DRAFT INSTREAM FLOW RECOMMENDATION March 13, 2014 Version

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 Hubbard Creek, located in Water Division 4.

Location and Land Status. Hubbard Creek originates approximately twelve miles northwest of Paonia near Crater Peak on the Grand Mesa. The creek flows into the North Fork of the Gunnison River near Bowie. This recommendation covers a reach that starts at the U.S. Forest Service boundary and extends downstream to the headgate of the Deertrail Ditch. This stream reach covers a distance of approximately 1.6 miles. The BLM manages approximately 1.1 miles of this stream reach, while 0.5 miles are in private ownership.

Existing Instream Flow Water Rights. In 1984, the Colorado Water Conservation Board appropriated an instream flow water right on Hubbard Creek as follows:

> Upper Forest Service boundary in Section 14, T12S R91W to lower Forest Service boundary in Section 35, T12S R91W – 3.0 cfs, January 1 to December 31.

The purpose of the recommendation is to extend instream flow protection further downstream to include BLM lands within the Hubbard Creek watershed.

Biological Summary. Hubbard Creek is a cold-water, moderate to high gradient stream. It flows through a canyon with a valley floor approximately one-fourth mile in width. The stream cuts through alluvial deposits in some locations and is constrained by bedrock in locations where the streams come close to the canyon walls. The stream generally has medium-sized substrate, consisting of gravels, cobbles, and small boulders. The stream has a good mix of pool and riffle habitat for supporting salmonids and native fishes.

Fisheries surveys have revealed self-sustaining populations of speckled dace, bluehead sucker, rainbow trout, and white sucker. Speckled dace and bluehead suckers are native species, and bluehead sucker appears on the BLM's sensitive species list. Fish surveys were completed during September, indicating that bluehead suckers utilize this habitat year-round, and not just during snowmelt runoff periods when bluehead suckers spawn. It is likely that bluehead sucker populations found in the Gunnison River also make use of habitat found in lower Hubbard Creek.

The riparian community in this part of Hubbard Creek is generally comprised of willow species, alder, and narrowleaf cottonwood. In general, the riparian community is in good condition, and

provides adequate shading and cover for fish habitat, and provides stream stability during flood events.

R2Cross Analysis. The BLM collected the following R2Cross data from Soldier 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)
09/27/2007	19.16 cfs	24.4 feet	Out of range	8.26 cfs
10/21/2008	2.70 cfs	23.8 feet	1.99 cfs	Out of range
10/21/2008	3.45 cfs	24.9 feet	1.70 cfs	Out of range
10/11/2012 #1	1.33 cfs	25.5 feet	3.01	Out of range cfs
		Averages:	2.23 cfs	8.26 cfs

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.

> 8.3 cubic feet per second is recommended for the snowmelt runoff period from April 1 through June 30. This recommendation is driven by the average velocity criteria. 8.6 cfs will also provide approximately 67% wetted perimeter in Hubbard Creek's channel, which averages approximately 24 feet in width. Wetting 67% of the channel will provide important physical habitat during a time of year when the fish population is completing key life cycle functions.
>
> 3.0 cubic feet per second is recommended for the summer and fall time period between July 1 and November 30. This flow rate will generally meet the wetted perimeter and average depth criteria, while providing velocities in the range between 0.5 feet and 1.0 feet per second.

2.0 cubic feet per second is recommended during the winter period between December 1 and March 31. This recommendation is driven by limited water availability during the winter. This flow rate generally meets the wetted perimeter and average velocity criteria in riffle habitat, and should prevent icing in pools .

Water Availability. The BLM recommends relying upon two data sources to confirm water availability. The first information source is diversion records from the Deertrail Ditch. Not only does this ditch have continuous diversion records from 1970 to the present, it also has some diversion records for winter months. The second information source is USGS Gage 09132940 (Hubbard Creek above Iron Point Gulch). This gage has been operated since 2012 in a location approximately two miles upstream from the upper terminus for the proposed instream flow water right. Estimates developed when using data from this gage will be conservative, because the gage does not measure inflow from downstream tributaries that contribute to flow in the proposed reach, such as Iron Point Gulch. In addition, the gage has not been operated during the winter because icing conditions in the canyon make the gage records inaccurate.

The BLM recommends use of USGS Gage 09132960 (Hubbard Creek at Highway 133 near Bowie Creek) for winter period flow estimates. Usage of this gage for the remainder of the year is not recommended because the gage is heavily influenced by operation of Deertrail Ditch. The winter data will need to be adjusted to account for limited diversions into Deertrail Ditch during the winter months.

The BLM is not aware of any decreed water rights for surface diversion within the proposed instream flow reach (check on Mapper). However, the BLM is aware of the following absolute decree water rights in upstream locations:

Carl Galpin Ditch – 3.0 cfs
West Hubbard Ditch – 9.0 cfs
William Beezly Ditch – 2.0 cfs

Bill McMillan Ditch – 5.0 cfs
Pilot Knob Ditch – 1.0 cfs
Terror Ditch Extension – 29.0 cfs
Jessie J. Barrow Ditches #1 and 2 – 1.5 cfs
Willow Creek Ditch – 0.62 cfs
Carter Ditch - 2.12 cfs
Wade Allen Ditch – 7 cfs
The Overland Ditch, owned by Overland Ditch and Reservoir Company, diverts from multiple small tributaries in the headwaters of the Terror Creek watershed. The water rights for the ditch allow the company to divert up to a total of 75 cfs from the Hubbard, Terror, Roadmap, Lower Cow Creek, and Leroux Creek drainages.

The BLM is also aware of 85 cfs of undeveloped conditional water rights in upstream locations associated with the Grand Mesa Canal. These rights appear to be owned by the Grand Mesa Water Conservancy District and North Fork Water Conservancy District.

USGS gage 09132940 appears to be located downstream from all of these ditches, so the gage records should reflect the hydrologic impacts of ditch operations.

Relationship to Land Management Plans. BLM land use plans for this area call for actions to maintain and enhance riparian and fisheries habitat. In general, any proposed new land use, such as right-of-way corridors or mineral development, must be implemented with no surface occupancy to avoid impacts to the creek. Any proposed land uses along this creek are also carefully reviewed and mitigated to prevent impacts to sensitive aquatic species which appear on BLM's sensitive species list. Establishing an instream flow water right would assist in meeting these objectives.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2014. We thank both Colorado Parks and Wildlife and the Colorado Water Conservation Board 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,

Leigh Espy
Deputy State Director
Resources and Fire

Cc: Jedd Sondergard, Uncompahgre FO
Barbara Sharrow, Uncompahgre FO

Uncompahgre Field Office Stream Surveys
September 2007

Hubbard Creek - Water Code #40751

Hubbard Creek, located northeast of Paonia, Colorado on BLM lands managed by the Uncompahgre Field Office was sampled on September 27, 2007. Hubbard Creek is tributary to North Fork Gunnison River. Presence/absence sampling was done in support of the Colorado BLM in-stream flow program. Sampling was conducted via backpack electro-shocker and approximately 250 feet of stream was sampled. Personnel present were Tom Fresques, Dennis Murphy, Roy Smith, Mike Eberle, and Gregor Dekleva.

A total of 28 fish were collected. See data sheet below.

Fish

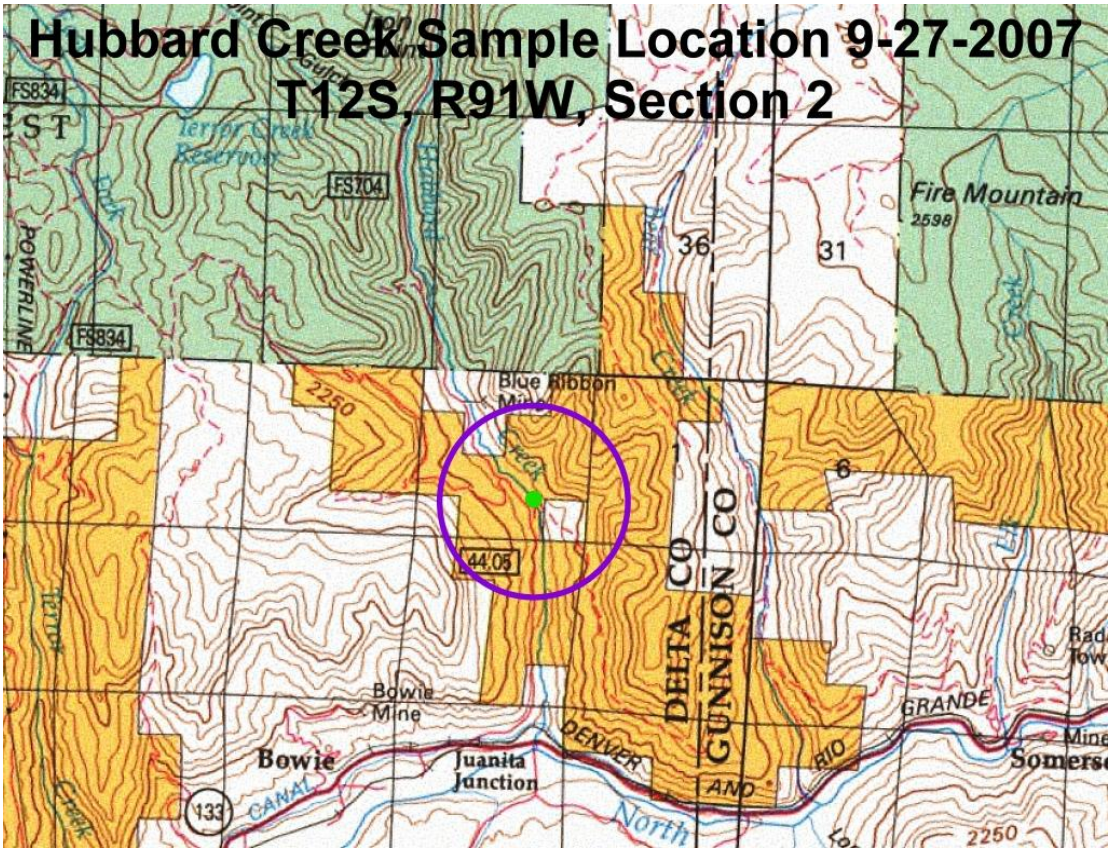
Bluehead sucker

White sucker

Rainbow trout

Hubbard Creek

Hubbard Creek



Map

STREAM SURVEY FISH SAMPLING FORM

WATER_Hubbard Creek_____ H2O CODE_40751_DATE_9-27-07

GEAR_Backpack Electroshocker EFFORT_250 ft.____ STATION #_1_ PASS 1

CREW Fresques, Murphy, Smith, Mike, Gregor DRAINAGE N. F. Gunnison River

LOCATION Just below confluence of West and East Fork Terror Creek

Pass	species	length	weight		species	length	weight	Pass
1	WHS	147						
	WHS	185						
	WHS	143						
	WHS	104						
	WHS	142						
	RBT	59						
	RBT	68						
	RBT	66						
	RBT	148						
	RBT	176						
	RBT	189						
	RBT	72						
	RBT	142						
	RBT	148						
	RBT	73						
	SPD	112						
	SPD	102						
	SPD	81						
	SPD	84						
	SPD	63						
	SPD	83						
	SPD	65						
	SPD	68						
	SPD	69						
	SPD	55						
	BHS	127						
	BHS	86						

SPD = Speckled dace
BHS = Bluehead sucker
RBT = Rainbow trout
WHS = White sucker

GPS Location:
Notes: Stream Width_12-20_ft. Sample Reach__250___ft.
Conductivity: Electroshocker settings

Discussion

The stream was running at approximately 4 to 5 cfs. Riparian habitat looked vigorous and some good pools were present. Water was slightly off color with an orange/brown tint that looked like oxidized iron. A two-pass removal estimate was not performed as flows and large pools did not allow for efficient sampling with only one shocker. Aquatic insects consisted primarily of caddisflies. No stoneflies or mayflies were observed during the brief survey. All fish appeared healthy and at least two age classes of trout were present. Bluehead suckers were rare and the presence of white suckers is a concern as they can hybridize with the native blueheads. An instream flow recommendation on this creek would be valuable in maintaining this fishery.

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

LOCATION INFORMATION

STREAM NAME:	Hubbard Creek
XS LOCATION:	200' upstream from bridge
XS NUMBER:	1
DATE:	11-Oct-12
OBSERVERS:	R. Smith, J. Sondergard
1/4 SEC:	SE
SECTION:	2
TWP:	13S
RANGE:	91W
PM:	Sixth
COUNTY:	Delta
WATERSHED:	N. Fk. Gunnison River
DIVISION:	4
DOW CODE:	40751
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:	0.018

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

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

STREAM NAME: Hubbard Creek
XS LOCATION: 200' upstream from bridge
XS NUMBER: 1

DATA POINTS= 24

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
1 RS & G	3.50	2.52			0.00		0.00	0.00	0.0%
	8.80	4.48			0.00		0.00	0.00	0.0%
W	12.10	4.95	0.00	0.00	0.00		0.00	0.00	0.0%
	13.10	5.12	0.17	0.15	1.01	0.17	0.13	0.02	1.4%
	13.60	5.15	0.20	0.61	0.50	0.20	0.10	0.06	4.6%
	14.10	5.20	0.25	0.86	0.50	0.25	0.13	0.11	8.1%
	14.60	5.16	0.21	1.01	0.50	0.21	0.11	0.11	8.0%
	15.10	5.25	0.30	1.12	0.51	0.30	0.15	0.17	12.6%
	15.60	5.15	0.20	1.02	0.51	0.20	0.10	0.10	7.7%
	16.10	5.27	0.32	0.92	0.51	0.32	0.16	0.15	11.1%
	16.60	5.25	0.30	1.10	0.50	0.30	0.15	0.17	12.4%
	17.10	5.12	0.17	1.02	0.52	0.17	0.09	0.09	6.5%
	17.60	5.25	0.30	0.90	0.52	0.30	0.11	0.09	7.1%
	17.80	5.32	0.37	0.10	0.21	0.37	0.09	0.01	0.7%
	18.10	5.15	0.20	0.00	0.34	0.20	0.08	0.00	0.0%
	18.60	5.17	0.22	0.79	0.50	0.22	0.09	0.07	5.2%
	18.90	5.14	0.19	0.64	0.30	0.19	0.05	0.03	2.3%
	19.10	5.17	0.22	1.09	0.20	0.22	0.08	0.08	6.3%
	19.60	5.12	0.17	0.75	0.50	0.17	0.09	0.06	4.8%
	20.10	5.09	0.14	0.23	0.50	0.14	0.07	0.02	1.2%
	20.60	4.97	0.02	0.00	0.51	0.02	0.02	0.00	0.0%
W	21.70	4.95	0.00	0.00	1.10		0.00	0.00	0.0%
	24.50	3.58			0.00		0.00	0.00	0.0%
1 LS & G	29.00	2.52			0.00		0.00	0.00	0.0%
TOTALS ----------					9.76	0.37 (Max.)	1.76	1.33	100.0%

Manning's n = 0.0845
Hydraulic Radius= 0.18061722

STREAM NAME: Hubbard Creek
XS LOCATION: 200' upstream from bridge
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.76	1.76	0.0%
4.70	1.76	4.45	152.2%
4.72	1.76	4.21	138.8%
4.74	1.76	3.98	125.7%
4.76	1.76	3.75	112.7%
4.78	1.76	3.53	100.0%
4.80	1.76	3.31	87.4%
4.82	1.76	3.09	75.1%
4.84	1.76	2.87	63.0%
4.86	1.76	2.66	51.1%
4.88	1.76	2.46	39.4%
4.90	1.76	2.25	27.9%
4.91	1.76	2.15	22.2%
4.92	1.76	2.06	16.6%
4.93	1.76	1.96	11.0%
4.94	1.76	1.86	5.5%
4.95	1.76	1.76	0.0%
4.96	1.76	1.67	-5.3%
4.97	1.76	1.58	-10.2%
4.98	1.76	1.50	-14.9%
4.99	1.76	1.42	-19.6%
5.00	1.76	1.34	-24.2%
5.02	1.76	1.18	-33.3%
5.04	1.76	1.02	-42.1%
5.06	1.76	0.87	-50.7%
5.08	1.76	0.72	-59.0%
5.10	1.76	0.58	-67.1%
5.12	1.76	0.45	-74.8%
5.14	1.76	0.32	-81.7%
5.16	1.76	0.22	-87.7%
5.18	1.76	0.14	-91.8%
5.20	1.76	0.09	-94.7%

