.41	0.25	-82.0%
5.64	1.41	0.20	-85.5%
5.66	1.41	0.16	-88.5%
5.68	1.41	0.12	-91.3%

WATERLINE AT ZERO
AREA ERROR = 5.420

STREAM NAME: Brewery Creek
XS LOCATION: At Brewery Creek Guard Station
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	4.63	9.69	0.90	1.17	8.75	10.94	100.0%	0.80	26.85	3.07
	4.67	9.65	0.87	1.13	8.36	10.85	99.2%	0.77	25.04	3.00
	4.72	9.60	0.82	1.08	7.88	10.73	98.1%	0.73	22.85	2.90
	4.77	9.55	0.77	1.03	7.40	10.62	97.1%	0.70	20.73	2.80
	4.82	9.50	0.73	0.98	6.92	10.50	96.0%	0.66	18.69	2.70
	4.87	9.45	0.68	0.93	6.45	10.39	95.0%	0.62	16.73	2.59
	4.92	9.40	0.64	0.88	5.98	10.27	93.9%	0.58	14.85	2.48
	4.97	9.35	0.59	0.83	5.51	10.16	92.9%	0.54	13.06	2.37
	5.02	9.30	0.54	0.78	5.04	10.05	91.8%	0.50	11.35	2.25
	5.07	9.25	0.50	0.73	4.58	9.93	90.8%	0.46	9.74	2.13
	5.12	9.20	0.45	0.68	4.12	9.82	89.7%	0.42	8.23	2.00
	5.17	9.15	0.40	0.63	3.66	9.70	88.7%	0.38	6.81	1.86
	5.22	9.09	0.35	0.58	3.20	9.59	87.6%	0.33	5.50	1.72
	5.27	9.04	0.30	0.53	2.75	9.47	86.6%	0.29	4.30	1.56
	5.32	8.99	0.26	0.48	2.30	9.36	85.5%	0.25	3.21	1.40
	5.37	8.94	0.21	0.43	1.85	9.24	84.5%	0.20	2.26	1.22
WL	5.42	8.87	0.16	0.38	1.40	9.11	83.3%	0.15	1.44	1.03
	5.47	8.40	0.12	0.33	0.97	8.60	78.6%	0.11	0.80	0.83
	5.52	5.43	0.11	0.28	0.61	5.60	51.2%	0.11	0.49	0.81