WATERLINE AT ZERO
AREA ERROR = 4.950

STREAM NAME: Hubbard Creek
XS LOCATION: 200' upstream from bridge
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	2.52	25.50	1.76	2.80	44.80	26.49	100.0%	1.69	150.12	3.35
	3.95	16.38	0.93	1.37	15.29	16.90	63.8%	0.90	33.76	2.21
	4.00	16.14	0.90	1.32	14.48	16.64	62.8%	0.87	31.14	2.15
	4.05	15.90	0.86	1.27	13.68	16.38	61.9%	0.83	28.62	2.09
	4.10	15.66	0.82	1.22	12.89	16.13	60.9%	0.80	26.19	2.03
	4.15	15.43	0.78	1.17	12.11	15.87	59.9%	0.76	23.87	1.97
	4.20	15.19	0.75	1.12	11.34	15.61	58.9%	0.73	21.64	1.91
	4.25	14.95	0.71	1.07	10.59	15.35	58.0%	0.69	19.52	1.84
	4.30	14.72	0.67	1.02	9.85	15.09	57.0%	0.65	17.49	1.78
	4.35	14.48	0.63	0.97	9.12	14.84	56.0%	0.61	15.56	1.71
	4.40	14.24	0.59	0.92	8.40	14.58	55.0%	0.58	13.73	1.63
	4.45	14.00	0.55	0.87	7.69	14.32	54.1%	0.54	12.00	1.56
	4.50	13.68	0.51	0.82	7.00	13.98	52.8%	0.50	10.42	1.49
	4.55	13.23	0.48	0.77	6.33	13.51	51.0%	0.47	9.01	1.42
	4.60	12.77	0.44	0.72	5.68	13.04	49.2%	0.44	7.70	1.36
	4.65	12.32	0.41	0.67	5.05	12.57	47.5%	0.40	6.49	1.29
	4.70	11.87	0.37	0.62	4.45	12.11	45.7%	0.37	5.38	1.21
	4.75	11.41	0.34	0.57	3.86	11.64	43.9%	0.33	4.37	1.13
	4.80	10.96	0.30	0.52	3.31	11.17	42.2%	0.30	3.47	1.05
	4.85	10.51	0.26	0.47	2.77	10.70	40.4%	0.26	2.65	0.96
	4.90	10.05	0.22	0.42	2.25	10.23	38.6%	0.22	1.94	0.86
WL	4.95	9.60	0.18	0.37	1.76	9.76	36.9%	0.18	1.33	0.75
	5.00	8.08	0.17	0.32	1.34	8.24	31.1%	0.16	0.94	0.70
	5.05	7.58	0.12	0.27	0.95	7.72	29.2%	0.12	0.55	0.58
	5.10	6.95	0.08	0.22	0.58	7.09	26.8%	0.08	0.26	0.44
	5.15	5.30	0.05	0.17	0.27	5.43	20.5%	0.05	0.08	0.32
	5.20	2.12	0.04	0.12	0.09	2.19	8.3%	0.04	0.03	0.29
	5.25	0.91	0.02	0.07	0.02	0.94	3.5%	0.02	0.00	0.16
	5.30	0.09	0.01	0.02	0.00	0.10	0.4%	0.01	0.00	0.10

STREAM NAME: Hubbard Creek
XS LOCATION: 200' upstream from bridge
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.33	cfs
CALCULATED FLOW (Qc)=	1.33	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	4.95	ft
CALCULATED WATERLINE (WLc)=	4.95	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.37	ft
MAX CALCULATED DEPTH (Dc)=	0.37	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	0.75	ft/sec
MANNING'S N=	0.084	
SLOPE=	0.018	ft/ft
.4 * Qm =	0.5	cfs
2.5 * Qm=	3.3	cfs

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

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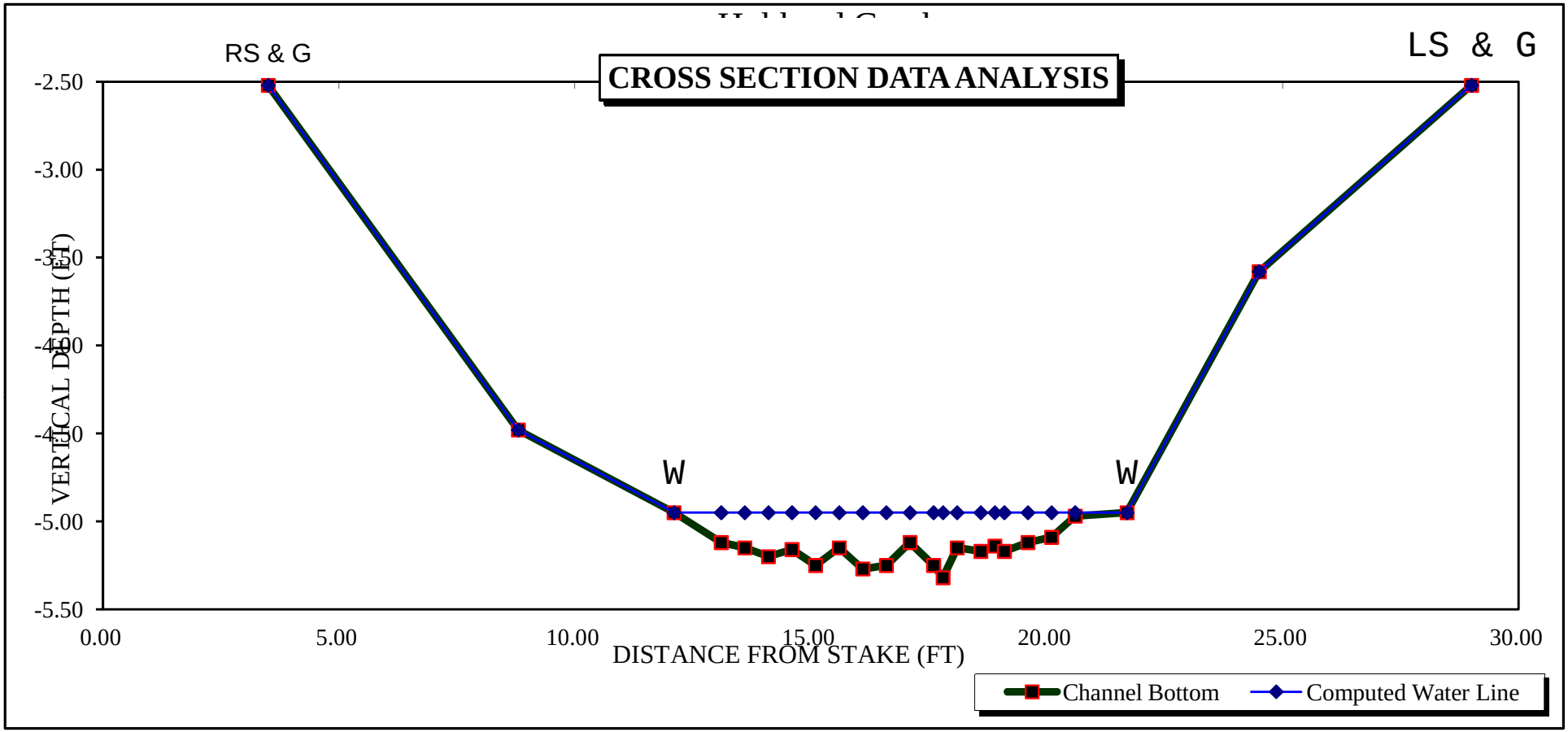
RECOMMENDATION BY: ………………...………..……............................... AGENCY...……………………......…....…....……...... DATE:......…...…......……………

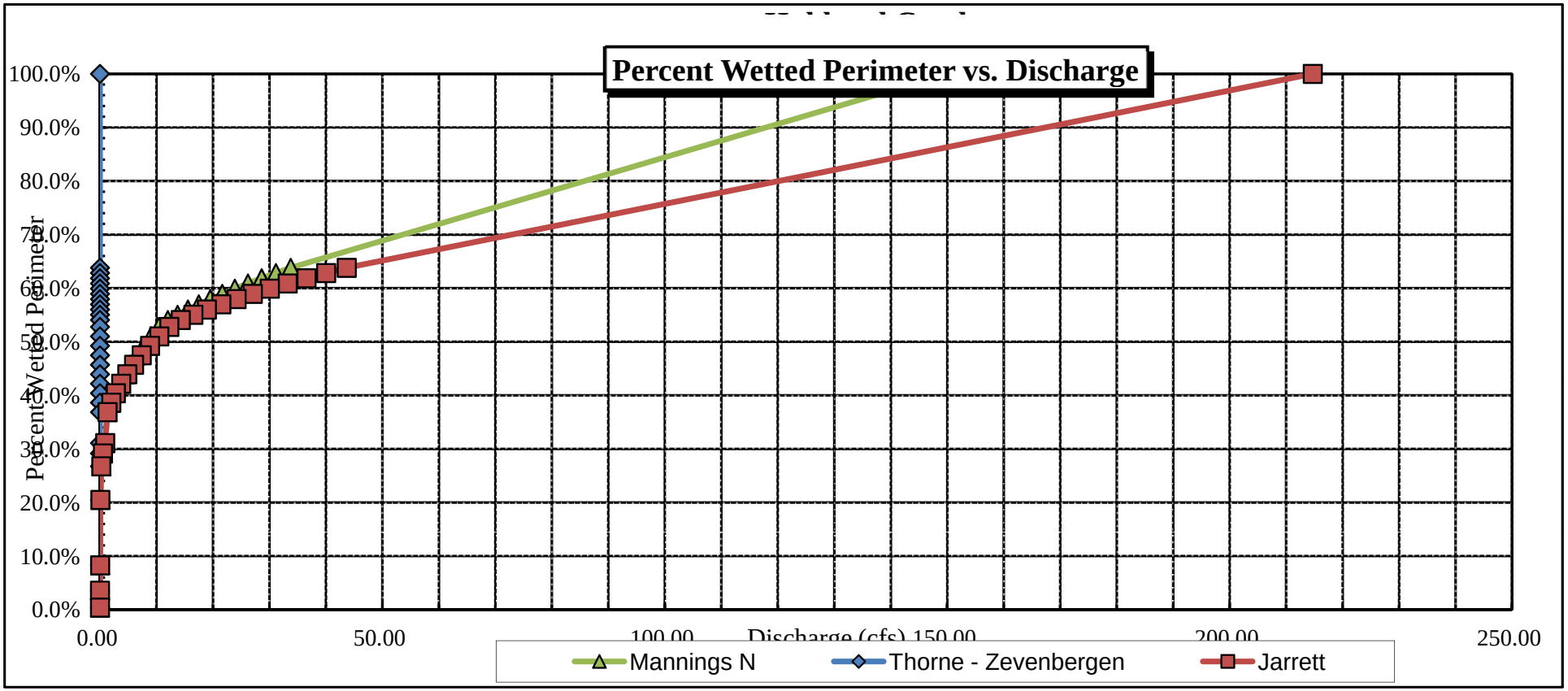
CWCB REVIEW BY: ..…………………………....…………………………………………………...…............. DATE:..................…………….....

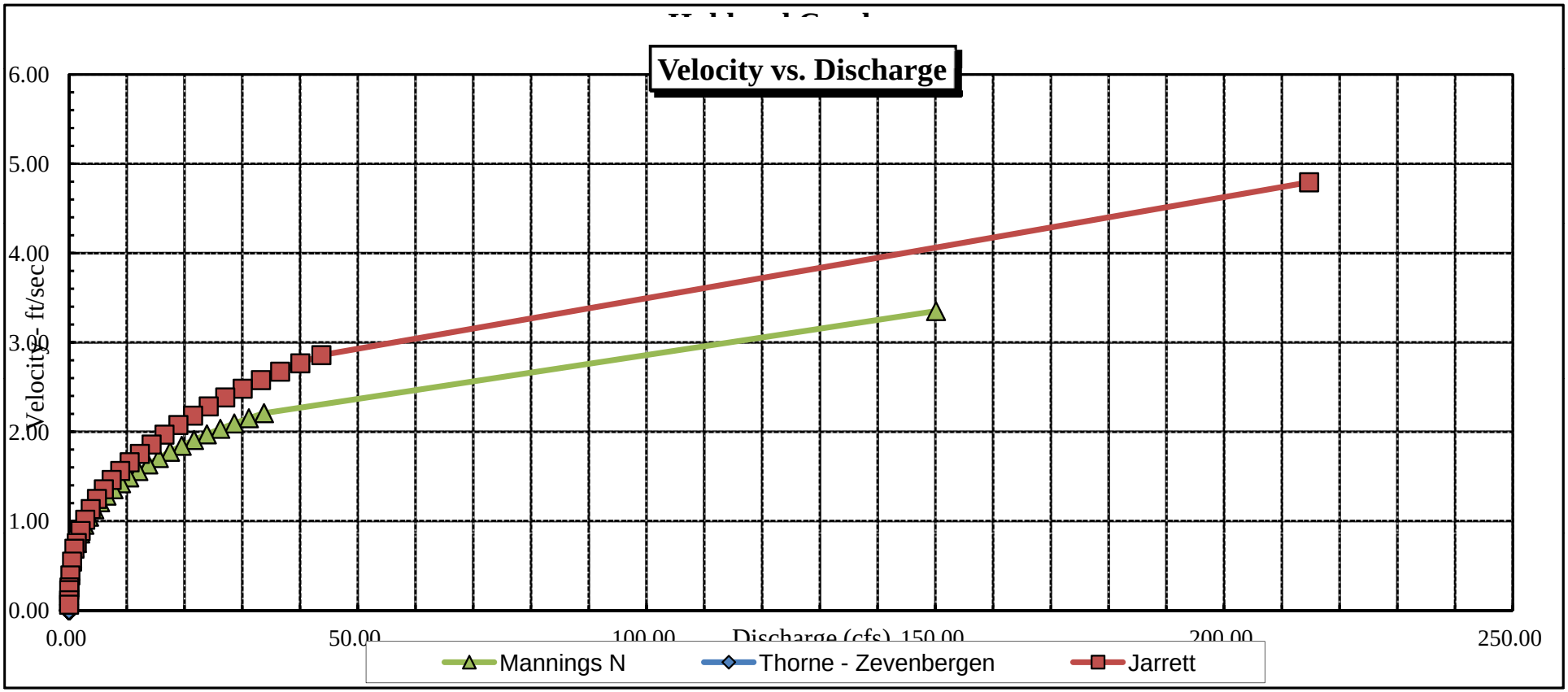
STREAM NAME: Hubbard Creek
XS LOCATION: 200' upstream from bridge
XS NUMBER: 1 Jarrett Variable Manning's n Correction Applied

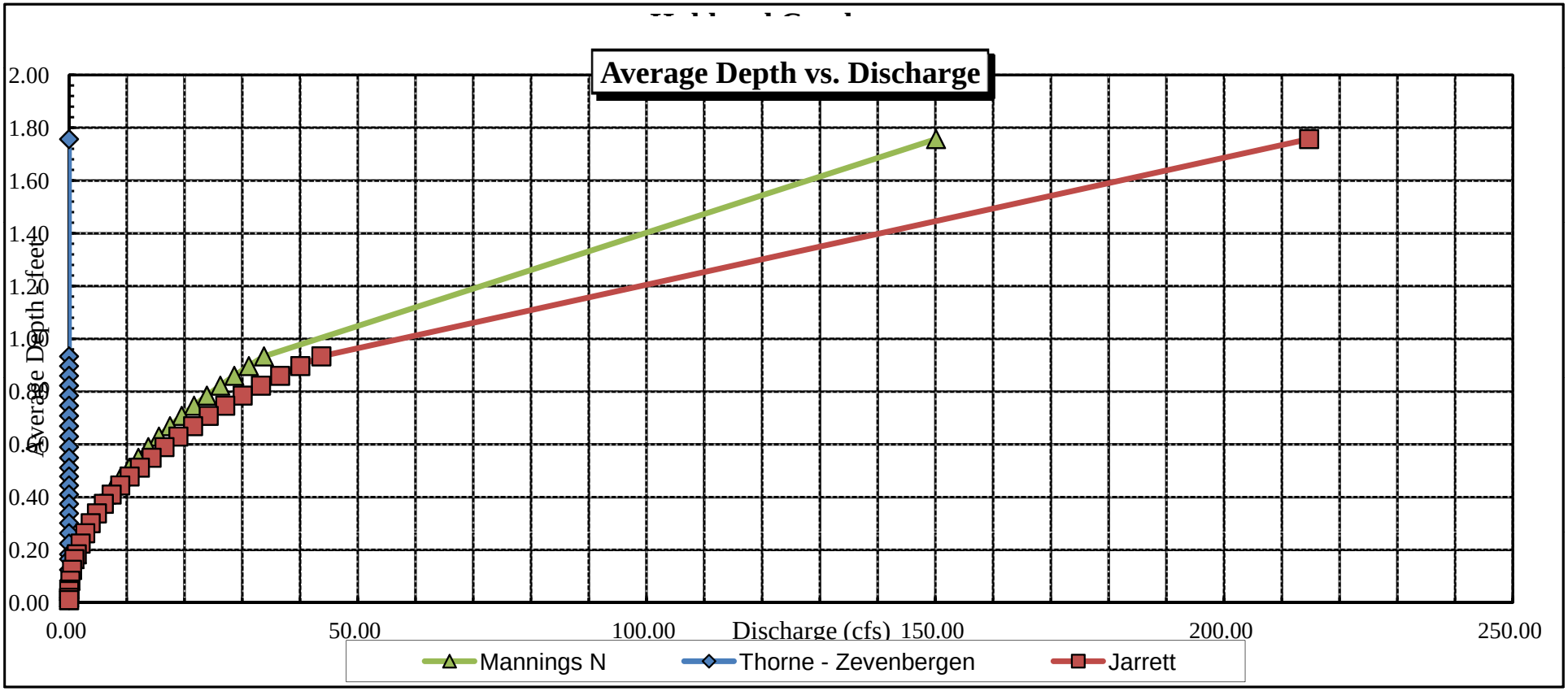
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

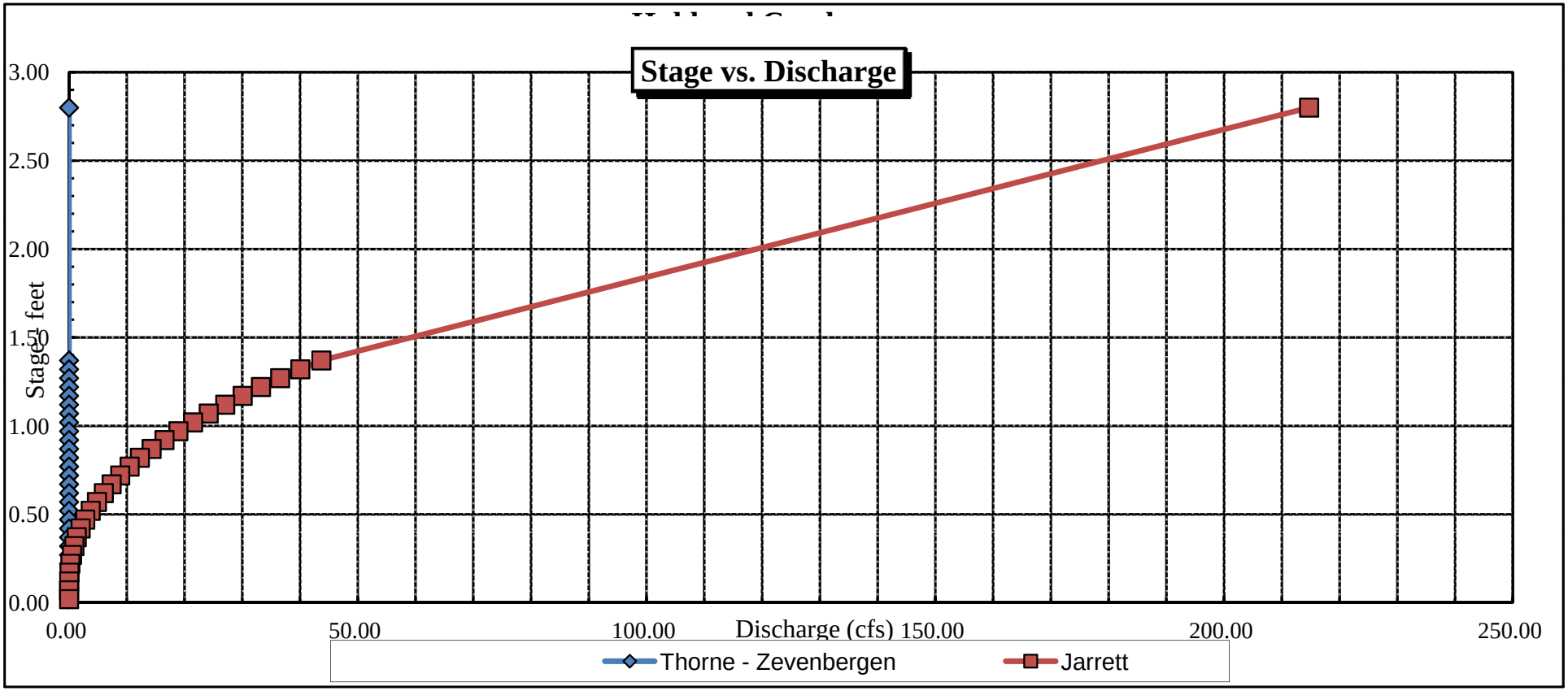
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	2.52	25.50	1.76	2.80	44.80	26.49	100.0%	1.69	214.72	4.79
	3.95	16.38	0.93	1.37	15.29	16.90	63.8%	0.90	43.69	2.86
	4.00	16.14	0.90	1.32	14.48	16.64	62.8%	0.87	40.04	2.77
	4.05	15.90	0.86	1.27	13.68	16.38	61.9%	0.83	36.56	2.67
	4.10	15.66	0.82	1.22	12.89	16.13	60.9%	0.80	33.23	2.58
	4.15	15.43	0.78	1.17	12.11	15.87	59.9%	0.76	30.06	2.48
	4.20	15.19	0.75	1.12	11.34	15.61	58.9%	0.73	27.04	2.38
	4.25	14.95	0.71	1.07	10.59	15.35	58.0%	0.69	24.18	2.28
	4.30	14.72	0.67	1.02	9.85	15.09	57.0%	0.65	21.48	2.18
	4.35	14.48	0.63	0.97	9.12	14.84	56.0%	0.61	18.93	2.08
	4.40	14.24	0.59	0.92	8.40	14.58	55.0%	0.58	16.53	1.97
	4.45	14.00	0.55	0.87	7.69	14.32	54.1%	0.54	14.29	1.86
	4.50	13.68	0.51	0.82	7.00	13.98	52.8%	0.50	12.27	1.75
	4.55	13.23	0.48	0.77	6.33	13.51	51.0%	0.47	10.49	1.66
	4.60	12.77	0.44	0.72	5.68	13.04	49.2%	0.44	8.86	1.56
	4.65	12.32	0.41	0.67	5.05	12.57	47.5%	0.40	7.38	1.46
	4.70	11.87	0.37	0.62	4.45	12.11	45.7%	0.37	6.03	1.36
	4.75	11.41	0.34	0.57	3.86	11.64	43.9%	0.33	4.82	1.25
	4.80	10.96	0.30	0.52	3.31	11.17	42.2%	0.30	3.75	1.13
	4.85	10.51	0.26	0.47	2.77	10.70	40.4%	0.26	2.81	1.02
	4.90	10.05	0.22	0.42	2.25	10.23	38.6%	0.22	2.00	0.89
WL	4.95	9.60	0.18	0.37	1.76	9.76	36.9%	0.18	1.33	0.75
	5.00	8.08	0.17	0.32	1.34	8.24	31.1%	0.16	0.92	0.69
	5.05	7.58	0.12	0.27	0.95	7.72	29.2%	0.12	0.52	0.55
	5.10	6.95	0.08	0.22	0.58	7.09	26.8%	0.08	0.23	0.39
	5.15	5.30	0.05	0.17	0.27	5.43	20.5%	0.05	0.07	0.26
	5.20	2.12	0.04	0.12	0.09	2.19	8.3%	0.04	0.02	0.23
	5.25	0.91	0.02	0.07	0.02	0.94	3.5%	0.02	0.00	0.11
	5.30	0.09	0.01	0.02	0.00	0.10	0.4%	0.01	0.00	0.06


CROSS SECTION DATA ANALYSIS
RS & G
LS & G
W
W
-2.50
-3.00
-5.00
-5.50
0.00
5.00
10.00
15.00
20.00
25.00
30.00
VERTICAL DEPTH (FT)
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
50.00
100.00
Discharge (cfs)
150.00
200.00
250.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Velocity - ft/sec
0.00
50.00
100.00
Discharge (cfs)
150.00
200.00
250.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth (feet)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
50.00
100.00
Discharge (cfs)
150.00
200.00
250.00
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Stage - feet
0.00
50.00
100.00
150.00
200.00
250.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Hubbard Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: 200' upstream from bridge						
DATE: 10-11-12	OBSERVERS: R. Smith, J. Sondergaard					
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 2	TOWNSHIP: 13 N/S	RANGE: 91 E/W	PM: 6th	
COUNTY: Delta	WATERSHED: N Fk Gunnison	WATER DIVISION: 4	DOW WATER CODE: 40751			
MAP(S): USGS:	GPS Zone 13 280992					
USFS:	4314732					

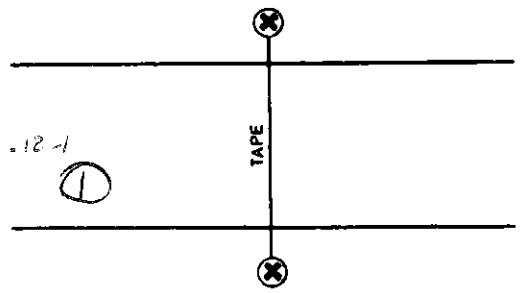
SUPPLEMENTAL DATA

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)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0 21.7	4.95 / 4.95
② WS Upstream	36.7	4.04
③ WS Downstream	27.0	5.23
SLOPE	1.19/63.7 = .018	

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

COMMENTS

pH = 8.04
Cond = 247
Temp: 11.7° C
Salinity = 0.1

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Hubbard Creek | CROSS-SECTION NO 1 | DATE 10-11-12 | SHEET __ OF __

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading ____ ft | TIME 3:45

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/G	3.5		2.52								
	8.8		4.48								
W	12.1		4.95								
	13.1		5.12	.17				.15			
	13.6		5.15	.20				.61			
	14.1		5.20	.25				.86			
	14.6		5.16	.21				1.01			
	15.1		5.25	.30				1.12			
	15.6		5.15	.20				1.02			
	16.1		5.27	.32				.92			
	16.6		5.25	.30				1.10			
	17.1		5.12	.17				1.02			
17.8>	17.6	5.32>	5.25	.30	<.37			.90	<.1		
	18.1		5.15	.20				0			
18.9>	18.6	5.14>	5.17	.22	<.19			.79	<.64		
	19.1		5.17	.22				1.09			
	19.6		5.12	.17				.75			
	20.1		5.09	.14				.23			
	20.6		4.97	.02				0			
W	21.7		4.95								
	24.5		3.58								
LS/G	29.0		2.52								
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:	Hubbard Creek
XS LOCATION:	500' upst. Fr USFS-Coal Co. boundary
XS NUMBER:	1
DATE:	21-Oct-08
OBSERVERS:	R. Smith, D. Murphy
1/4 SEC:	SW
SECTION:	35
TWP:	12S
RANGE:	91W
PM:	Sixth
COUNTY:	Delta
WATERSHED:	N. Fk. Gunnison River
DIVISION:	4
DOW CODE:	40751
USGS MAP:	Bowie 7.5'
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:	0.006

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

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

STREAM NAME: Hubbard Creek
XS LOCATION: 500' upst. Fr USFS-Coal Co. boundary
XS NUMBER: 1

DATA POINTS= 28

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
1	RS & G	6.00	4.01			0.00		0.00	0.00	0.0%
		8.50	4.48			0.00		0.00	0.00	0.0%
	W	9.50	4.70			0.00		0.00	0.00	0.0%
		10.00	4.90	0.20	0.37	0.54	0.20	0.10	0.04	1.4%
		10.50	4.75	0.05	0.00	0.52	0.05	0.03	0.00	0.0%
		11.00	4.80	0.10	0.69	0.50	0.10	0.05	0.03	1.3%
		11.50	4.90	0.20	1.06	0.51	0.20	0.10	0.11	3.9%
		12.00	5.25	0.55	0.01	0.61	0.55	0.41	0.00	0.2%
		13.00	4.75	0.05	0.00	1.12	0.05	0.05	0.00	0.0%
		14.00	4.80	0.10	0.38	1.00	0.10	0.10	0.04	1.4%
		15.00	4.75	0.20	0.57	1.00	0.20	0.20	0.11	4.2%
		16.00	4.75	0.20	0.15	1.00	0.20	0.20	0.03	1.1%
		17.00	5.10	0.40	0.15	1.06	0.40	0.40	0.06	2.2%
		18.00	5.10	0.40	0.34	1.00	0.40	0.40	0.14	5.0%
		19.00	5.20	0.50	0.78	1.00	0.50	0.50	0.39	14.4%
		20.00	5.25	0.55	0.84	1.00	0.55	0.55	0.46	17.1%
		21.00	5.20	0.50	0.90	1.00	0.50	0.50	0.45	16.6%
		22.00	5.30	0.60	0.51	1.00	0.60	0.60	0.31	11.3%
		23.00	4.95	0.25	0.05	1.06	0.25	0.25	0.01	0.5%
		24.00	5.00	0.30	1.10	1.00	0.30	0.30	0.33	12.2%
		25.00	4.85	0.20	0.74	1.01	0.20	0.20	0.15	5.5%
		26.00	4.80	0.10	0.22	1.00	0.10	0.08	0.02	0.6%
		26.50	4.85	0.05	0.00	0.50	0.05	0.03	0.00	0.0%
		27.00	5.10	0.40	0.15	0.56	0.40	0.20	0.03	1.1%
		27.50	4.75	0.05	0.00	0.61	0.05	0.03	0.00	0.0%
	W	28.00	4.70			0.50		0.00	0.00	0.0%
1	G	30.00	3.95			0.00		0.00	0.00	0.0%
	LS	31.00	3.35			0.00		0.00	0.00	0.0%
	TOTALS ----------					19.12	0.6 (Max.)	5.26	2.70	100.0%

Manning's n = 0.0948
Hydraulic Radius= 0.2751887

STREAM NAME: Hubbard Creek
XS LOCATION: 500' upst. Fr USFS-Coal Co. boundary
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	5.26	4.96	-5.7%
4.45	5.26	9.81	86.5%
4.47	5.26	9.41	78.8%
4.49	5.26	9.01	71.1%
4.51	5.26	8.61	63.6%
4.53	5.26	8.21	56.0%
4.55	5.26	7.82	48.6%
4.57	5.26	7.43	41.2%
4.59	5.26	7.04	33.8%
4.61	5.26	6.66	26.5%
4.63	5.26	6.28	19.2%
4.65	5.26	5.90	12.0%
4.66	5.26	5.71	8.5%
4.67	5.26	5.52	4.9%
4.68	5.26	5.33	1.4%
4.69	5.26	5.15	-2.2%
4.70	5.26	4.96	-5.7%
4.71	5.26	4.78	-9.2%
4.72	5.26	4.60	-12.7%
4.73	5.26	4.41	-16.1%
4.74	5.26	4.23	-19.6%
4.75	5.26	4.05	-23.0%
4.77	5.26	3.73	-29.2%
4.79	5.26	3.43	-34.9%
4.81	5.26	3.15	-40.1%
4.83	5.26	2.90	-45.0%
4.85	5.26	2.66	-49.5%
4.87	5.26	2.43	-53.7%
4.89	5.26	2.22	-57.8%
4.91	5.26	2.02	-61.6%
4.93	5.26	1.82	-65.4%
4.95	5.26	1.63	-69.0%