	5.57	3.58	0.11	0.23	0.39	3.70	33.8%	0.10	0.31	0.79
	5.62	2.48	0.10	0.18	0.24	2.57	23.5%	0.09	0.18	0.73
	5.67	1.84	0.07	0.13	0.13	1.89	17.3%	0.07	0.08	0.60
	5.72	1.34	0.04	0.08	0.05	1.36	12.4%	0.04	0.02	0.42
	5.77	0.40	0.01	0.03	0.01	0.41	3.7%	0.01	0.00	0.21

STREAM NAME: Brewery Creek
XS LOCATION: At Brewery Creek Guard Station
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.44	cfs
CALCULATED FLOW (Qc)=	1.44	cfs
(Qm-Qc)/Qm * 100 =	-0.1	%
MEASURED WATERLINE (WLm)=	5.43	ft
CALCULATED WATERLINE (WLc)=	5.42	ft
(WLm-WLc)/WLm * 100 =	0.1	%
MAX MEASURED DEPTH (Dm)=	0.35	ft
MAX CALCULATED DEPTH (Dc)=	0.38	ft
(Dm-Dc)/Dm * 100	-8.6	%
MEAN VELOCITY=	1.03	ft/sec
MANNING'S N=	0.076	
SLOPE=	0.033	ft/ft
.4 * Qm =	0.6	cfs
2.5 * Qm=	3.6	cfs

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

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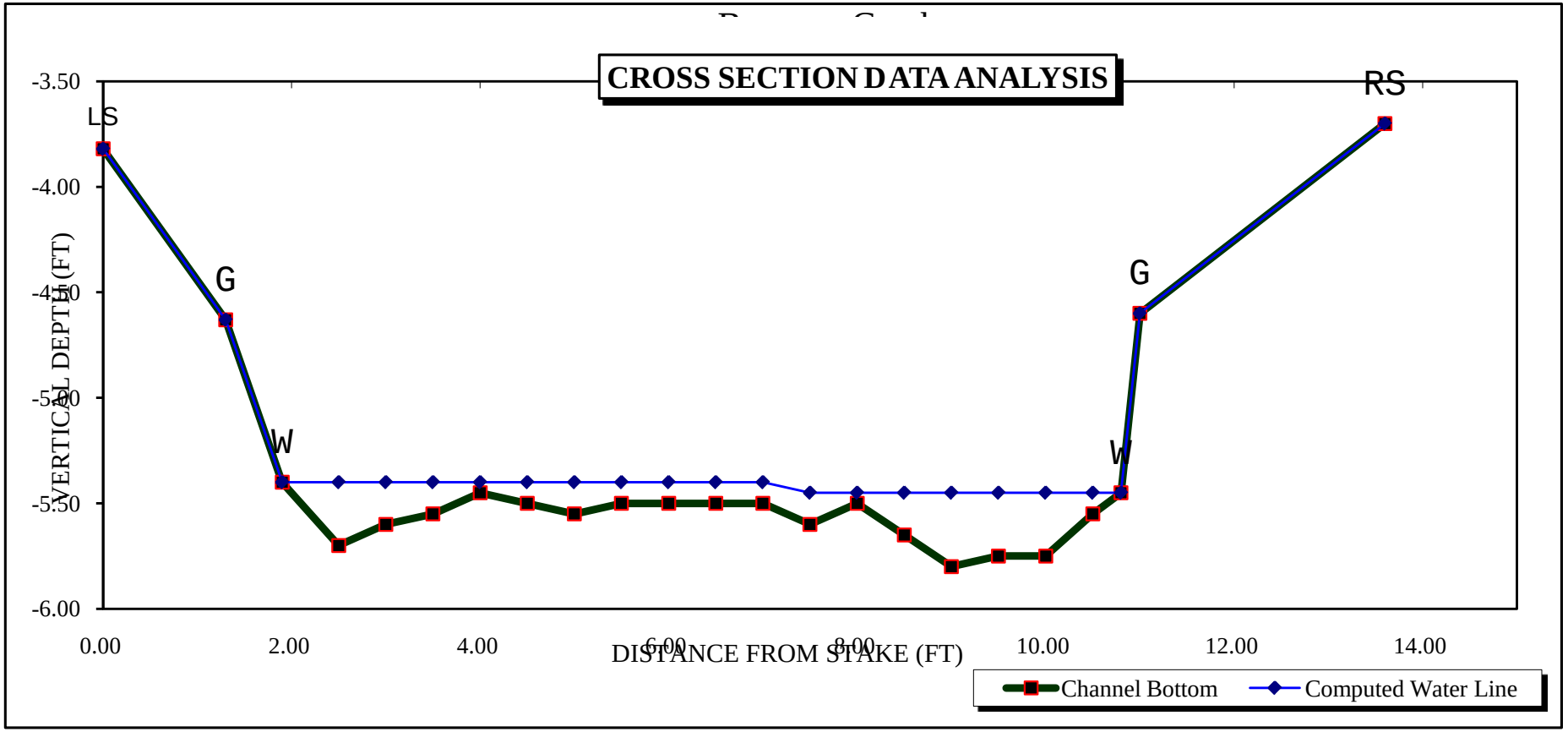
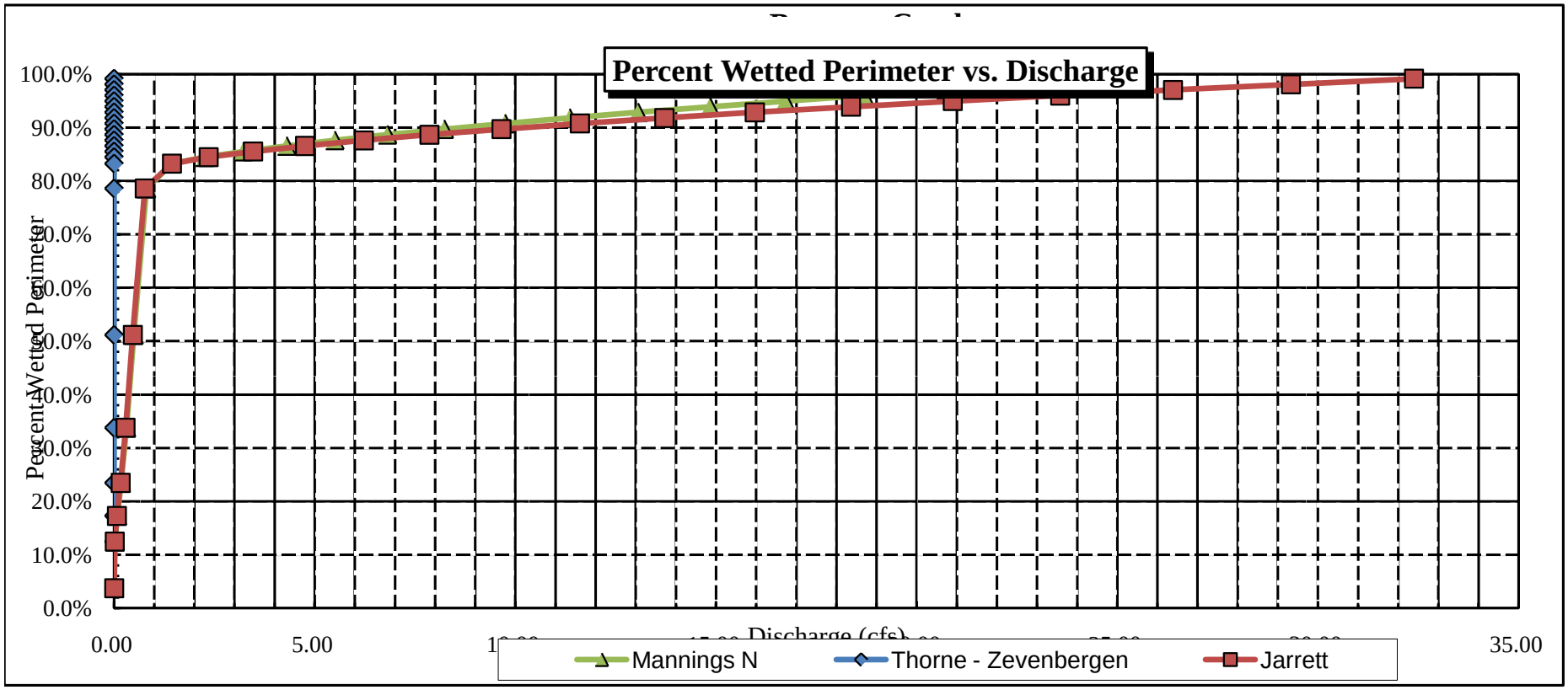
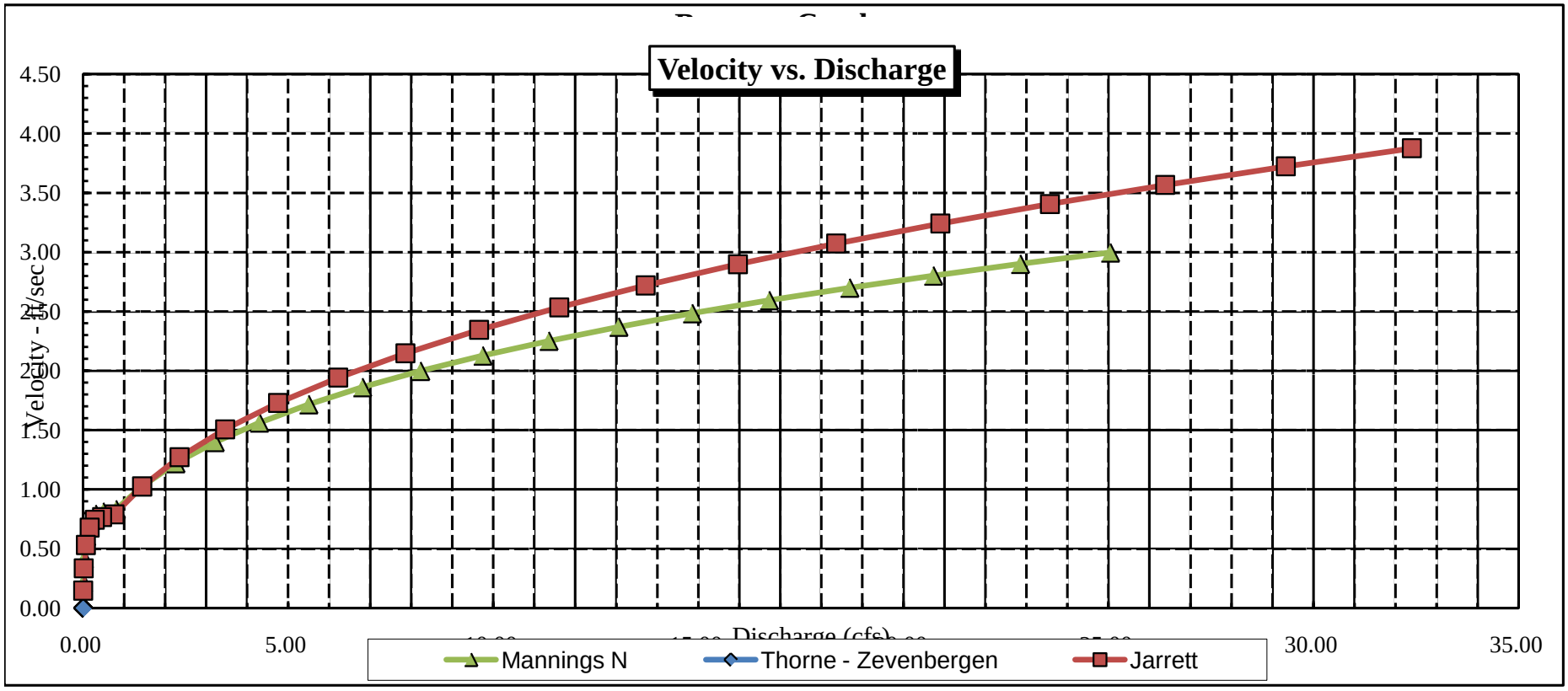
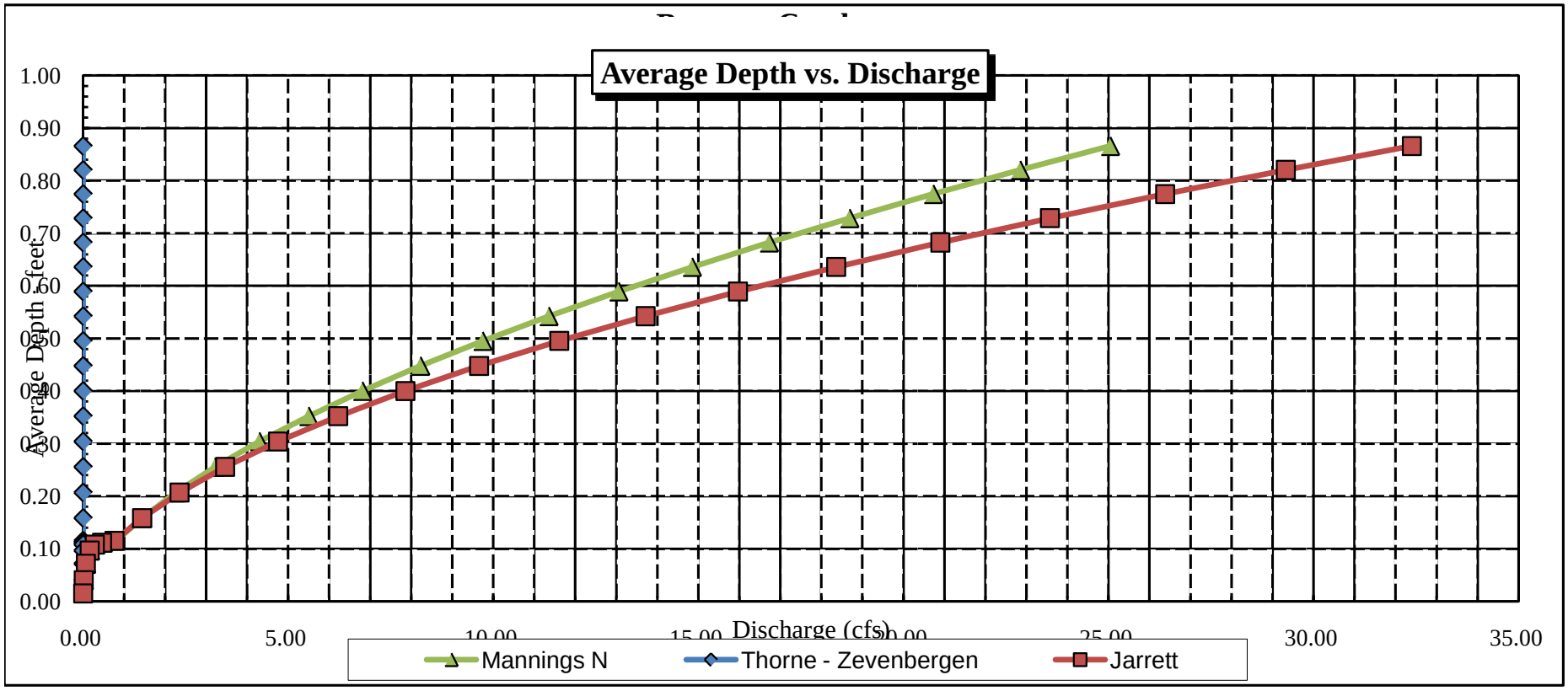
RECOMMENDATION BY: ……………………...………..……............................... AGENCY..……………………….....……....…...……...... DATE:......…....…......……………

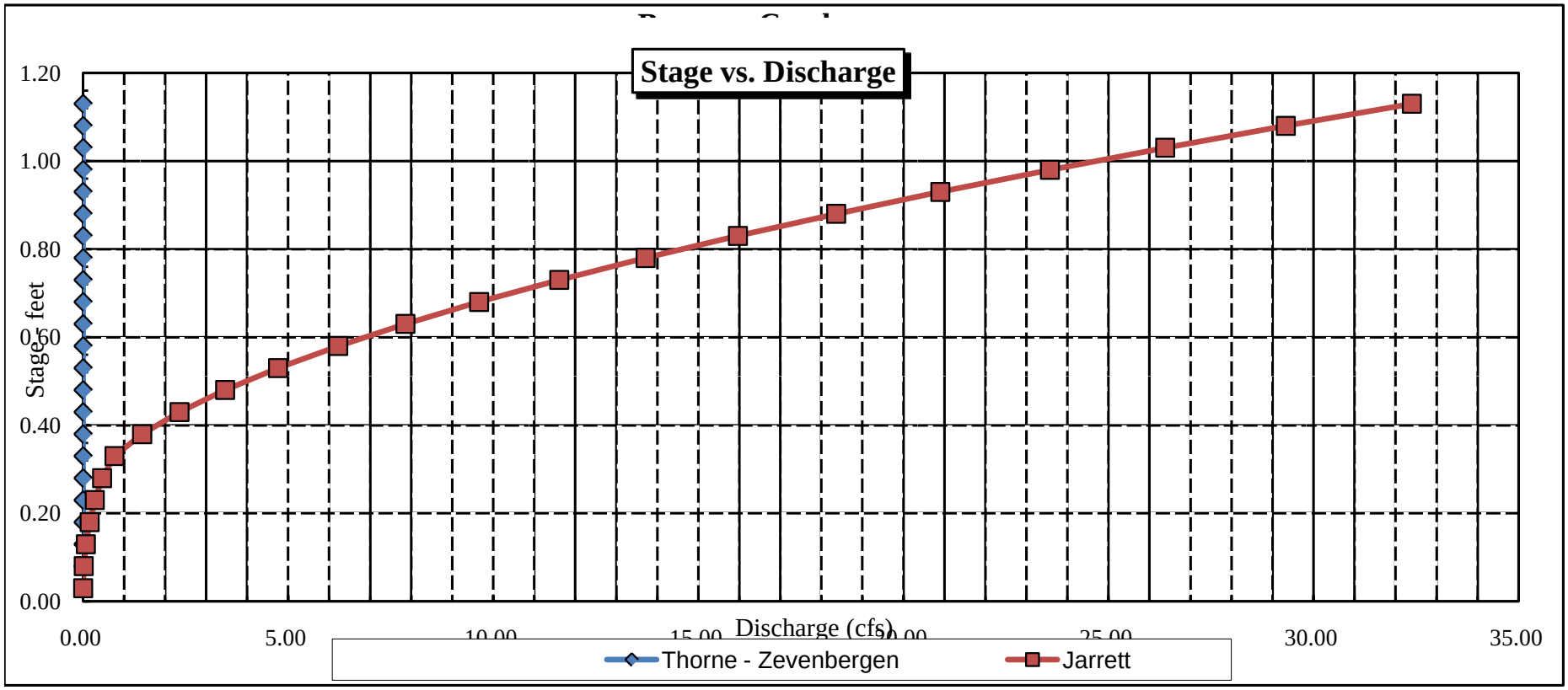
CWCB REVIEW BY: ..……………………………....……………………………………………………......................................…............. DATE:..................…………….....…


CROSS SECTION DATA ANALYSIS
LS
G
W
G
W
RS
-3.50
-4.00
-4.50
-5.00
-5.50
-6.00
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


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
35.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
5.00
30.00
35.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Average Depth (feet)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
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
Discharge (cfs)
Thorne - Zevenbergen
Jarrett