WATERLINE AT ZERO
AREA ERROR = 4.684

STREAM NAME: Hubbard Creek
XS LOCATION: 500' upst. Fr USFS-Coal Co. boundary
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	4.01	23.84	0.82	1.29	19.53	24.66	100.0%	0.79	20.31	1.04
	4.03	23.65	0.80	1.27	18.96	24.46	99.2%	0.78	19.44	1.03
	4.08	23.25	0.77	1.22	17.79	24.05	97.5%	0.74	17.68	0.99
	4.13	22.85	0.73	1.17	16.64	23.63	95.9%	0.70	16.00	0.96
	4.18	22.45	0.69	1.12	15.51	23.22	94.2%	0.67	14.39	0.93
	4.23	22.05	0.65	1.07	14.39	22.81	92.5%	0.63	12.86	0.89
	4.28	21.65	0.61	1.02	13.30	22.39	90.8%	0.59	11.42	0.86
	4.33	21.25	0.58	0.97	12.23	21.98	89.2%	0.56	10.05	0.82
	4.38	20.85	0.54	0.92	11.18	21.57	87.5%	0.52	8.76	0.78
	4.43	20.46	0.50	0.87	10.14	21.15	85.8%	0.48	7.55	0.74
	4.48	20.06	0.46	0.82	9.13	20.74	84.1%	0.44	6.42	0.70
	4.53	19.70	0.41	0.77	8.14	20.37	82.6%	0.40	5.36	0.66
	4.58	19.34	0.37	0.72	7.16	19.99	81.1%	0.36	4.39	0.61
	4.63	18.98	0.33	0.67	6.20	19.62	79.6%	0.32	3.50	0.56
WL	4.68	18.62	0.28	0.62	5.26	19.24	78.1%	0.27	2.69	0.51
	4.73	18.08	0.24	0.57	4.34	18.69	75.8%	0.23	1.99	0.46
	4.78	14.77	0.24	0.52	3.52	15.34	62.2%	0.23	1.60	0.46
	4.83	12.17	0.23	0.47	2.85	12.69	51.5%	0.22	1.28	0.45
	4.88	10.54	0.22	0.42	2.29	10.98	44.5%	0.21	0.98	0.43
	4.93	9.57	0.19	0.37	1.79	9.94	40.3%	0.18	0.69	0.39
	4.98	7.98	0.17	0.32	1.34	8.28	33.6%	0.16	0.48	0.36
	5.03	6.92	0.14	0.27	0.98	7.14	29.0%	0.14	0.31	0.32
	5.08	6.29	0.10	0.22	0.65	6.44	26.1%	0.10	0.17	0.26
	5.13	4.53	0.08	0.17	0.38	4.64	18.8%	0.08	0.09	0.23
	5.18	3.72	0.05	0.12	0.18	3.78	15.4%	0.05	0.03	0.16
	5.23	1.55	0.02	0.07	0.03	1.58	6.4%	0.02	0.00	0.09
	5.28	0.21	0.01	0.02	0.00	0.21	0.9%	0.01	0.00	0.05

STREAM NAME: Hubbard Creek
XS LOCATION: 500' upst. Fr USFS-Coal Co. boundary
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	2.70	cfs
CALCULATED FLOW (Qc)=	2.69	cfs
(Qm-Qc)/Qm * 100 =	0.4	%
MEASURED WATERLINE (WLm)=	4.70	ft
CALCULATED WATERLINE (WLc)=	4.68	ft
(WLm-WLc)/WLm * 100 =	0.3	%
MAX MEASURED DEPTH (Dm)=	0.60	ft
MAX CALCULATED DEPTH (Dc)=	0.62	ft
(Dm-Dc)/Dm * 100	-2.7	%
MEAN VELOCITY=	0.51	ft/sec
MANNING'S N=	0.095	
SLOPE=	0.006	ft/ft
.4 * Qm =	1.1	cfs
2.5 * Qm=	6.8	cfs

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

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

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

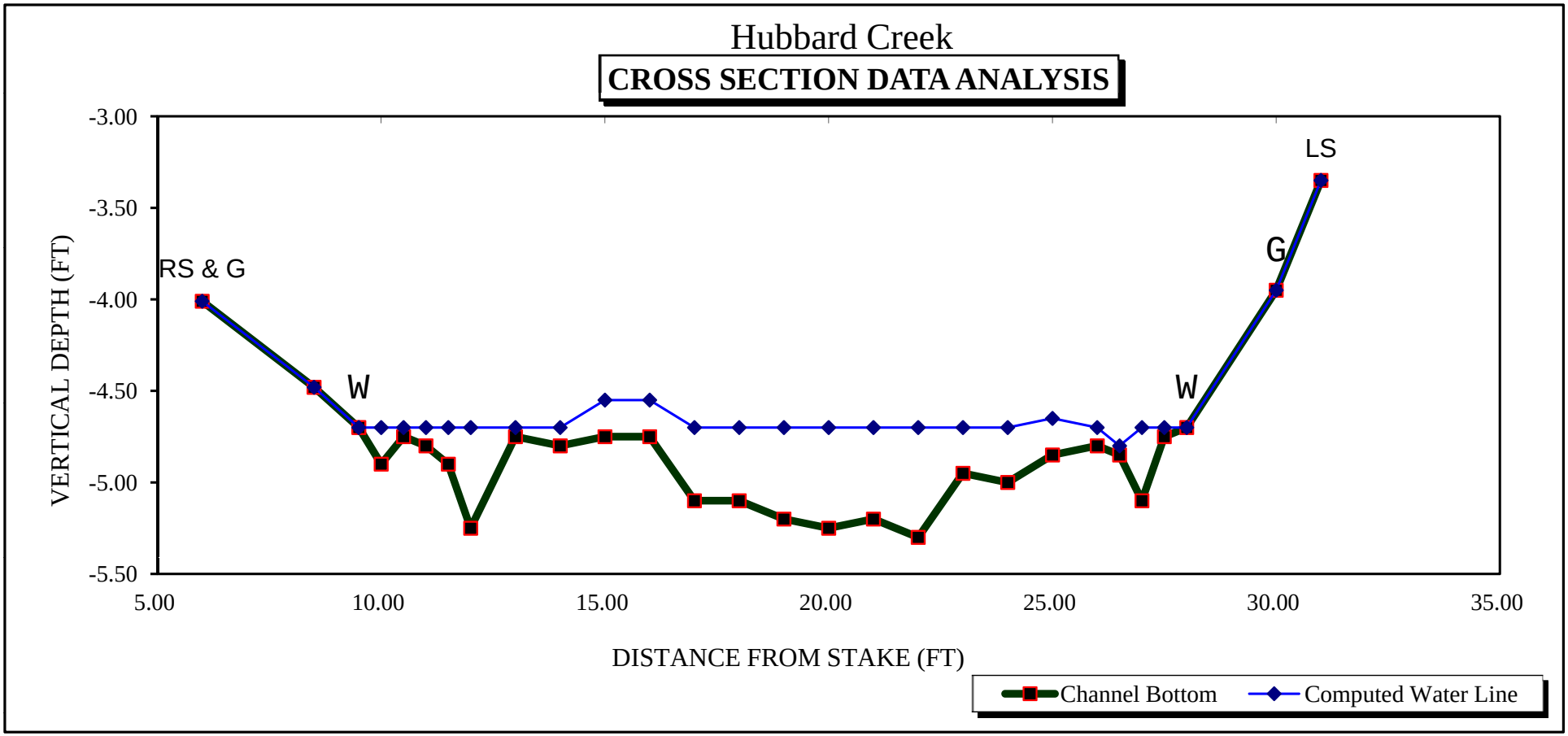
RECOMMENDATION BY: ………………....……...…................................ AGENCY...……………………......…....…...……...... DATE:......…...…......……………

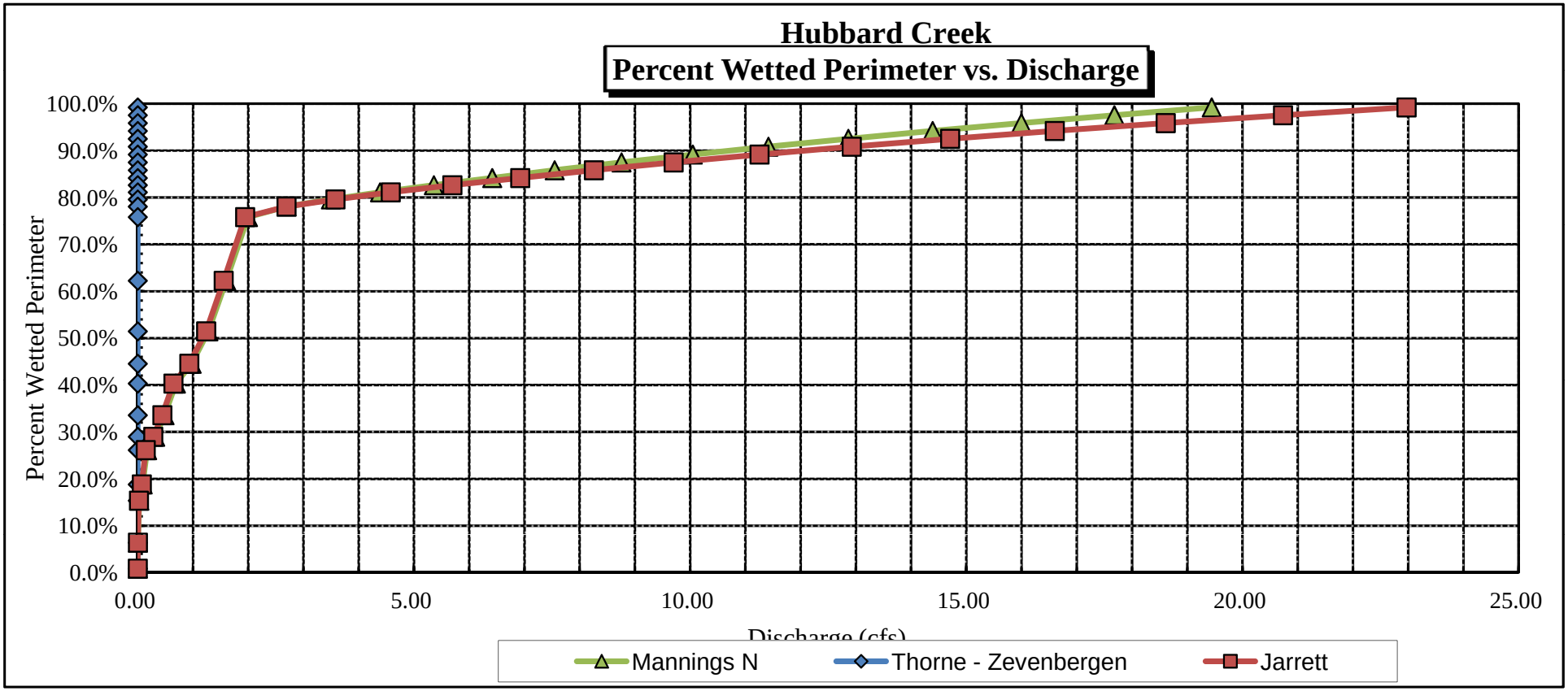
CWCB REVIEW BY: ...……………………….....………………………………………………..…............. DATE:.................…………….....…

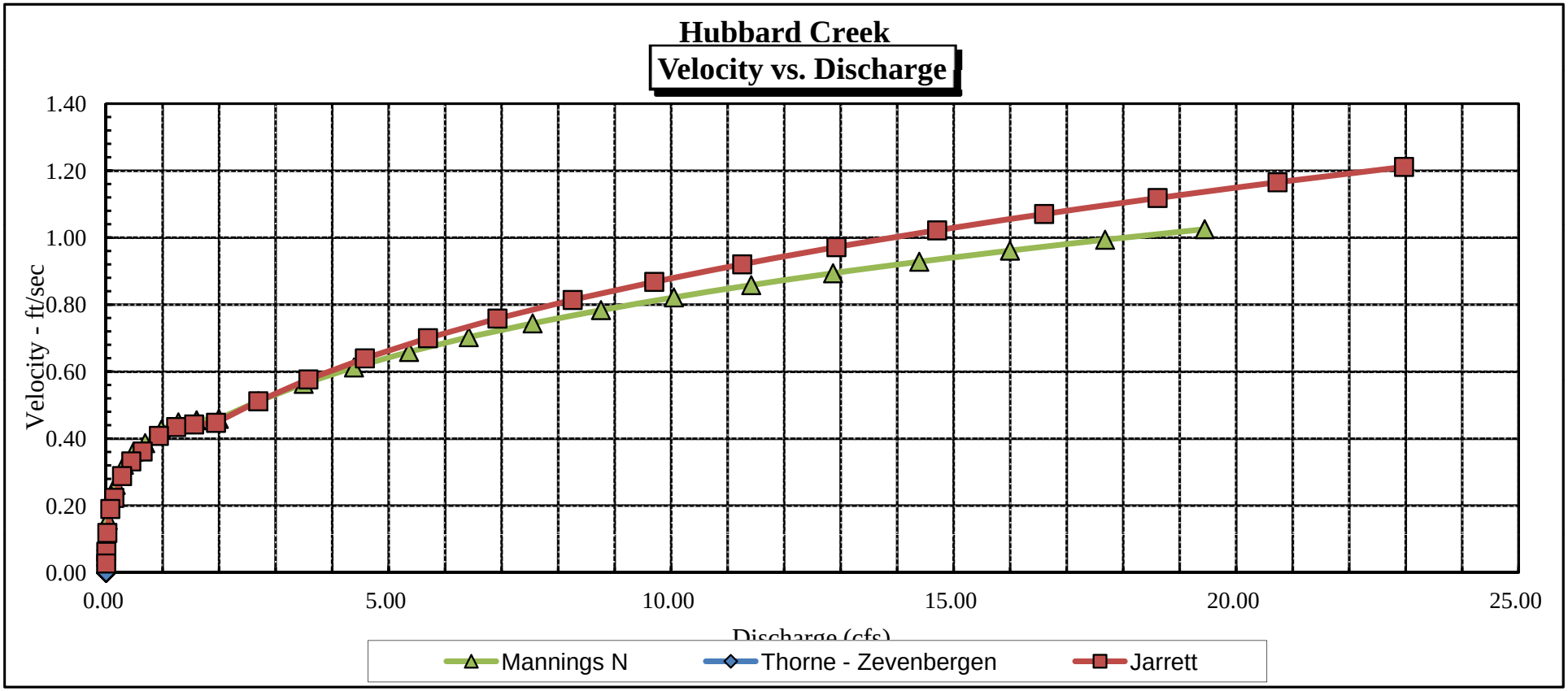
STREAM NAME: Hubbard Creek
XS LOCATION: 500' upst. Fr USFS-Coal Co. boundary
XS NUMBER: 1 Jarrett Variable Manning's n Correction Applied

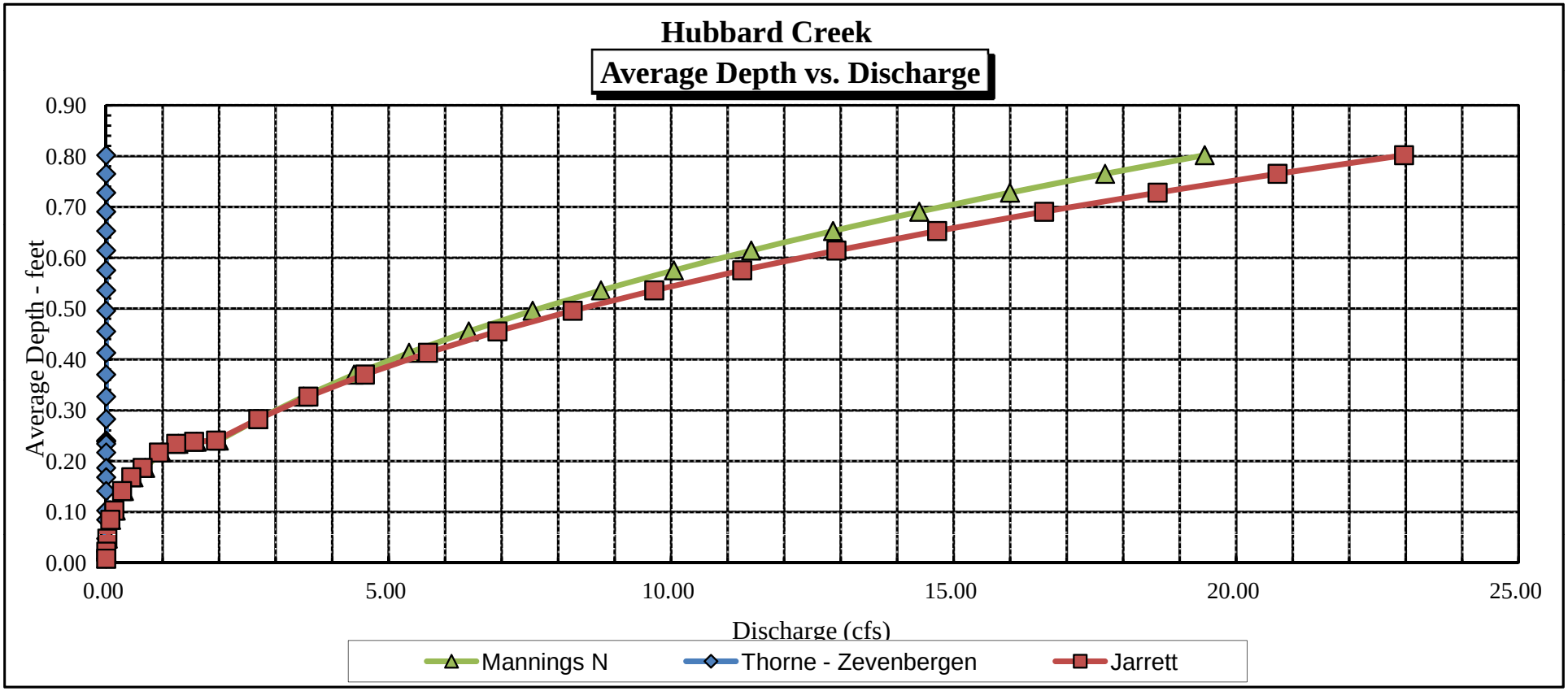
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

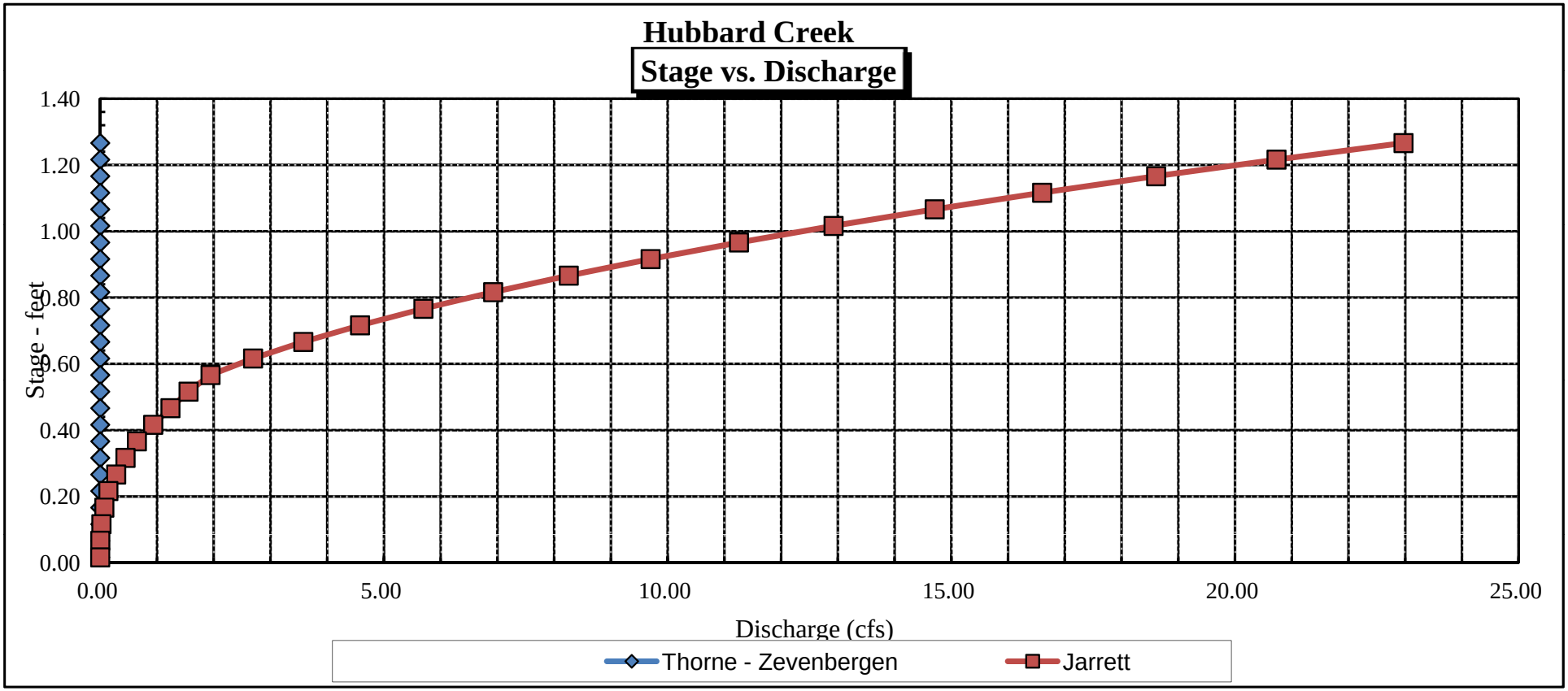
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	4.01	23.84	0.82	1.29	19.53	24.66	100.0%	0.79	24.08	1.23
	4.03	23.65	0.80	1.27	18.96	24.46	99.2%	0.78	22.97	1.21
	4.08	23.25	0.77	1.22	17.79	24.05	97.5%	0.74	20.73	1.17
	4.13	22.85	0.73	1.17	16.64	23.63	95.9%	0.70	18.61	1.12
	4.18	22.45	0.69	1.12	15.51	23.22	94.2%	0.67	16.60	1.07
	4.23	22.05	0.65	1.07	14.39	22.81	92.5%	0.63	14.71	1.02
	4.28	21.65	0.61	1.02	13.30	22.39	90.8%	0.59	12.93	0.97
	4.33	21.25	0.58	0.97	12.23	21.98	89.2%	0.56	11.26	0.92
	4.38	20.85	0.54	0.92	11.18	21.57	87.5%	0.52	9.70	0.87
	4.43	20.46	0.50	0.87	10.14	21.15	85.8%	0.48	8.26	0.81
	4.48	20.06	0.46	0.82	9.13	20.74	84.1%	0.44	6.92	0.76
	4.53	19.70	0.41	0.77	8.14	20.37	82.6%	0.40	5.70	0.70
	4.58	19.34	0.37	0.72	7.16	19.99	81.1%	0.36	4.58	0.64
	4.63	18.98	0.33	0.67	6.20	19.62	79.6%	0.32	3.58	0.58
WL	4.68	18.62	0.28	0.62	5.26	19.24	78.1%	0.27	2.69	0.51
	4.73	18.08	0.24	0.57	4.34	18.69	75.8%	0.23	1.94	0.45
	4.78	14.77	0.24	0.52	3.52	15.34	62.2%	0.23	1.56	0.44
	4.83	12.17	0.23	0.47	2.85	12.69	51.5%	0.22	1.24	0.43
	4.88	10.54	0.22	0.42	2.29	10.98	44.5%	0.21	0.93	0.41
	4.93	9.57	0.19	0.37	1.79	9.94	40.3%	0.18	0.65	0.36
	4.98	7.98	0.17	0.32	1.34	8.28	33.6%	0.16	0.45	0.33
	5.03	6.92	0.14	0.27	0.98	7.14	29.0%	0.14	0.28	0.29
	5.08	6.29	0.10	0.22	0.65	6.44	26.1%	0.10	0.14	0.22
	5.13	4.53	0.08	0.17	0.38	4.64	18.8%	0.08	0.07	0.19
	5.18	3.72	0.05	0.12	0.18	3.78	15.4%	0.05	0.02	0.12
	5.23	1.55	0.02	0.07	0.03	1.58	6.4%	0.02	0.00	0.06
	5.28	0.21	0.01	0.02	0.00	0.21	0.9%	0.01	0.00	0.03


Hubbard Creek
CROSS SECTION DATA ANALYSIS
-3.00
-3.50
-4.00
-4.50
-5.00
-5.50
VERTICAL DEPTH (FT)
RS & G
W
W
G
LS
5.00
10.00
15.00
20.00
25.00
30.00
35.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Hubbard 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
5.00
10.00
15.00
20.00
25.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Hubbard Creek
Velocity vs. Discharge
Velocity - ft/sec
1.40
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
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Hubbard Creek
Average Depth vs. Discharge
Average Depth - feet
0.90
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
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Hubbard Creek
Stage vs. Discharge
Stage - feet
1.40
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
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Hubbard Creek						CROSS-SECTION NO.: 1	
CROSS-SECTION LOCATION: 500 ft. upstream from USFS - coal company boundary							
DATE: 10-21-08	OBSERVERS: R. Smith, D Murphy						
LEGAL DESCRIPTION	¼ SECTION: SW	SECTION: 35	TOWNSHIP: 12 N/S	RANGE: 91 E/W	PM: 6th		
COUNTY: Delta	WATERSHED: N. Fk. Gunnison	WATER DIVISION: 4	DOW WATER CODE: 40751				
MAP(S): USGS: Bowie 7.5'							
USFS:							

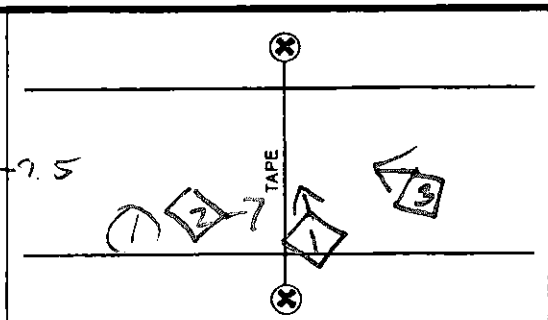
SUPPLEMENTAL DATA

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: 2" to 18"	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 28.0	4.70 / 4.70
② WS Upstream	14.0	4.65
③ WS Downstream	10.0	4.80
SLOPE	0.15 / 24.0 =	

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: 8.5
TDS: 220
Temp: 40 C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Hubbard Creek	CROSS-SECTION NO.: 1	DATE: 10-21-08	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 10:00 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/G	6.0		4.01								
	8.5		4.48								
W	9.5		4.70								
	10		4.90	.2				.37			
	10.5		4.75	.05				0			
	11		4.80	.1				.69			
	11.5		4.90	.2				1.06			
	12		5.25	.55				.01			
	13		4.75	.05				0			
	14		4.80	.10				.38			
	15		4.75	.20				.57			
	16		4.75	.20				.15			
	17		5.10	.40				.15			
	18		5.10	.40				.34			
	19		5.20	.50				.78			
	20		5.25	.55				.84			
	21		5.20	.50				.90			
	22		5.30	.60				.51			
	23		4.95	.25				.05			
	24		5.00	.30				1.10			
	25		4.85	.20				0.74			
	26		4.80	.10				0.22			
	26.5		4.85	.05				0			
	27		5.10	.40				.15			
	27.5		4.75	05				0			
W	28.0		4.70								
G	30.0		3.95								
LS	31.0		3.35								
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:	Hubbard Creek
XS LOCATION:	200 ft. upstream from bridge
XS NUMBER:	2
DATE:	21-Oct-08
OBSERVERS:	R. Smith, D. Murphy
1/4 SEC:	SE
SECTION:	2
TWP:	13S
RANGE:	91W
PM:	Sixth
COUNTY:	Delta
WATERSHED:	N. Fk. Gunnison
DIVISION:	4
DOW CODE:	40751
USGS MAP:	Bowie 7.5'
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:	0.01

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

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

STREAM NAME: Hubbard Creek
XS LOCATION: 200 ft. upstream from bridge
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
1	RS & G	9.50	3.75			0.00		0.00	0.00	0.0%
	W	11.70	4.75			0.00		0.00	0.00	0.0%
		12.00	4.85	0.10	0.00	0.32	0.10	0.07	0.00	0.0%
		13.00	5.00	0.25	0.00	1.01	0.25	0.25	0.00	0.0%
		14.00	4.95	0.20	0.00	1.00	0.20	0.20	0.00	0.0%
		15.00	5.00	0.25	0.55	1.00	0.25	0.25	0.14	4.0%
		16.00	5.00	0.25	0.99	1.00	0.25	0.25	0.25	7.2%
		17.00	5.00	0.25	1.23	1.00	0.25	0.25	0.31	8.9%
		18.00	5.15	0.45	0.90	1.01	0.45	0.45	0.41	11.8%
		19.00	5.15	0.40	0.39	1.00	0.40	0.40	0.16	4.5%
		20.00	5.15	0.40	0.01	1.00	0.40	0.40	0.00	0.1%
		21.00	5.05	0.30	0.27	1.00	0.30	0.30	0.08	2.4%
		22.00	5.15	0.40	0.38	1.00	0.40	0.40	0.15	4.4%
		23.00	5.15	0.40	0.60	1.00	0.40	0.30	0.18	5.2%
		23.50	5.15	0.40	1.03	0.50	0.40	0.20	0.21	6.0%
		24.00	5.20	0.45	1.96	0.50	0.45	0.34	0.66	19.2%
		25.00	5.35	0.65	0.40	1.01	0.65	0.65	0.26	7.5%
		26.00	5.15	0.50	0.73	1.02	0.50	0.50	0.37	10.6%
		27.00	5.30	0.60	0.08	1.01	0.60	0.60	0.05	1.4%
		28.00	5.30	0.60	0.12	1.00	0.60	0.60	0.07	2.1%
		29.00	5.15	0.45	0.16	1.01	0.45	0.45	0.07	2.1%
		30.00	5.15	0.45	0.20	1.00	0.45	0.45	0.09	2.6%
		31.00	4.75	0.05	0.00	1.08	0.05	0.04	0.00	0.0%
	W	31.50	4.70			0.50		0.00	0.00	0.0%
1	LS & G	34.50	3.70			0.00		0.00	0.00	0.0%
	TOTALS ----------					19.99	0.65 (Max.)	7.34	3.45	100.0%

Manning's n = 0.1624
Hydraulic Radius= 0.36724857

STREAM NAME: Hubbard Creek
XS LOCATION: 200 ft. upstream from bridge
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	7.34	7.39	0.7%
4.48	7.34	12.49	70.2%
4.50	7.34	12.07	64.5%
4.52	7.34	11.66	58.8%
4.54	7.34	11.24	53.1%
4.56	7.34	10.82	47.5%
4.58	7.34	10.41	41.9%
4.60	7.34	10.00	36.3%
4.62	7.34	9.59	30.7%
4.64	7.34	9.19	25.2%
4.66	7.34	8.78	19.7%
4.68	7.34	8.38	14.2%
4.69	7.34	8.18	11.5%
4.70	7.34	7.98	8.8%
4.71	7.34	7.78	6.0%
4.72	7.34	7.59	3.3%
4.73	7.34	7.39	0.7%
4.74	7.34	7.19	-2.0%
4.75	7.34	7.00	-4.6%
4.76	7.34	6.81	-7.3%
4.77	7.34	6.61	-9.9%
4.78	7.34	6.42	-12.5%
4.80	7.34	6.04	-17.7%
4.82	7.34	5.66	-22.9%
4.84	7.34	5.28	-28.0%
4.86	7.34	4.91	-33.2%
4.88	7.34	4.53	-38.2%
4.90	7.34	4.17	-43.2%
4.92	7.34	3.80	-48.2%
4.94	7.34	3.44	-53.1%
4.96	7.34	3.08	-58.0%
4.98	7.34	2.74	-62.7%

WATERLINE AT ZERO
AREA ERROR = 4.728

STREAM NAME: Hubbard Creek
XS LOCATION: 200 ft. upstream from bridge
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	3.75	24.85	1.17	1.60	29.14	25.41	100.0%	1.15	29.23	1.00
	3.78	24.71	1.15	1.57	28.46	25.25	99.4%	1.13	28.21	0.99
	3.83	24.45	1.11	1.52	27.23	24.97	98.3%	1.09	26.41	0.97
	3.88	24.19	1.08	1.47	26.02	24.70	97.2%	1.05	24.65	0.95
	3.93	23.93	1.04	1.42	24.81	24.42	96.1%	1.02	22.96	0.93
	3.98	23.67	1.00	1.37	23.62	24.14	95.0%	0.98	21.31	0.90
	4.03	23.41	0.96	1.32	22.45	23.86	93.9%	0.94	19.73	0.88
	4.08	23.15	0.92	1.27	21.28	23.58	92.8%	0.90	18.19	0.85
	4.13	22.89	0.88	1.22	20.13	23.30	91.7%	0.86	16.72	0.83
	4.18	22.63	0.84	1.17	19.00	23.02	90.6%	0.83	15.29	0.81
	4.23	22.37	0.80	1.12	17.87	22.74	89.5%	0.79	13.93	0.78
	4.28	22.11	0.76	1.07	16.76	22.46	88.4%	0.75	12.62	0.75
	4.33	21.85	0.72	1.02	15.66	22.19	87.3%	0.71	11.36	0.73
	4.38	21.59	0.68	0.97	14.57	21.91	86.2%	0.67	10.17	0.70
	4.43	21.33	0.63	0.92	13.50	21.63	85.1%	0.62	9.03	0.67
	4.48	21.07	0.59	0.87	12.44	21.35	84.0%	0.58	7.94	0.64
	4.53	20.81	0.55	0.82	11.39	21.07	82.9%	0.54	6.92	0.61
	4.58	20.55	0.50	0.77	10.36	20.79	81.8%	0.50	5.96	0.58
	4.63	20.29	0.46	0.72	9.34	20.51	80.7%	0.46	5.06	0.54
	4.68	20.03	0.42	0.67	8.33	20.23	79.6%	0.41	4.22	0.51
WL	4.73	19.57	0.37	0.62	7.34	19.76	77.8%	0.37	3.47	0.47
	4.78	19.15	0.33	0.57	6.37	19.32	76.1%	0.33	2.78	0.44
	4.83	18.87	0.29	0.52	5.42	19.03	74.9%	0.28	2.15	0.40
	4.88	18.50	0.24	0.47	4.49	18.64	73.4%	0.24	1.59	0.35
	4.93	18.04	0.20	0.42	3.57	18.17	71.5%	0.20	1.11	0.31
	4.98	16.48	0.16	0.37	2.70	16.59	65.3%	0.16	0.74	0.27
	5.03	13.12	0.15	0.32	1.98	13.22	52.0%	0.15	0.51	0.26
	5.08	12.11	0.11	0.27	1.34	12.20	48.0%	0.11	0.28	0.21
	5.13	10.66	0.07	0.22	0.77	10.72	42.2%	0.07	0.12	0.16
	5.18	4.72	0.08	0.17	0.40	4.77	18.8%	0.08	0.07	0.17
	5.23	3.40	0.06	0.12	0.20	3.43	13.5%	0.06	0.03	0.14
	5.28	2.15	0.03	0.07	0.06	2.16	8.5%	0.03	0.00	0.08
	5.33	0.26	0.01	0.02	0.00	0.27	1.0%	0.01	0.00	0.05

STREAM NAME: Hubbard Creek
XS LOCATION: 200 ft. upstream from bridge
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	3.45	cfs
CALCULATED FLOW (Qc)=	3.47	cfs
(Qm-Qc)/Qm * 100 =	-0.7	%
MEASURED WATERLINE (WLm)=	4.73	ft
CALCULATED WATERLINE (WLc)=	4.73	ft
(WLm-WLc)/WLm * 100 =	-0.1	%
MAX MEASURED DEPTH (Dm)=	0.65	ft
MAX CALCULATED DEPTH (Dc)=	0.62	ft
(Dm-Dc)/Dm * 100	4.2	%
MEAN VELOCITY=	0.47	ft/sec
MANNING'S N=	0.162	
SLOPE=	0.01	ft/ft
.4 * Qm =	1.4	cfs
2.5 * Qm=	8.6	cfs

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

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

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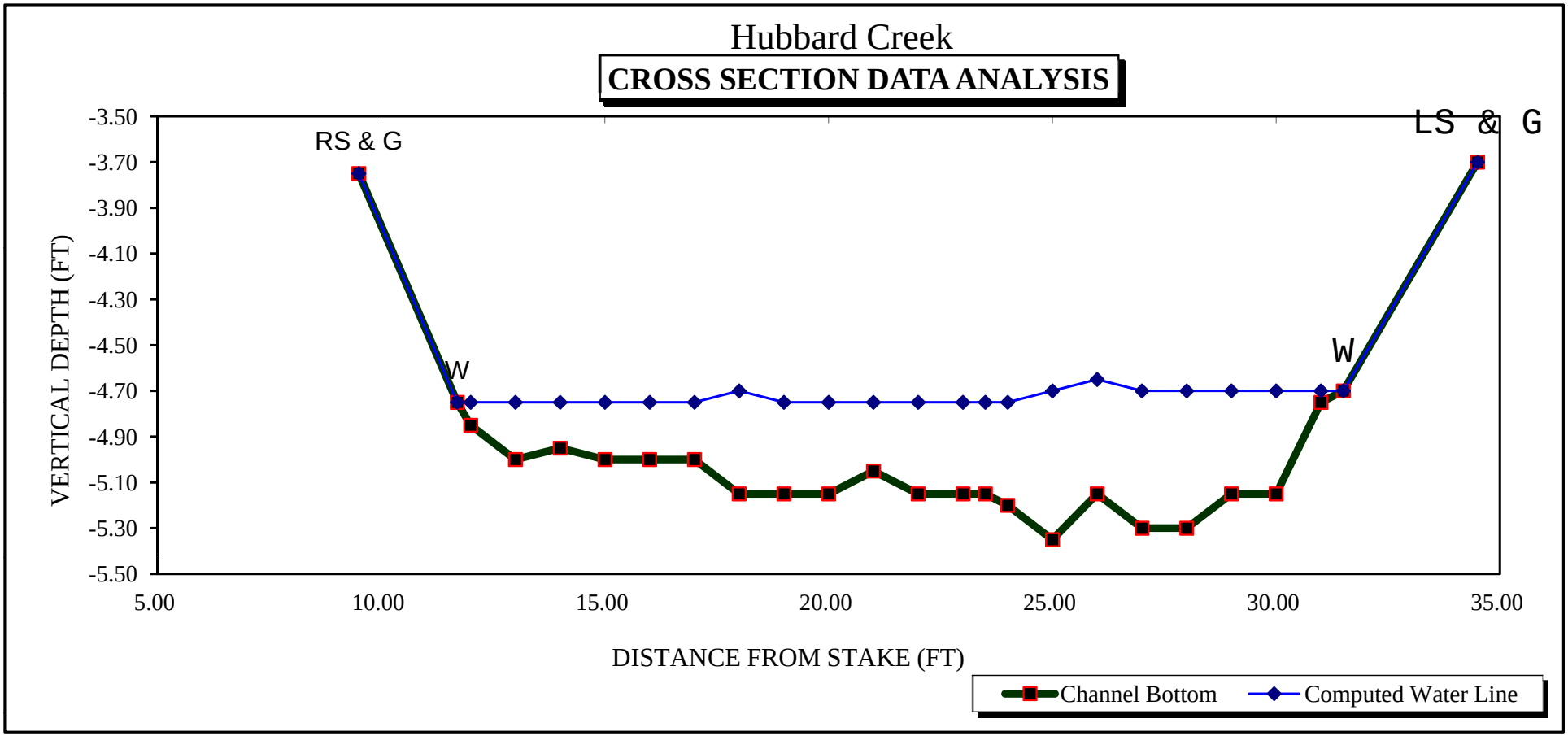
RECOMMENDATION BY: ……………………………………………… AGENCY……………………………………………… DATE:……………………………

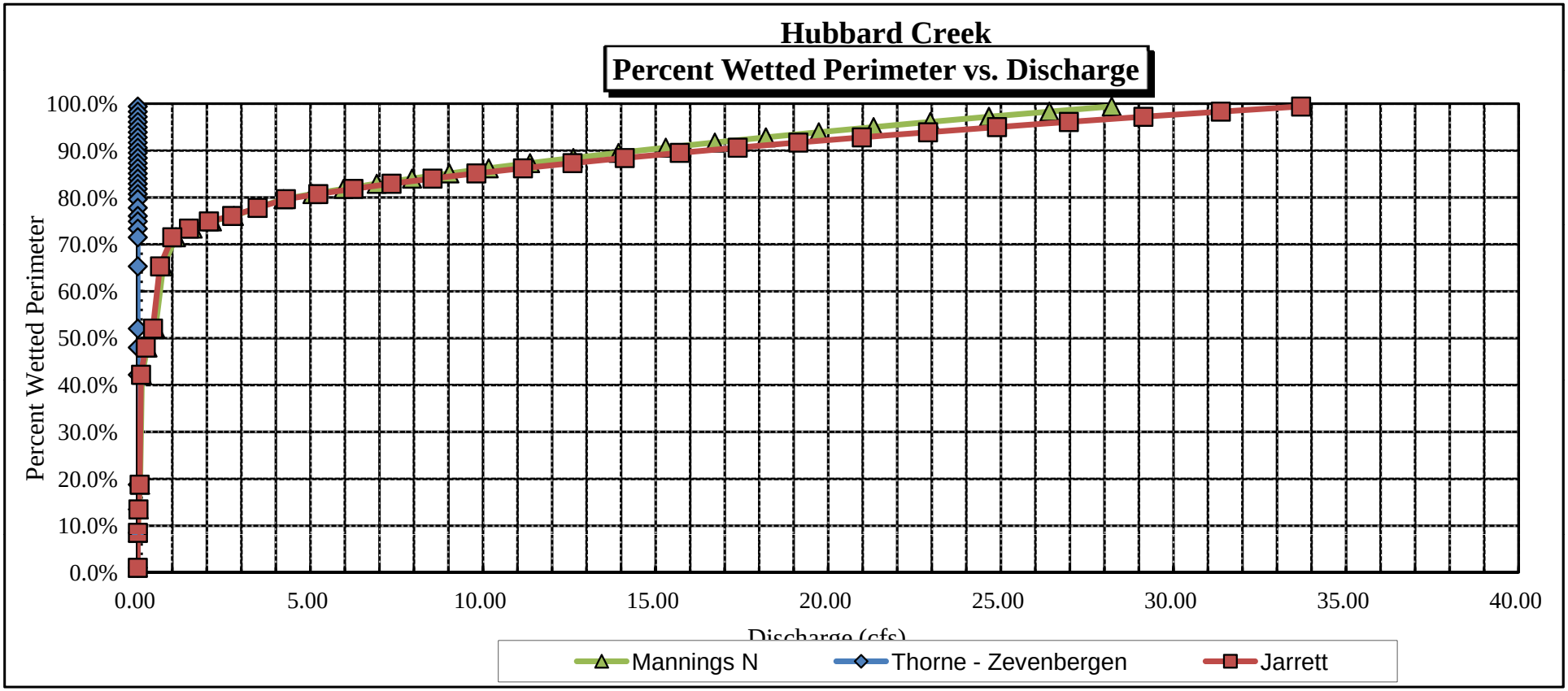
CWCB REVIEW BY: …… DATE:……………………………

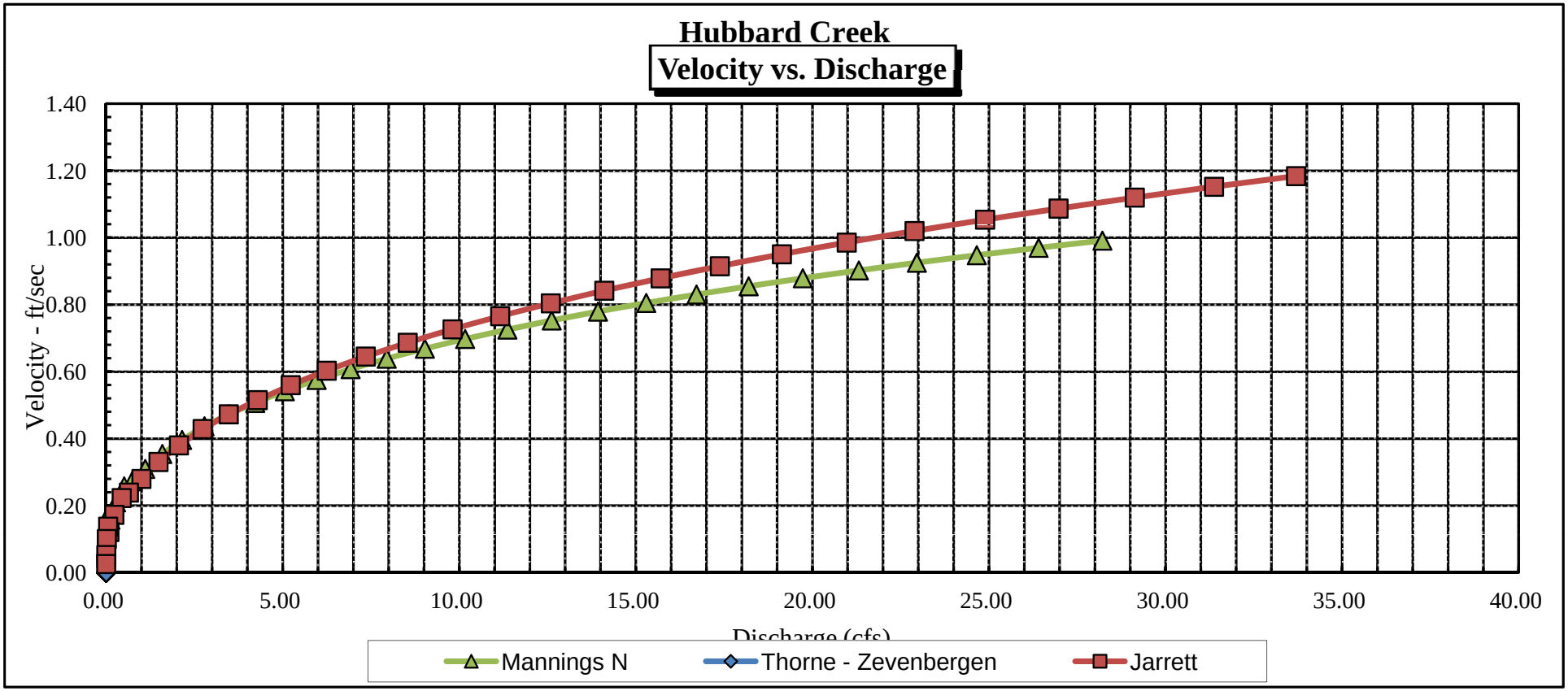
STREAM NAME: Hubbard Creek
XS LOCATION: 200 ft. upstream from bridge
XS NUMBER: 2 Jarrett Variable Manning's n Correction Applied

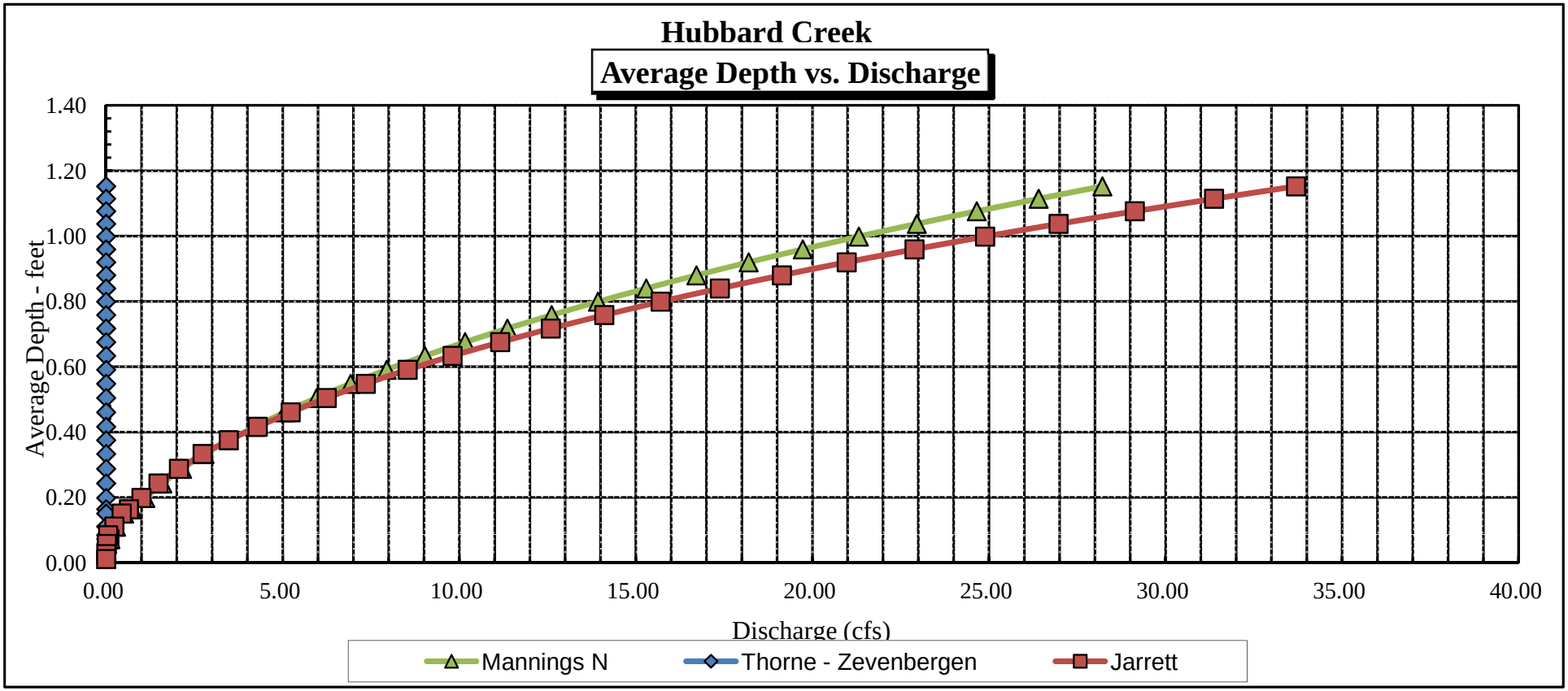
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

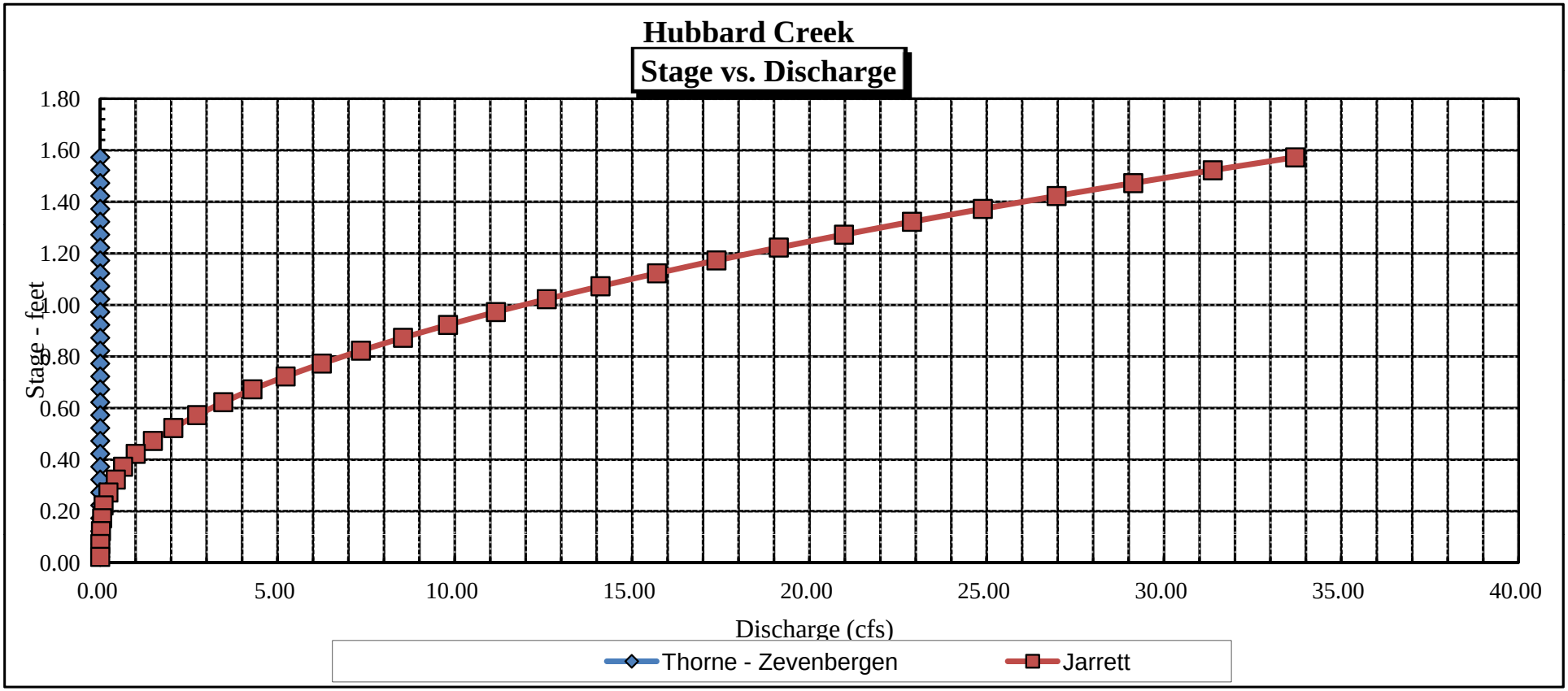
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	3.75	24.85	1.17	1.60	29.14	25.41	100.0%	1.15	35.01	1.20
	3.78	24.71	1.15	1.57	28.46	25.25	99.4%	1.13	33.70	1.18
	3.83	24.45	1.11	1.52	27.23	24.97	98.3%	1.09	31.37	1.15
	3.88	24.19	1.08	1.47	26.02	24.70	97.2%	1.05	29.13	1.12
	3.93	23.93	1.04	1.42	24.81	24.42	96.1%	1.02	26.97	1.09
	3.98	23.67	1.00	1.37	23.62	24.14	95.0%	0.98	24.89	1.05
	4.03	23.41	0.96	1.32	22.45	23.86	93.9%	0.94	22.89	1.02
	4.08	23.15	0.92	1.27	21.28	23.58	92.8%	0.90	20.97	0.99
	4.13	22.89	0.88	1.22	20.13	23.30	91.7%	0.86	19.13	0.95
	4.18	22.63	0.84	1.17	19.00	23.02	90.6%	0.83	17.38	0.91
	4.23	22.37	0.80	1.12	17.87	22.74	89.5%	0.79	15.70	0.88
	4.28	22.11	0.76	1.07	16.76	22.46	88.4%	0.75	14.11	0.84
	4.33	21.85	0.72	1.02	15.66	22.19	87.3%	0.71	12.59	0.80
	4.38	21.59	0.68	0.97	14.57	21.91	86.2%	0.67	11.16	0.77
	4.43	21.33	0.63	0.92	13.50	21.63	85.1%	0.62	9.81	0.73
	4.48	21.07	0.59	0.87	12.44	21.35	84.0%	0.58	8.54	0.69
	4.53	20.81	0.55	0.82	11.39	21.07	82.9%	0.54	7.35	0.65
	4.58	20.55	0.50	0.77	10.36	20.79	81.8%	0.50	6.25	0.60
	4.63	20.29	0.46	0.72	9.34	20.51	80.7%	0.46	5.23	0.56
	4.68	20.03	0.42	0.67	8.33	20.23	79.6%	0.41	4.29	0.52
WL	4.73	19.57	0.37	0.62	7.34	19.76	77.8%	0.37	3.47	0.47
	4.78	19.15	0.33	0.57	6.37	19.32	76.1%	0.33	2.73	0.43
	4.83	18.87	0.29	0.52	5.42	19.03	74.9%	0.28	2.06	0.38
	4.88	18.50	0.24	0.47	4.49	18.64	73.4%	0.24	1.48	0.33
	4.93	18.04	0.20	0.42	3.57	18.17	71.5%	0.20	1.00	0.28
	4.98	16.48	0.16	0.37	2.70	16.59	65.3%	0.16	0.64	0.24
	5.03	13.12	0.15	0.32	1.98	13.22	52.0%	0.15	0.44	0.22
	5.08	12.11	0.11	0.27	1.34	12.20	48.0%	0.11	0.23	0.17
	5.13	10.66	0.07	0.22	0.77	10.72	42.2%	0.07	0.09	0.12
	5.18	4.72	0.08	0.17	0.40	4.77	18.8%	0.08	0.05	0.14
	5.23	3.40	0.06	0.12	0.20	3.43	13.5%	0.06	0.02	0.10
	5.28	2.15	0.03	0.07	0.06	2.16	8.5%	0.03	0.00	0.05
	5.33	0.26	0.01	0.02	0.00	0.27	1.0%	0.01	0.00	0.03


Hubbard Creek
CROSS SECTION DATA ANALYSIS
RS & G
W
W
LS & G
-3.50
-3.70
-3.90
-4.10
-4.30
-4.50
-4.70
-4.90
-5.10
-5.30
-5.50
VERTICAL DEPTH (FT)
5.00
10.00
15.00
20.00
25.00
30.00
35.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Hubbard 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
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Hubbard Creek
Velocity vs. Discharge
Velocity - ft/sec
1.40
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
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Hubbard Creek
Average Depth vs. Discharge
Average Depth - feet
1.40
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
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Hubbard Creek
Stage vs. Discharge
Stage - feet
1.80
1.60
1.40
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
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

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

CROSS-SECTION LOCATION: 200 ft. upstream from bridge

DATE: 10-21-08 | OBSERVERS: R. Smith, D. Murphy

LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP:	RANGE:	PM:
	SE	2	13 N/S	71 E/W	6th

COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:
Delta	N Fk. Gunnison	4	40751

MAP(S): USGS: Bowie 7.5' | USFS:

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO | METER TYPE: M-M

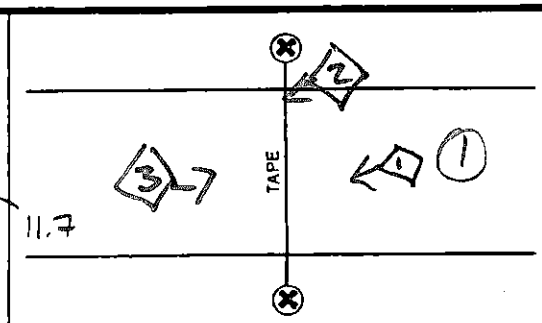
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: 2" to 18" | 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 31.5 →	4.70 / 4.75
② WS Upstream	7.0	4.65
③ WS Downstream	10.0	4.82
SLOPE	0.17 / 17.0 = 0.01	

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

TDS = 220

Ph = 8.5

Temp = 5° C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Hubbard Creek	CROSS-SECTION NO.: 2	DATE: 10-20-08	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 11:15 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)
R S/G	9.5		3.75								
W	11.7		4.75								
	12		4.85	.1				Ø			
	13		5.00	.25				Ø			
	14		4.95	.20				Ø			
	15		5.00	.25				.55			
	16		5.00	.25				.99			
	17		5.00	.25				1.23			
	18		5.15	.45				.90			
	19		5.15	.40				.39			
	20		5.15	.40				.01			
	21	5.15	5.05	.30				.27			
	22		5.15	.40				.38			
	23	<23.5	5.15	.40	<.4			.60	<1.03		
	24		5.20	.45				1.96			
	25		6.35	.65				.40			
	26		5.15	.50				.73			
	27		5.30	.60				.08			
	28		5.30	.60				.12			
	29		5.15	.45				.16			
	30		5.15	.45				.20			
	31		4.75	.05				Ø			
W	31.5		4.70								
LS/G	34.5		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:	Hubbard Creek
XS LOCATION:	1.5 miles u.s. f/ conf. w/ N Fk. Gunnison
XS NUMBER:	1
DATE:	27-Sep-07
OBSERVERS:	R. Smith, D. Murphy
1/4 SEC:	SE
SECTION:	2
TWP:	13S
RANGE:	91W
PM:	Sixth
COUNTY:	Delta
WATERSHED:	Gunnison
DIVISION:	4
DOW CODE:	40751
USGS MAP:	Bowie 7.5'
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: 0.018

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

ASSIGNED TO: ….....…….....DATE.....

STREAM NAME: Hubbard Creek
XS LOCATION: 1.5 miles u.s. f/ conf. w/ N Fk. Gunnison
XS NUMBER: 1

DATA POINTS= 27

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	1.50	4.95			0.00		0.00	0.00	0.0%
		6.00	5.12			0.00		0.00	0.00	0.0%
		8.00	5.57			0.00		0.00	0.00	0.0%
1	G	9.00	5.96			0.00		0.00	0.00	0.0%
		11.00	6.62			0.00		0.00	0.00	0.0%
	W	12.20	7.18			0.00		0.00	0.00	0.0%
		12.30	7.60	0.40	0.88	0.43	0.40	0.16	0.14	0.7%
		13.00	7.85	0.65	1.55	0.74	0.65	0.55	0.86	4.5%
		14.00	7.65	0.45	1.32	1.02	0.45	0.45	0.59	3.1%
		15.00	8.10	0.90	1.18	1.10	0.90	0.90	1.06	5.5%
		16.00	8.15	0.95	0.71	1.00	0.95	0.95	0.67	3.5%
		17.00	8.00	0.80	0.67	1.01	0.80	0.80	0.54	2.8%
		18.00	7.95	0.75	3.04	1.00	0.75	0.75	2.28	11.9%
		19.00	8.00	0.80	1.16	1.00	0.80	0.80	0.93	4.8%
		20.00	8.10	0.90	1.87	1.00	0.90	0.90	1.68	8.8%
		21.00	8.05	0.85	3.31	1.00	0.85	0.85	2.81	14.7%
		22.00	8.10	0.90	2.69	1.00	0.90	0.90	2.42	12.6%
		23.00	8.00	0.80	1.80	1.00	0.80	0.80	1.44	7.5%
		24.00	8.20	1.00	1.16	1.02	1.00	1.00	1.16	6.1%
		25.00	8.20	1.00	0.89	1.00	1.00	1.00	0.89	4.6%
		26.00	8.20	1.00	0.62	1.00	1.00	1.00	0.62	3.2%
		27.00	8.40	1.20	0.71	1.02	1.20	1.20	0.85	4.4%
		28.00	8.10	0.90	0.23	1.04	0.90	0.90	0.21	1.1%
		29.00	7.50	0.20	0.01	1.17	0.20	0.16	0.00	0.0%
	W	29.60	7.17			0.68		0.00	0.00	0.0%
1	G	33.50	5.92			0.00		0.00	0.00	0.0%
	LS	35.00	5.10			0.00		0.00	0.00	0.0%
	TOTALS ----------					18.25	1.2 (Max.)	14.07	19.16	100.0%

Manning's n = 0.1231
Hydraulic Radius= 0.77095083

STREAM NAME: Hubbard Creek
XS LOCATION: 1.5 miles u.s. f/ conf. w/ N Fk. Gunnison
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	14.07	14.58	3.6%
6.93	14.07	19.09	35.7%
6.95	14.07	18.72	33.0%
6.97	14.07	18.35	30.4%
6.99	14.07	17.98	27.8%
7.01	14.07	17.61	25.1%
7.03	14.07	17.25	22.6%
7.05	14.07	16.88	20.0%
7.07	14.07	16.52	17.4%
7.09	14.07	16.16	14.9%
7.11	14.07	15.81	12.3%
7.13	14.07	15.45	9.8%
7.14	14.07	15.28	8.6%
7.15	14.07	15.10	7.3%
7.16	14.07	14.93	6.1%
7.17	14.07	14.75	4.8%
7.18	14.07	14.58	3.6%
7.19	14.07	14.40	2.4%
7.20	14.07	14.23	1.1%
7.21	14.07	14.06	-0.1%
7.22	14.07	13.88	-1.3%
7.23	14.07	13.71	-2.6%
7.25	14.07	13.37	-5.0%
7.27	14.07	13.02	-7.5%
7.29	14.07	12.68	-9.9%
7.31	14.07	12.33	-12.4%
7.33	14.07	11.99	-14.8%
7.35	14.07	11.65	-17.2%
7.37	14.07	11.31	-19.6%
7.39	14.07	10.97	-22.0%
7.41	14.07	10.63	-24.4%
7.43	14.07	10.29	-26.9%

WATERLINE AT ZERO
AREA ERROR = 7.204

STREAM NAME: Hubbard Creek
XS LOCATION: 1.5 miles u.s. f/ conf. w/ N Fk. Gunnison
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	5.96	24.38	1.63	2.44	39.79	25.65	100.0%	1.55	86.35	2.17
	6.20	22.87	1.49	2.20	34.02	24.07	93.8%	1.41	69.40	2.04
	6.25	22.57	1.46	2.15	32.89	23.75	92.6%	1.38	66.17	2.01
	6.30	22.26	1.43	2.10	31.77	23.42	91.3%	1.36	63.03	1.98
	6.35	21.95	1.40	2.05	30.66	23.10	90.1%	1.33	59.97	1.96
	6.40	21.64	1.37	2.00	29.57	22.78	88.8%	1.30	56.99	1.93
	6.45	21.34	1.34	1.95	28.50	22.45	87.5%	1.27	54.10	1.90
	6.50	21.03	1.30	1.90	27.44	22.13	86.3%	1.24	51.28	1.87
	6.55	20.72	1.27	1.85	26.39	21.81	85.0%	1.21	48.55	1.84
	6.60	20.41	1.24	1.80	25.37	21.48	83.8%	1.18	45.89	1.81
	6.65	20.14	1.21	1.75	24.35	21.19	82.6%	1.15	43.27	1.78
	6.70	19.87	1.18	1.70	23.35	20.91	81.5%	1.12	40.71	1.74
	6.75	19.61	1.14	1.65	22.37	20.62	80.4%	1.08	38.23	1.71
	6.80	19.35	1.11	1.60	21.39	20.34	79.3%	1.05	35.82	1.67
	6.85	19.08	1.07	1.55	20.43	20.06	78.2%	1.02	33.49	1.64
	6.90	18.82	1.04	1.50	19.48	19.78	77.1%	0.99	31.24	1.60
	6.95	18.56	1.00	1.45	18.55	19.50	76.0%	0.95	29.06	1.57
	7.00	18.29	0.96	1.40	17.63	19.21	74.9%	0.92	26.95	1.53
	7.05	18.03	0.93	1.35	16.72	18.93	73.8%	0.88	24.92	1.49
	7.10	17.77	0.89	1.30	15.82	18.65	72.7%	0.85	22.97	1.45
	7.15	17.51	0.85	1.25	14.94	18.37	71.6%	0.81	21.09	1.41
WL	7.20	17.33	0.81	1.20	14.07	18.16	70.8%	0.78	19.23	1.37
	7.25	17.23	0.77	1.15	13.21	18.00	70.2%	0.73	17.40	1.32
	7.30	17.13	0.72	1.10	12.35	17.85	69.6%	0.69	15.64	1.27
	7.35	17.02	0.68	1.05	11.50	17.69	69.0%	0.65	13.96	1.21
	7.40	16.92	0.63	1.00	10.65	17.54	68.4%	0.61	12.36	1.16
	7.45	16.82	0.58	0.95	9.80	17.38	67.8%	0.56	10.84	1.11
	7.50	16.72	0.54	0.90	8.97	17.23	67.2%	0.52	9.39	1.05
	7.55	16.62	0.49	0.85	8.13	17.08	66.6%	0.48	8.03	0.99
	7.60	16.52	0.44	0.80	7.30	16.92	66.0%	0.43	6.75	0.92
	7.65	16.26	0.40	0.75	6.48	16.65	64.9%	0.39	5.60	0.86
	7.70	15.68	0.36	0.70	5.68	16.02	62.5%	0.35	4.61	0.81
	7.75	15.09	0.33	0.65	4.92	15.40	60.0%	0.32	3.72	0.76
	7.80	14.51	0.29	0.60	4.18	14.78	57.6%	0.28	2.91	0.70
	7.85	13.96	0.25	0.55	3.46	14.19	55.3%	0.24	2.19	0.63
	7.90	13.76	0.20	0.50	2.77	13.97	54.5%	0.20	1.53	0.55
	7.95	13.40	0.16	0.45	2.09	13.59	53.0%	0.15	0.97	0.46
	8.00	11.24	0.13	0.40	1.47	11.40	44.4%	0.13	0.61	0.41
	8.05	9.30	0.10	0.35	0.96	9.42	36.7%	0.10	0.34	0.35
	8.10	5.69	0.10	0.30	0.58	5.77	22.5%	0.10	0.21	0.35
	8.15	4.05	0.08	0.25	0.34	4.11	16.0%	0.08	0.11	0.31
	8.20	1.63	0.10	0.20	0.16	1.68	6.6%	0.10	0.05	0.34
	8.25	1.22	0.07	0.15	0.09	1.25	4.9%	0.07	0.02	0.28
	8.30	0.80	0.05	0.10	0.04	0.82	3.2%	0.05	0.01	0.21
	8.35	0.38	0.02	0.05	0.01	0.39	1.5%	0.02	0.00	0.13

STREAM NAME: Hubbard Creek
XS LOCATION: 1.5 miles u.s. f/ conf. w/ N Fk. Gunnison
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	19.16	cfs
CALCULATED FLOW (Qc)=	19.23	cfs
(Qm-Qc)/Qm * 100 =	-0.4	%
MEASURED WATERLINE (WLm)=	7.18	ft
CALCULATED WATERLINE (WLc)=	7.20	ft
(WLm-WLc)/WLm * 100 =	-0.4	%
MAX MEASURED DEPTH (Dm)=	1.20	ft
MAX CALCULATED DEPTH (Dc)=	1.20	ft
(Dm-Dc)/Dm * 100	0.3	%
MEAN VELOCITY=	1.37	ft/sec
MANNING'S N=	0.123	
SLOPE=	0.018	ft/ft
.4 * Qm =	7.7	cfs
2.5 * Qm=	47.9	cfs

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

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

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

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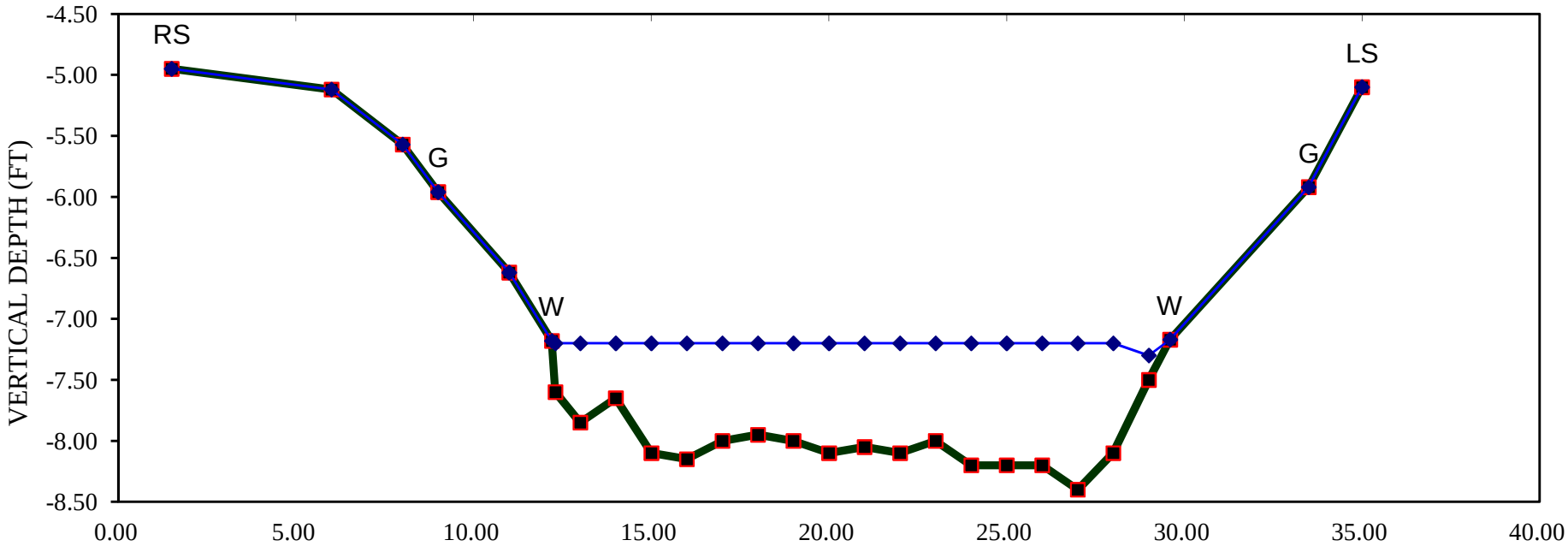
RECOMMENDATION BY: ………………….. AGENCY.. DATE:................................

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

Home Print

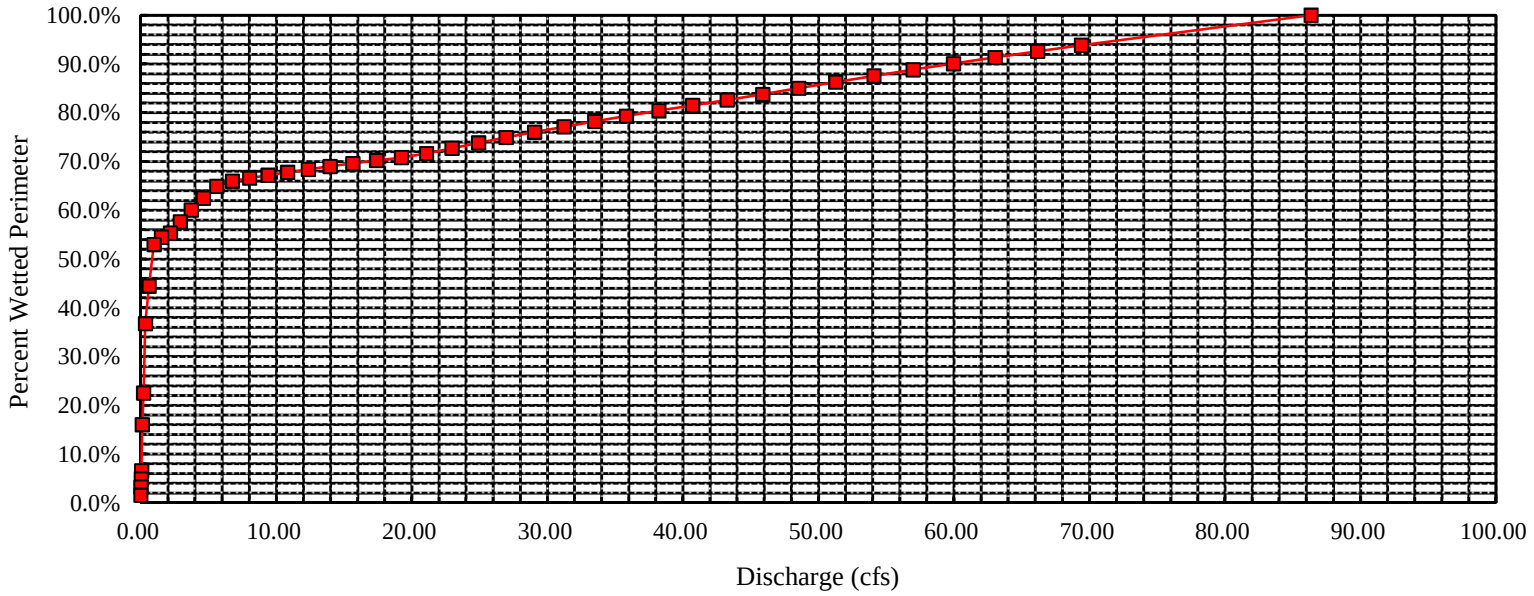
Hubbard Creek

CROSS SECTION DATA ANALYSIS



Home Print

Percent Wetted Perimeter vs. Discharge



COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Hubbard Creek						CROSS-SECTION NO.:	
CROSS-SECTION LOCATION: Approx 1.5 miles upstream from confluence w/ N. Fk. Gunnison							
DATE: 9-27-07	OBSERVERS: R. Smith, D. Murphy						
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 2	TOWNSHIP: 13 N(S)	RANGE: 91 E(W)	PM: 6th		
COUNTY: Delta	WATERSHED: N. Fk Gunn.	WATER DIVISION: 4	DOW WATER CODE: 40751				
MAP(S): USGS: Bowie 7.5'	GPS 0281646						
USFS:	4313568						

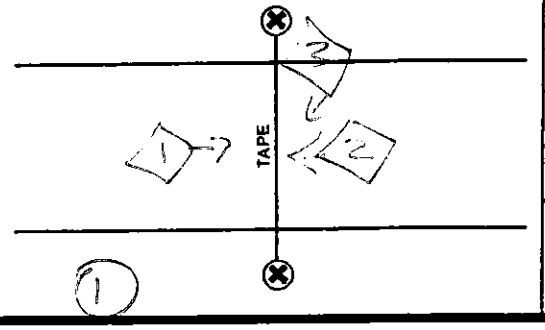
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE: Marsh-McBirney			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 4" cobbles to 2 foot		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	7.17/7.18
(2) WS Upstream	5.0	6.80
(3) WS Downstream	15.0	7.34
SLOPE	0.54/30.0 = 0.018	

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
see attached survey																	

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

COMMENTS

TDS = 110
Ph = 8.2
Temp: 60°F

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Hubbard Creek	CROSS-SECTION NO.: 1	DATE: 9-27-07	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 12:30

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	1.5		4.95								
	6.0		5.12								
	8.0		5.57								
G	9.0		5.96								
	11.0		6.62								
W	12.2		7.18								
	12.3		7.60	0.4				.88			
	13.0		7.85	0.65				1.55			
	14.0		7.65	0.45				1.32			
	15.0		8.10	0.9				1.18			
	16.0		8.15	0.95				0.71			
	17.0		8.00	0.8				0.67			
	18.0		7.95	0.75				3.04			
	19.0		8.00	0.80				1.16			
	20.0		8.10	0.90				1.87			
	21.0		8.05	0.95				3.31			
	22.0		8.10	0.90				2.69			
	23.0		8.00	0.80				1.80			
	24.0		8.20	1.00				1.16			
	25.0		8.20	1.00				0.89			
	26.0		8.20	1.00				0.62			
	27.0		8.40	1.20				0.71			
	28.0		8.10	0.90				0.23			
	29.0		7.50	0.20				0.01			
W	29.6		7.17								
G	33.5		5.92								
LS	35.0		5.10								
TOTALS:											

End of Measurement	Time: 12:50	Gage Reading: _____ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY: