Stream: Big Beaver Creek

Executive Summary

Water Division: 6
Water District: 43
CDOW#: 24935
CWCB ID: 10/6/A-002

Segment: Confluence with Allen Creek to Confluence with East Beaver Creek

Upper Terminus: CONFLUNCE WITH ALLEN CREEK
(Latitude 40° 04' 37.59"N) (Longitude 107° 36' 32.86"W)

Lower Terminus: CONFLUENCE WITH EAST BEAVER CREEK
(Latitude 40° 02' 5.77"N) (Longitude 107° 38' 40.56"W)

Watershed: Upper White (HUC#: 14050005)
Counties: Rio Blanco
Length: 3.94 miles
USGS Quad(s): Sawmill Mountain, Fawn Creek
Existing ISF: 5-03CW276, 2.9 cfs (April 1 – July 14), 1.0 cfs (July 15 – March 31)
Flow Recommendation (increase): 2.1 cfs (April 1 – June 30)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated instream flow file folder forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) recommended this segment of Big Beaver Creek to the CWCB for an increased water right under the Instream Flow Program. Big Beaver Creek is being considered for an increase because it has a natural environment that can be preserved to a reasonable degree with an increased instream flow water right.

Big Beaver Creek is approximately 12 miles long. It begins in the White River National Forest at an elevation of 9,680 feet and terminates at the confluence with the White River at an elevation of 6,985 feet. Approximately 85% of the land on the 3.94 mile segment addressed by this report is publicly owned. The total drainage area of the creek is approximately 19.8 square miles. Big Beaver Creek is located within Rio Blanco County and generally flows in a southwesterly direction.

The subject of this report is a segment of Big Beaver Creek beginning at the confluence with the Allen Creek downstream to the confluence with East Beaver Creek. The proposed segment is located approximately 16 miles southeast of Meeker. Staff has received only one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Justification for Instream Flow Increase

This segment contains a population of native Colorado River Cutthroat Trout. BLM believes that all streams providing habitat for Colorado River Cutthroat Trout merit full protection under the CWCB instream flow program. From the BLM perspective, full protection means protecting flow rates that meet all three instream flow criteria whenever sufficient water is available in the stream system. The BLM is investigating whether the Big Beaver Creek population should be identified as a core conservation population. BLM and CDOW also have plans to investigate barriers along the creek, and if necessary, construct barriers to prevent non-native fish passage from Lake Avery up into this stream reach. BLM believes that all feasible opportunities to manage viable Colorado River Cutthroat Trout populations should be supported by instream flow water rights, because such actions help make formal listing of the species under the Endangered Species Act unnecessary.

Instream Flow Recommendation

The BLM recommended an increase of 2.1 cfs (April 1 to June 30), based on its data collection efforts. The modeling results from this survey effort are within the confidence interval produced by the R2Cross model.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence. w/ Allen Creek	Confluence w/ East Beaver Creek	3.94	15%	85%

67% of the public lands are managed by the BLM and the remaining 18% are managed by the U.S. Forest Service.

Biological Data

Big Beaver Creek is a high gradient stream with moderate to large substrate size, with boulders commonly found in the stream channel. Most of the creek is confined by a narrow valley. The riparian community is diverse, vigorous, and provides substantial shading for the creek. Riparian species include cottonwood, alder, birch, willow, and spruce.

The creek provides a good mixture of runs, riffles, and pools for fish habitat. Aquatic insects are diverse and abundant, and include mayfly, caddisfly, and stonefly species. Fishery surveys confirmed that the population of Colorado River Cutthroat Trout and mottled sculpin survived the drought year of 2002-2003 and continue to thrive. BLM is in the process of testing the fish population for genetic purity

Field Survey Data

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Biological Flow Recommendation

The CWCB staff relied upon the biological expertise of the cooperating agencies to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. The CDOW has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, two data sets were collected with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon 2 of 3 hydraulic criteria. It is believed that recommendations that fall outside of the accuracy range of the model, over 250% of the measured discharge or under 40% of the measured discharge may not give an accurate estimate of the necessary instream flow required.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	7/14/2008	5.27	13.2 – 2.1	5.83	2.92
BLM	7/14/2008	5.06	12.6 – 2.0	4.44	2.64

The summer flow, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 5.0 cfs. This recommendation was derived by averaging the results of the two data sets. The recommended flow of 2.1 cfs, when added to the existing flow of 2.9 cfs is equal to 5.0 cfs.

Hydrologic Data and Analysis

After receiving the cooperating agency's biologic recommendation, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation. This evaluation was done through a computation that is, in essence, a "water balance". In concept a "water balance" computation can be viewed as an accounting exercise. When done in its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), the balance tries to account for all water depletions (losses) until a selected end point is reached. Water losses include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. These losses are individually or collectively subtracted from the input to reveal the net amount of stream runoff as represented by the discharge measured by stream gages. Of course, the measured stream flow need not be the end point of interest; indeed, when looking at issues of water use to extinction stream flow measurements may only describe intermediate steps in the complex accounting process that is a water balance carried out to a net value of zero.

In its analysis, CWCB staff has attempted to use this idea of balancing inputs and losses to determine if water is available for the recommended Instream Flow Appropriation. Of course, this analysis must be a practical exercise rather than a lengthy, and costly, scientific investigation. As a result, staff has simplified the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The process may be described through the following description of the steps used to complete the evaluation for this particular stream.

The first step required in determining water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case this means

looking at the data from a gage at the LT. Further, this data, in the best case, has been collected for a long period of time (the longer the better) including wet and dry periods. In the case of **Big Beaver Creek** no such gage is available at the LT. In fact, there is no gage on Big Beaver Creek. It is thus necessary to describe the normal flow regime at Big Beaver Creek above the LT through a "representative" gage station. The gage station selected for this purpose was LOST CREEK NEAR BUFORD, CO. (USGS 09302450), a gage with a 25 year period of record (POR) collected between 1964 and 1989. The gage is at an elevation of 7,560 ft above mean sea level (amsl) and has a drainage area of 21.5 mi^2. In this instance, due to the absence of existing significant upstream consumptive irrigation uses or transbasin diversions, the hydrograph (plot of discharge over time) produced from this gage was not "adjusted". To make the measured data from Lost Creek transferrable to Big Beaver Creek above the LT, all that was required was multiplication of the measured hydrograph by an area ratio; specifically, the area of Big Beaver Creek above the LT (19.8 mi^2 above the LT) to Lost Creek near Buford, CO (21.5 mi^2 above the gage). Unlike the situation in Lost Creek, there were several diversions in the watershed above Big Beaver Creek above the LT. Consequently, the resulting proportioned hydrograph had to be "adjusted" (decreased) to reflect existing consumptive irrigation depletions on Big Beaver Creek. The final hydrograph thus represents a distribution of flow over time that has been reduced to reflect existing human uses.

{The Following discussion is based upon the US Geological Survey's *Techniques of Water-Resources Investigations* Series, *Book 4: Hydrologic Analysis and Interpretation, Chapter A3: Statistical Methods in Water Resources* (Chapter 3: Describing Uncertainty) by D.R. Helsel and R. M. Hirsch. This technical reference provides the scientific background and guidance important to the systematic interpretation of hydrologic data. The document is available online and is a valuable aid to understanding and interpreting the analyses described here.}

The next step in producing a representation of the discharge at Big Beaver Creek above the LT was to compute the Geometric Mean of the area-prorated data values from the Lost Creek near Buford, CO Hydrograph. This step is of value because of the inherent statistical weaknesses found in any collection of data intended to measure natural stream discharge. Without getting into the details of statistical theory, it is worth noting that a set of discharge measurements is inherently inaccurate, no matter how well collected, due to the difficulties attendant to data collection, especially hydrologic data. To give deference to this fact and to increase the value of the hydrograph product of this analysis, the Geometric Means of the data were computed and plotted along with the 95% Confidence Intervals about the data. The resultant hydrograph, including recommended Instream Flow values, is displayed in Figure 1 with the data displayed in Table 2.

Figure 1

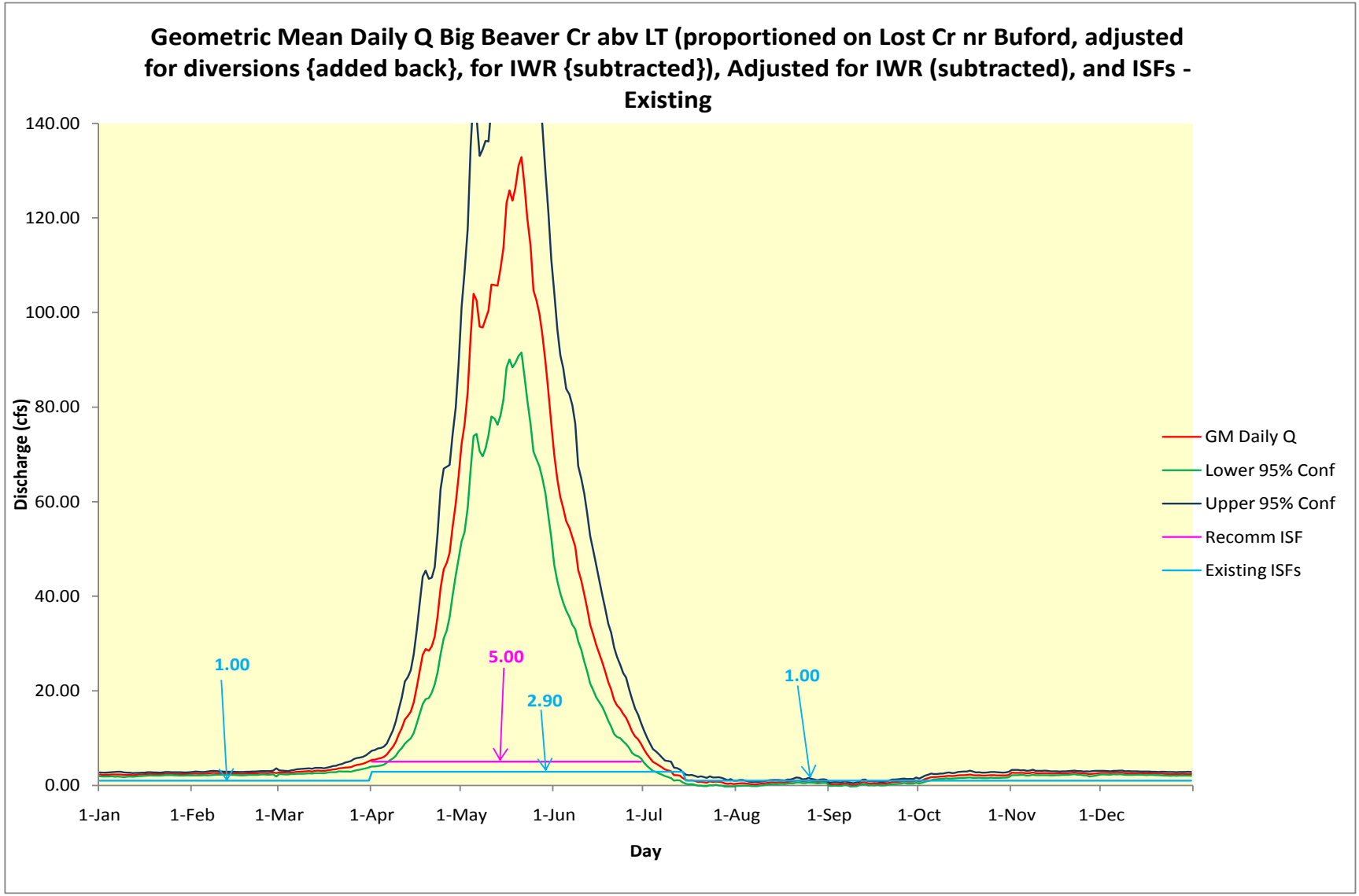

Geometric Mean Daily Q Big Beaver Cr abv LT (proportioned on Lost Cr nr Buford, adjusted for diversions {added back}, for IWR {subtracted}), Adjusted for IWR (subtracted), and ISFs - Existing
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Discharge (cfs)
1.00
5.00
2.90
1.00
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Day
GM Daily Q
Lower 95% Conf
Upper 95% Conf
Recomm ISF
Existing ISFs

Table 2. Geometric Mean Discharge and Recommended Instream Flows

Date	Existing ISF	Recommended ISF	Proportioned Adjusted GM (abv gage) Adj (-) for Irr & OoB in Big Beaver Cr abv LT
1-Jan	1		2.30
2-Jan	1		2.23
3-Jan	1		2.24
4-Jan	1		2.27
5-Jan	1		2.31
6-Jan	1		2.28
7-Jan	1		2.32
8-Jan	1		2.30
9-Jan	1		2.19
10-Jan	1		2.22
11-Jan	1		2.25
12-Jan	1		2.18
13-Jan	1		2.21
14-Jan	1		2.28
15-Jan	1		2.31
16-Jan	1		2.34
17-Jan	1		2.42
18-Jan	1		2.43
19-Jan	1		2.37
20-Jan	1		2.39
21-Jan	1		2.37
22-Jan	1		2.41
23-Jan	1		2.47
24-Jan	1		2.46
25-Jan	1		2.45
26-Jan	1		2.41
27-Jan	1		2.42
28-Jan	1		2.40
29-Jan	1		2.39
30-Jan	1		2.40
31-Jan	1		2.43
1-Feb	1		2.45
2-Feb	1		2.49
3-Feb	1		2.47
4-Feb	1		2.46
5-Feb	1		2.47
6-Feb	1		2.48
7-Feb	1		2.57
8-Feb	1		2.62
9-Feb	1		2.62
10-Feb	1		2.58
11-Feb	1		2.57
12-Feb	1		2.55
13-Feb	1		2.52

14-Feb	1		2.53
15-Feb	1		2.51
16-Feb	1		2.48
17-Feb	1		2.46
18-Feb	1		2.46
19-Feb	1		2.51
20-Feb	1		2.52
21-Feb	1		2.56
22-Feb	1		2.56
23-Feb	1		2.57
24-Feb	1		2.63
25-Feb	1		2.64
26-Feb	1		2.62
27-Feb	1		2.62
28-Feb	1		2.73
29-Feb	1		2.61
1-Mar	1		2.76
2-Mar	1		2.72
3-Mar	1		2.67
4-Mar	1		2.64
5-Mar	1		2.74
6-Mar	1		2.79
7-Mar	1		2.89
8-Mar	1		2.91
9-Mar	1		2.94
10-Mar	1		2.98
11-Mar	1		3.03
12-Mar	1		2.96
13-Mar	1		3.09
14-Mar	1		3.11
15-Mar	1		3.08
16-Mar	1		3.04
17-Mar	1		3.18
18-Mar	1		3.29
19-Mar	1		3.38
20-Mar	1		3.40
21-Mar	1		3.63
22-Mar	1		3.65
23-Mar	1		3.78
24-Mar	1		3.82
25-Mar	1		3.85
26-Mar	1		4.16
27-Mar	1		4.32
28-Mar	1		4.43
29-Mar	1		4.58
30-Mar	1		4.80
31-Mar	1		5.10
1-Apr	2.9	5.00	5.41
2-Apr	2.9	5.00	5.46

3-Apr	2.9	5.00	5.66
4-Apr	2.9	5.00	5.77
5-Apr	2.9	5.00	6.00
6-Apr	2.9	5.00	6.52
7-Apr	2.9	5.00	7.34
8-Apr	2.9	5.00	8.15
9-Apr	2.9	5.00	9.24
10-Apr	2.9	5.00	10.82
11-Apr	2.9	5.00	12.09
12-Apr	2.9	5.00	13.98
13-Apr	2.9	5.00	14.70
14-Apr	2.9	5.00	15.58
15-Apr	2.9	5.00	17.53
16-Apr	2.9	5.00	20.87
17-Apr	2.9	5.00	24.32
18-Apr	2.9	5.00	27.63
19-Apr	2.9	5.00	28.86
20-Apr	2.9	5.00	28.46
21-Apr	2.9	5.00	29.41
22-Apr	2.9	5.00	31.45
23-Apr	2.9	5.00	35.84
24-Apr	2.9	5.00	41.75
25-Apr	2.9	5.00	45.70
26-Apr	2.9	5.00	47.01
27-Apr	2.9	5.00	49.18
28-Apr	2.9	5.00	54.55
29-Apr	2.9	5.00	59.62
30-Apr	2.9	5.00	65.56
1-May	2.9	5.00	72.27
2-May	2.9	5.00	76.28
3-May	2.9	5.00	83.18
4-May	2.9	5.00	95.04
5-May	2.9	5.00	103.98
6-May	2.9	5.00	102.60
7-May	2.9	5.00	97.00
8-May	2.9	5.00	96.79
9-May	2.9	5.00	98.61
10-May	2.9	5.00	100.47
11-May	2.9	5.00	105.91
12-May	2.9	5.00	105.80
13-May	2.9	5.00	105.67
14-May	2.9	5.00	109.26
15-May	2.9	5.00	113.54
16-May	2.9	5.00	123.21
17-May	2.9	5.00	125.82
18-May	2.9	5.00	123.65
19-May	2.9	5.00	126.35
20-May	2.9	5.00	131.03
21-May	2.9	5.00	132.88

22-May	2.9	5.00	127.01
23-May	2.9	5.00	119.81
24-May	2.9	5.00	114.15
25-May	2.9	5.00	104.70
26-May	2.9	5.00	102.61
27-May	2.9	5.00	99.87
28-May	2.9	5.00	95.53
29-May	2.9	5.00	89.63
30-May	2.9	5.00	83.27
31-May	2.9	5.00	76.42
1-Jun	2.9	5.00	69.93
2-Jun	2.9	5.00	64.64
3-Jun	2.9	5.00	60.95
4-Jun	2.9	5.00	58.58
5-Jun	2.9	5.00	55.88
6-Jun	2.9	5.00	54.48
7-Jun	2.9	5.00	52.47
8-Jun	2.9	5.00	50.49
9-Jun	2.9	5.00	45.56
10-Jun	2.9	5.00	43.24
11-Jun	2.9	5.00	40.36
12-Jun	2.9	5.00	37.42
13-Jun	2.9	5.00	33.98
14-Jun	2.9	5.00	31.98
15-Jun	2.9	5.00	29.65
16-Jun	2.9	5.00	27.88
17-Jun	2.9	5.00	26.16
18-Jun	2.9	5.00	24.17
19-Jun	2.9	5.00	21.84
20-Jun	2.9	5.00	20.24
21-Jun	2.9	5.00	18.07
22-Jun	2.9	5.00	16.92
23-Jun	2.9	5.00	16.19
24-Jun	2.9	5.00	15.10
25-Jun	2.9	5.00	14.32
26-Jun	2.9	5.00	12.93
27-Jun	2.9	5.00	11.45
28-Jun	2.9	5.00	10.33
29-Jun	2.9	5.00	9.74
30-Jun	2.9	5.00	8.80
1-Jul	2.9		7.61
2-Jul	2.9		6.57
3-Jul	2.9		5.73
4-Jul	2.9		4.97
5-Jul	2.9		4.65
6-Jul	2.9		4.20
7-Jul	2.9		3.78
8-Jul	2.9		3.36
9-Jul	2.9		3.19

10-Jul	2.9	2.97
11-Jul	2.9	2.16
12-Jul	2.9	2.18
13-Jul	2.9	2.05
14-Jul	2.9	1.54
15-Jul	1	1.15
16-Jul	1	1.05
17-Jul	1	1.09
18-Jul	1	0.94
19-Jul	1	0.72
20-Jul	1	0.76
21-Jul	1	0.66
22-Jul	1	0.59
23-Jul	1	0.85
24-Jul	1	0.73
25-Jul	1	0.79
26-Jul	1	0.75
27-Jul	1	0.65
28-Jul	1	0.44
29-Jul	1	0.33
30-Jul	1	0.40
31-Jul	1	0.25
1-Aug	1	0.38
2-Aug	1	0.44
3-Aug	1	0.47
4-Aug	1	0.42
5-Aug	1	0.32
6-Aug	1	0.22
7-Aug	1	0.25
8-Aug	1	0.22
9-Aug	1	0.36
10-Aug	1	0.40
11-Aug	1	0.51
12-Aug	1	0.63
13-Aug	1	0.66
14-Aug	1	0.63
15-Aug	1	0.66
16-Aug	1	0.66
17-Aug	1	0.63
18-Aug	1	0.76
19-Aug	1	0.78
20-Aug	1	0.87
21-Aug	1	1.07
22-Aug	1	1.03
23-Aug	1	0.84
24-Aug	1	0.84
25-Aug	1	1.03
26-Aug	1	0.94
27-Aug	1	0.86

28-Aug	1	0.75
29-Aug	1	0.83
30-Aug	1	0.86
31-Aug	1	0.82
1-Sep	1	0.20
2-Sep	1	0.25
3-Sep	1	0.28
4-Sep	1	0.23
5-Sep	1	0.23
6-Sep	1	0.45
7-Sep	1	0.36
8-Sep	1	0.11
9-Sep	1	0.09
10-Sep	1	0.14
11-Sep	1	0.36
12-Sep	1	0.64
13-Sep	1	0.68
14-Sep	1	0.38
15-Sep	1	0.42
16-Sep	1	0.37
17-Sep	1	0.43
18-Sep	1	0.32
19-Sep	1	0.35
20-Sep	1	0.39
21-Sep	1	0.57
22-Sep	1	0.71
23-Sep	1	0.70
24-Sep	1	0.76
25-Sep	1	0.83
26-Sep	1	0.92
27-Sep	1	0.79
28-Sep	1	0.81
29-Sep	1	0.80
30-Sep	1	1.05
1-Oct	1	0.82
2-Oct	1	1.07
3-Oct	1	1.33
4-Oct	1	1.51
5-Oct	1	1.73
6-Oct	1	1.78
7-Oct	1	1.79
8-Oct	1	1.89
9-Oct	1	1.89
10-Oct	1	1.99
11-Oct	1	2.01
12-Oct	1	1.94
13-Oct	1	2.00
14-Oct	1	2.12
15-Oct	1	2.14

16-Oct	1	2.18
17-Oct	1	2.21
18-Oct	1	2.32
19-Oct	1	2.16
20-Oct	1	2.10
21-Oct	1	2.15
22-Oct	1	2.06
23-Oct	1	2.05
24-Oct	1	2.09
25-Oct	1	2.16
26-Oct	1	2.15
27-Oct	1	2.10
28-Oct	1	2.10
29-Oct	1	2.09
30-Oct	1	2.13
31-Oct	1	2.22
1-Nov	1	2.67
2-Nov	1	2.66
3-Nov	1	2.65
4-Nov	1	2.65
5-Nov	1	2.66
6-Nov	1	2.52
7-Nov	1	2.58
8-Nov	1	2.73
9-Nov	1	2.58
10-Nov	1	2.56
11-Nov	1	2.59
12-Nov	1	2.59
13-Nov	1	2.58
14-Nov	1	2.52
15-Nov	1	2.51
16-Nov	1	2.56
17-Nov	1	2.53
18-Nov	1	2.57
19-Nov	1	2.57
20-Nov	1	2.59
21-Nov	1	2.66
22-Nov	1	2.72
23-Nov	1	2.61
24-Nov	1	2.58
25-Nov	1	2.50
26-Nov	1	2.50
27-Nov	1	2.33
28-Nov	1	2.44
29-Nov	1	2.52
30-Nov	1	2.60
1-Dec	1	2.66
2-Dec	1	2.66
3-Dec	1	2.63

4-Dec	1	2.60
5-Dec	1	2.69
6-Dec	1	2.65
7-Dec	1	2.70
8-Dec	1	2.68
9-Dec	1	2.57
10-Dec	1	2.58
11-Dec	1	2.58
12-Dec	1	2.57
13-Dec	1	2.58
14-Dec	1	2.57
15-Dec	1	2.54
16-Dec	1	2.51
17-Dec	1	2.53
18-Dec	1	2.51
19-Dec	1	2.49
20-Dec	1	2.46
21-Dec	1	2.48
22-Dec	1	2.44
23-Dec	1	2.41
24-Dec	1	2.38
25-Dec	1	2.40
26-Dec	1	2.38
27-Dec	1	2.41
28-Dec	1	2.43
29-Dec	1	2.41
30-Dec	1	2.42
31-Dec	1	2.39

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are no decreed surface diversions within this reach of stream. Staff has determined that water is available for an increase appropriation on Big Beaver Creek, between the confluence with the Allen Creek to the confluence with East Beaver Creek, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

Staff recommends the Board form its intent to appropriate on the following stream reach:

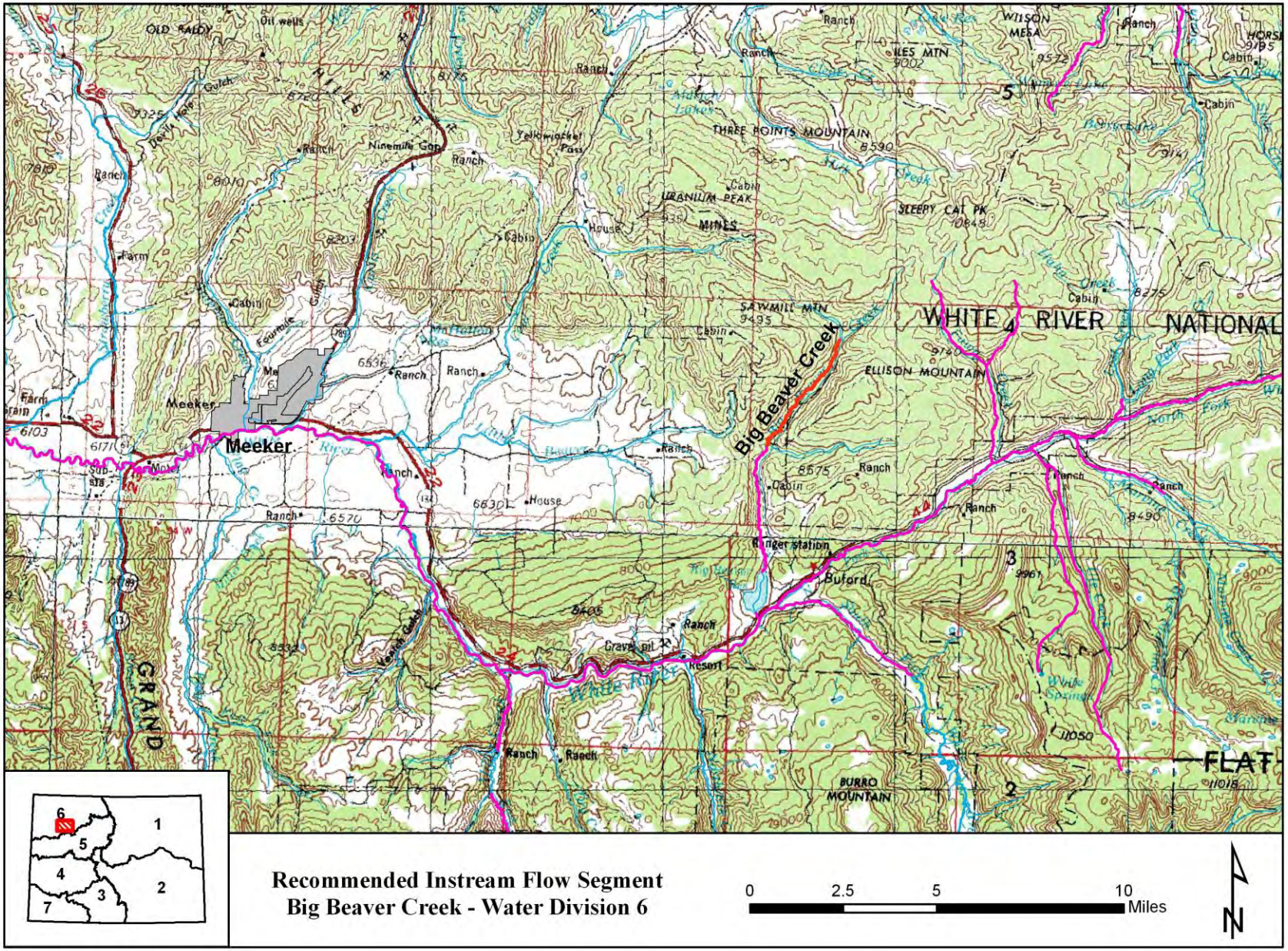
Segment: Confluence with Allen Creek to Confluence with East Beaver Creek

Upper Terminus: CONFLUNCE WITH ALLEN CREEK
(Latitude 40° 04' 37.59"N) (Longitude 107° 36' 32.86"W)
UTM North: 4439578.05 UTM East: 277522.96
SE SW S4 T1N R91W 6th PM
1500' East of the West Section Line; 73' North of the South Section Line

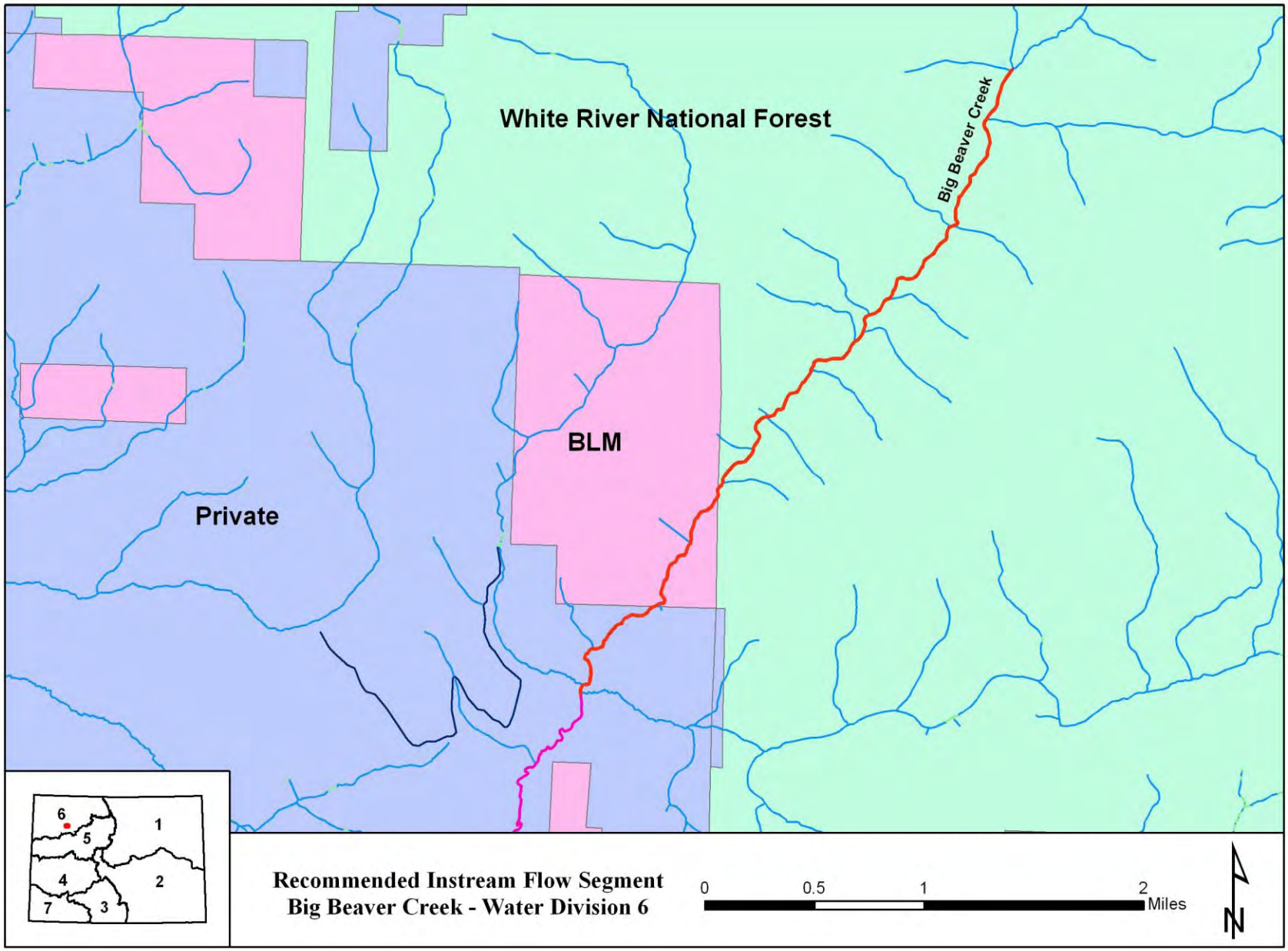
Lower Terminus: CONFLUENCE WITH EAST BEAVER CREEK
(Latitude 40° 02' 5.77"N) (Longitude 107° 38' 40.56"W)
UTM North: 4434985.96 UTM East: 274358.94
SE SW S19 T1N R91W 6th PM
1760' East of the West Section Line; 570' North of the South Section Line

Watershed: Upper White (HUC#: 14050005)
Counties: Rio Blanco
Length: 3.94 miles
USGS Quad(s): Sawmill Mountain, Fawn Creek
Existing ISF: 5-03CW276, 2.9 cfs (April 1 – July 14), 1.0 cfs (July 15 – March 31)
Flow Recommendation (increase): 2.1 cfs (April 1 – June 30)

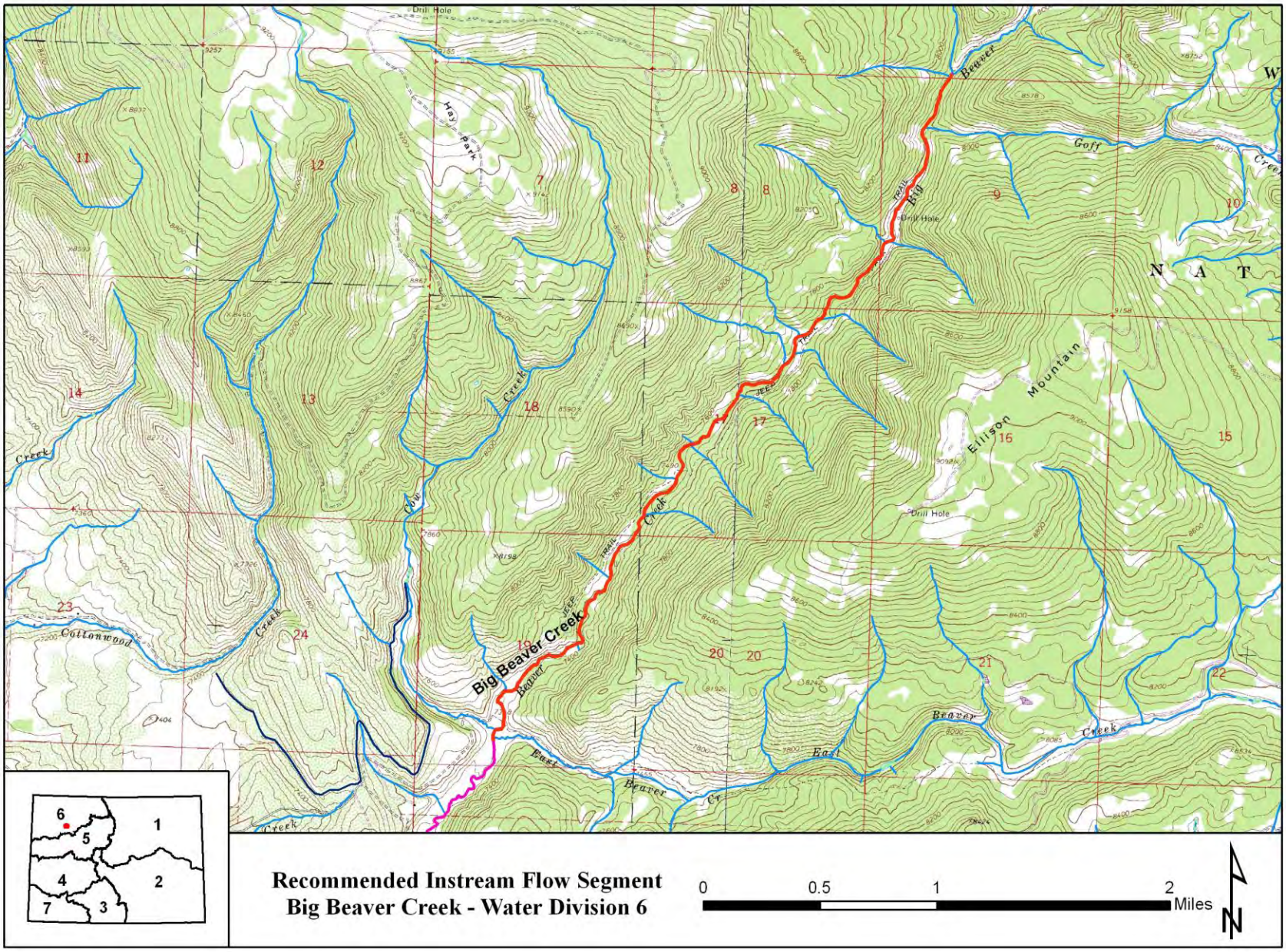
Vicinity Map



Land Use Map


White River National Forest
Big Beaver Creek
BLM
Private
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Big Beaver Creek - Water Division 6
0
0.5
1
2
Miles
N

Topographic & Water Rights Map



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

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 an instream flow enlargement on Big Beaver Creek, located in Water Division 6. In 2002, the BLM forwarded an initial instream flow recommendation on this stream to protect Colorado River Cutthroat Trout. In 2003, the board appropriated a water right for 2.9 cfs (April 1 to July 14) and 1.0 cfs (July 15 – March 31) based upon that recommendation. At the time of the earlier recommendation, the BLM possessed insufficient data to make a summer flow recommendation based on meeting all three of the Colorado Water Conservation Board (CWCB)'s instream flow criteria, and instead submitted a recommendation based upon meeting two of three criteria. Since that time, the BLM has collected additional data on the creek that will allow us to make a recommendation based upon three of three criteria.

Location and Land Status: Big Beaver Creek is a tributary to the White River approximately 16 miles southeast of Meeker. The stream reach covered by this recommendation runs from the confluence with Allen Creek to the confluence with East Beaver Creek. Eighty-five percent of the 3.1 mile reach is located on public lands, while the remaining 15 percent is located on private lands.

Biological Summary: Big Beaver Creek is a high gradient stream with moderate to large substrate size, with boulders commonly found in the stream channel. Most of the creek is confined by a narrow valley. The riparian community is diverse, vigorous, and provides substantial shading for the creek. Riparian species include cottonwood, alder, birch, willow, and spruce.

The creek provides a good mixture of runs, riffles, and pools for fish habitat. Aquatic insects are diverse and abundant, and include mayfly, caddisfly, and stonefly species. Fishery surveys confirmed that the population of Colorado River Cutthroat Trout and mottled sculpin survived the drought year of 2002-2003 and continue to thrive. The BLM is in the process of testing the fish population for genetic purity.

R2Cross Analysis: The BLM collected the following R2Cross data from the creek.

Party	Date	Discharge	250%-40%	Summer (3/3)	Winter (2/3)
BLM	07/14/2008	5.27	2.1-13.2	5.83	2.92
BLM	07/14/2008	5.06	2.0-12.6	4.44	2.64

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

> An enlargement of 2.1 cfs is recommended for the snowmelt runoff period, from April 1 through June 30. This recommendation is driven by the average depth and average velocity criteria. The large channel substrate and narrow valley tends to concentrate flow in a few usable channels between rocks, so this flow rate is necessary to make more of the channel usable by salmonids. If this recommendation is implemented, the total instream flow water right on the creek during the snowmelt runoff period will be 5.0 cfs.

Justification for insteam flow enlargement: The BLM believes that all streams providing habitat for Colorado River Cutthroat Trout merit full protection under the CWCB instream flow program. From the BLM perspective, full protection means protecting flow rates that meet all three instream flow criteria whenever sufficient water is available in the stream system. The BLM is investigating whether the Big Beaver Creek population should be identified as a core conservation population. The BLM and CDOW also have plans to investigate barriers along the creek, and if necessary, construct barriers to prevent non-native fish passage from Lake Avery up into this stream reach. The BLM believes that all feasible opportunities to manage viable Colorado River Cutthroat Trout populations should be supported by instream flow water rights, because such actions help make formal listing of the species under the Endangered Species Act unnecessary.

Water Availability: The BLM is not aware of any water rights within the proposed reach.

There are no historic gage records available for Big Beaver Creek. The BLM recommends conducting a paired basin analysis using data from South Fork Williams Fork gage near Pagoda, CO (USGS 09249200). The South Fork of the Williams Fork drains the opposite side of Sleepy Cat Peak, so the South Fork basin experiences very similar weather and temperature patterns to Big Beaver Creek.

Relationship to Management Plans: The White River Resource Management Plan identifies Big Beaver Creek as one of the few Colorado River Cutthroat Trout fisheries managed by the BLM in this field office. BLM monitoring has established that current livestock grazing practices remain compatible with the maintenance of proper functioning conditions, and has implemented cooperative efforts with the U.S. Forest Service and CDOW to further study the

fish population and watershed conditions in this creek. If this population turns out to have genetic purity, the BLM may implement more intensive management actions to expand and protect the fish population.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with the BLM's draft recommendation in February 2009. We thank both the Division of Wildlife and the 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,

Linda Anañia

Linda Anañia,
Deputy State Director, Natural Resources and Fire

cc: Kent Walter, White River FO
Ed Hollowed, White River FO
Bob Lange, White River FO

DRAFT INSTREAM FLOW RECOMMENDATION

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

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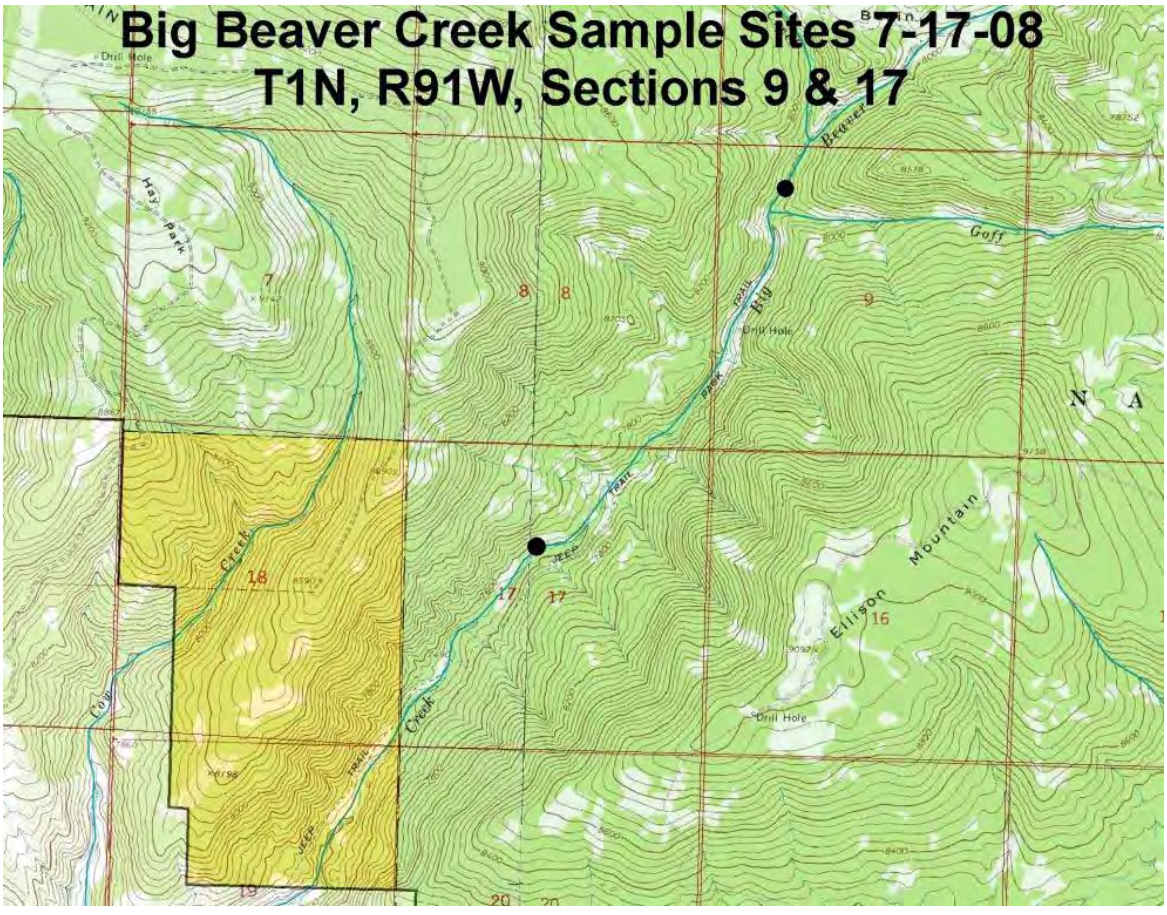
Sincerely,

Linda Anania
Deputy State Director
Resources and Fire

cc: Kent Walter, White River FO
Ed Hollowed, White River FO
Bob Lange, White River FO

White River Field Office Stream Surveys
July 2008
Big Beaver Creek - Water Code #24935

Big Beaver Creek, located northeast of Meeker, Colorado on USFS lands managed by the White River National Forest was sampled on July 17, 2008. Big Beaver Creek is tributary to Lake Avery and then the North Fork White River. Work was done cooperatively with the USFS, and CDOW and the plan was to sample a lower BLM segment but we miscalculated where we were and failed to sample a BLM reach. We sampled two 300 foot reaches and completed a two pass removal population estimate at each site. In addition, fin clips were obtained from 30 adult cutthroats at each site for genetic analysis. Sampling was conducted via backpack electro-shocker. Personnel present were Greg Glasgow, USFS Fish Biologist, Tom Fresques, BLM Fish Biologist, Gregor Dekleva, Bio Tech, Alex Griffith, Bio Tech, and CDOW Technicians, Brandon and Sam.



Big Beaver Creek

Working up fish

Colorado River cutthroat trout *(Oncorhynchus clarki pleuriticus)*

Mottled sculpin

Discussion:
Riparian condition was good and vegetation along the creek consisted of cottonwood, alder, birch, willow, horsetail, current, sedges, spruce, and aspen. Fish habitat was good with a good mix of runs, riffles, and pools. Fish appeared healthy and aquatic insects were diverse and abundant with caddis, mayflies, and stoneflies present. Within the sample stations, Colorado River cutthroat trout and mottled sculpin were the only species collected. One rainbow trout was caught via hook and line by Sam, CDOW Technician approximately 75 feet downstream of the upper sample station.

It is believed that some sort of barrier keeps the majority of fish from moving out of Lake Avery and up into Big Beaver Creek. This is important in that Lake Avery contains non-native rainbow trout that can hybridize with the pure native cutthroat found in the creek. However, based on the capture of an obvious rainbow trout in the upper reaches of the creek, the barrier may not be entirely effective at all flows. It may be that due to the exceptionally high flows this past spring, some non-native fish were able to move upstream.

Recommendations:

- Hike the BLM reach and look for barriers. Work with CDOW and private land owners between the BLM reach and the Lake to locate barrier(s). Determine adequacy of barrier(s) once located and work cooperatively to improve them as needed

- May want to get some fin clips from lower down in the stream on BLM and/or private lands above the lake

- Pursue instream flow recommendations for this creek in cooperation with the USFS

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Big Beaver Creek | CROSS-SECTION NO.: 1

CROSS-SECTION LOCATION: At Blk. private boundary

DATE: 7/14 | OBSERVERS: Bob LANGE, Roy SMITH

LEGAL DESCRIPTION | ¼ SECTION: NE | SECTION: 19 | TOWNSHIP: 1 (N)/S | RANGE: 9 E/(W) | PM: 6th

COUNTY: Rio Blanco | WATERSHED: White R. | WATER DIVISION: 6 | DOW WATER CODE: 34735

MAP(S): USGS: Zone 13 0274755

USFS: 7,384 ft. 4435364

SUPPLEMENTAL DATA

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

METER NUMBER: | DATE RATED: | CALIB/SPIN: _____ sec | TAPE WEIGHT: _____ lbs/foot | TAPE TENSION: _____ lbs

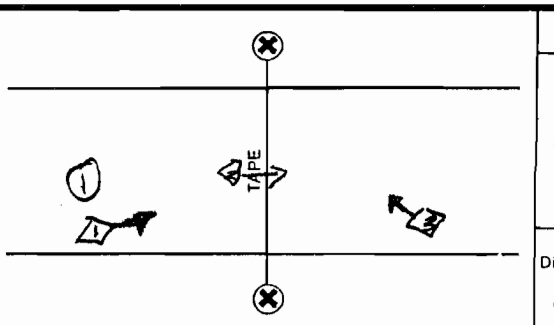
CHANNEL BED MATERIAL SIZE RANGE: 4" Cobbles to 2' boulders.

PHOTOGRAPHS TAKEN: (YES)/NO 3 | NUMBER OF PHOTOGRAPHS:

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	3.33/3.33
② WS Upstream	10.0	3.57
③ WS Downstream	14.0	3.08
SLOPE	0.49/24.0 = .0204	

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:

Caddis Fly, May Fly, Stone Fly, Nematodes

COMMENTS

TDS: 390 Ph= 8.5 Temp= 14° C

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Big Beaver Creek	CROSS-SECTION NO.: 1	DATE: 7-11-08	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 1:25 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)G	1.0		2.54								
W	5.5		3.33								
	6.0		3.58	0.25					0.89		
	7.0		3.60	0.3					0.61		
	8.0		3.31	0					Ø		
	9.0		3.45	0.15					0.35		
	10.0		3.75	0.40					1.14		
	11.0		3.70	0.35					1.57		
	12.0		3.55	0.20					2.07		
	13.0		3.50	0.15					0.94		
	14.0		3.60	0.30					0.76		
	15.0		3.60	0.30					0.98		
	16.0		3.90	0.30					Ø		
	17.0		3.90	0.30					0.65		
	18.0		3.60	0.30					0.07		
	19.0		3.60	0.30					0.97		
	20.0		3.60	0.30					0.89		
	21.0		3.70	0.35					1.36		
	22.0		3.75	0.45					1.00		
	23.0		3.70	0.40					0.14		
	24.0		3.70	0.60					1.53		
	25.0		3.58	0.25					0.66		
W	25.4		3.33								
R S+G	26.0		2.65								
TOTALS:											

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

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Big Beaver Creek	CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: At BLM private boundary	
DATE: 7-14-08	OBSERVERS: R. Smith, B. Lange
LEGAL DESCRIPTION	¼ SECTION: NE; SECTION: 19; TOWNSHIP: 1 N/S (N circled); RANGE: 91 E/W (W circled); PM: 6th
COUNTY: Rio Blanco	WATERSHED: White; WATER DIVISION: 6; DOW WATER CODE: 24935
MAP(S): USGS:	GPS Z13 0227874
USFS:	4435378

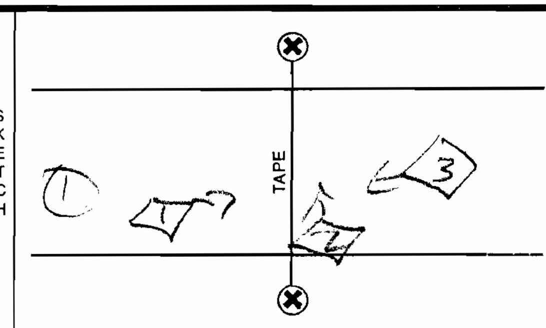
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES/NO (YES circled)	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: 4" cobble to 2' boulders	PHOTOGRAPHS TAKEN: YES/NO (YES circled)	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	3.78/3.71
(2) WS Upstream	11.0	3.39
(3) WS Downstream	11.0	3.91
SLOPE	0.52/22.0 .024	

SKETCH



LEGEND: Stake ⊗ Station (1) Photo ◇→

Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO (NO circled)	DISTANCE ELECTROFISHED: ______ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO (YES circled)

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:

caddisfly, mayfly, stonefly

COMMENTS

TDS = 390
Ph = 8.5
Temp 1[illegible] C

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Big Beaver Ck.	CROSS-SECTION NO.: 2	DATE: 7-24-08	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ft	TIME: 2:40 PM

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
G RS	1.0		2.89								
W	4.0		5.71	∅				∅			
	5.0		3.75	0.05				∅			
	6.0		3.4	0.10				1.11			
	7.0		3.8	0.10				0.20			
	8.0		3.9	0.20				0.97			
	9.0		4.05	0.35				0.41			
	9.5		4.15	0.45				0.97			
	10.0		4.15	0.45				1.84			
	10.5		4.1	0.40				0.92			
	11.0		4.1	0.40				0.99			
	11.5		4.15	0.40				1.25			
	12.0		4.1	0.40				2.50			
	12.5		4.2	0.50				1.54			
	13.0		4.05	0.30				∅			
	13.5		3.95	0.20				2.22			
	14.0		4.00	0.25				2.85			
	14.5		4.05	0.30				2.33			
	15.0		4.20	0.45				1.04			
	15.5		4.05	0.30				1.92			
	16.0		4.0	0.25				1.80			
	16.5		4.10	~~0.35~~ 0.50				0.50			
	17.0		3.90	0.10				0.23			
	18.0		3.85	0.10				1.28			
	19.0		4.00	0.25				1.95			
	20.0		4.05	0.30				0.16			
	21.0		3.90	0.15				0.26			
W (LB)	21.6		3.78	∅				∅			
G (RB)	24.0		2.87								
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:	Big Beaver Creek
XS LOCATION:	At BLM-private boundary
XS NUMBER:	1
DATE:	14-Jul-08
OBSERVERS:	R. Smith, B. Lange
1/4 SEC:	NE
SECTION:	19
TWP:	1N
RANGE:	91W
PM:	Sixth
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	24935
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:	0.0204

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

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

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
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	LS & G	1.00	2.54			0.00		0.00	0.00	0.0%
	W	5.50	3.33			0.00		0.00	0.00	0.0%
		6.00	3.58	0.25	0.89	0.56	0.25	0.19	0.17	3.2%
		7.00	3.60	0.30	0.61	1.00	0.30	0.30	0.18	3.5%
		8.00	3.31	0.00	0.00	1.04		0.00	0.00	0.0%
		9.00	3.45	0.15	0.35	1.01	0.15	0.15	0.05	1.0%
		10.00	3.75	0.40	1.14	1.04	0.40	0.40	0.46	8.6%
		11.00	3.70	0.35	1.57	1.00	0.35	0.35	0.55	10.4%
		12.00	3.55	0.20	2.07	1.01	0.20	0.20	0.41	7.8%
		13.00	3.50	0.15	0.94	1.00	0.15	0.15	0.14	2.7%
		14.00	3.60	0.30	0.76	1.00	0.30	0.30	0.23	4.3%
		15.00	3.65	0.30	0.98	1.00	0.30	0.30	0.29	5.6%
		16.00	3.55	0.30	0.00	1.00	0.30	0.30	0.00	0.0%
		17.00	3.60	0.30	0.65	1.00	0.30	0.30	0.20	3.7%
		18.00	3.60	0.30	0.07	1.00	0.30	0.30	0.02	0.4%
		19.00	3.60	0.30	0.97	1.00	0.30	0.30	0.29	5.5%
		20.00	3.60	0.30	0.89	1.00	0.30	0.30	0.27	5.1%
		21.00	3.70	0.35	1.36	1.00	0.35	0.35	0.48	9.0%
		22.00	3.75	0.45	1.00	1.00	0.45	0.45	0.45	8.5%
		23.00	3.70	0.40	0.14	1.00	0.40	0.40	0.06	1.1%
		24.00	3.90	0.60	1.53	1.02	0.60	0.60	0.92	17.4%
		25.00	3.58	0.25	0.66	1.05	0.25	0.18	0.12	2.2%
	W	25.40				3.60		0.00	0.00	0.0%
1	RS & G	26.00				0.00		0.00	0.00	0.0%
	TOTALS ----------					23.36	0.6 (Max.)	5.81	5.27	100.0%

Manning's n = 0.0925
Hydraulic Radius= 0.24882405

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	5.81	5.68	-2.2%
3.07	5.81	10.76	85.1%
3.09	5.81	10.34	77.9%
3.11	5.81	9.92	70.7%
3.13	5.81	9.51	63.6%
3.15	5.81	9.10	56.5%
3.17	5.81	8.68	49.4%
3.19	5.81	8.28	42.4%
3.21	5.81	7.87	35.4%
3.23	5.81	7.47	28.5%
3.25	5.81	7.07	21.6%
3.27	5.81	6.67	14.7%
3.28	5.81	6.47	11.3%
3.29	5.81	6.27	7.9%
3.30	5.81	6.07	4.5%
3.31	5.81	5.88	1.1%
3.32	5.81	5.68	-2.2%
3.33	5.81	5.49	-5.6%
3.34	5.81	5.30	-8.9%
3.35	5.81	5.10	-12.2%
3.36	5.81	4.91	-15.5%
3.37	5.81	4.73	-18.7%
3.39	5.81	4.35	-25.1%
3.41	5.81	3.98	-31.5%
3.43	5.81	3.62	-37.7%
3.45	5.81	3.26	-43.9%
3.47	5.81	2.91	-50.0%
3.49	5.81	2.56	-56.0%
3.51	5.81	2.21	-62.0%
3.53	5.81	1.88	-67.7%
3.55	5.81	1.56	-73.1%
3.57	5.81	1.27	-78.2%

WATERLINE AT ZERO
AREA ERROR = 3.313

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private 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	2.54	24.12	0.94	1.36	22.73	25.37	100.0%	0.90	48.44	2.13
	2.56	23.98	0.92	1.34	22.16	25.21	99.4%	0.88	46.65	2.10
	2.61	23.69	0.89	1.29	20.97	24.87	98.0%	0.84	42.93	2.05
	2.66	23.40	0.85	1.24	19.80	24.54	96.7%	0.81	39.35	1.99
	2.71	23.11	0.81	1.19	18.63	24.20	95.4%	0.77	35.91	1.93
	2.76	22.82	0.77	1.14	17.48	23.86	94.0%	0.73	32.60	1.86
	2.81	22.53	0.73	1.09	16.35	23.52	92.7%	0.70	29.43	1.80
	2.86	22.24	0.68	1.04	15.23	23.18	91.3%	0.66	26.41	1.73
	2.91	21.95	0.64	0.99	14.13	22.84	90.0%	0.62	23.52	1.67
	2.96	21.66	0.60	0.94	13.04	22.50	88.7%	0.58	20.78	1.59
	3.01	21.37	0.56	0.89	11.96	22.16	87.3%	0.54	18.19	1.52
	3.06	21.08	0.52	0.84	10.90	21.82	86.0%	0.50	15.74	1.44
	3.11	20.79	0.47	0.79	9.85	21.48	84.7%	0.46	13.44	1.36
	3.16	20.50	0.43	0.74	8.82	21.14	83.3%	0.42	11.30	1.28
	3.21	20.21	0.39	0.69	7.80	20.80	82.0%	0.38	9.31	1.19
	3.26	19.92	0.34	0.64	6.80	20.46	80.6%	0.33	7.48	1.10
WL	3.31	19.59	0.30	0.59	5.81	20.09	79.2%	0.29	5.83	1.00
	3.36	18.89	0.26	0.54	4.85	19.32	76.2%	0.25	4.43	0.91
	3.41	18.26	0.21	0.49	3.92	18.62	73.4%	0.21	3.19	0.81
	3.46	17.67	0.17	0.44	3.03	17.97	70.8%	0.17	2.12	0.70
	3.51	16.83	0.13	0.39	2.16	17.05	67.2%	0.13	1.25	0.58
	3.56	14.66	0.09	0.34	1.36	14.81	58.4%	0.09	0.64	0.47
	3.61	7.90	0.10	0.29	0.76	8.00	31.5%	0.10	0.37	0.48
	3.66	5.64	0.08	0.24	0.43	5.72	22.5%	0.08	0.18	0.41
	3.71	3.84	0.05	0.19	0.18	3.89	15.3%	0.05	0.06	0.30
	3.76	1.11	0.07	0.14	0.08	1.15	4.5%	0.07	0.03	0.38
	3.81	0.70	0.04	0.09	0.03	0.73	2.9%	0.04	0.01	0.28
	3.86	0.30	0.02	0.04	0.01	0.31	1.2%	0.02	0.00	0.16

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	5.27	cfs
CALCULATED FLOW (Qc)=	5.83	cfs
(Qm-Qc)/Qm * 100 =	-10.6	%
MEASURED WATERLINE (WLm)=	3.32	ft
CALCULATED WATERLINE (WLc)=	3.31	ft
(WLm-WLc)/WLm * 100 =	0.2	%
MAX MEASURED DEPTH (Dm)=	0.60	ft
MAX CALCULATED DEPTH (Dc)=	0.59	ft
(Dm-Dc)/Dm * 100	2.2	%
MEAN VELOCITY=	1.00	ft/sec
MANNING'S N=	0.093	
SLOPE=	0.0204	ft/ft
.4 * Qm =	2.1	cfs
2.5 * Qm=	13.2	cfs

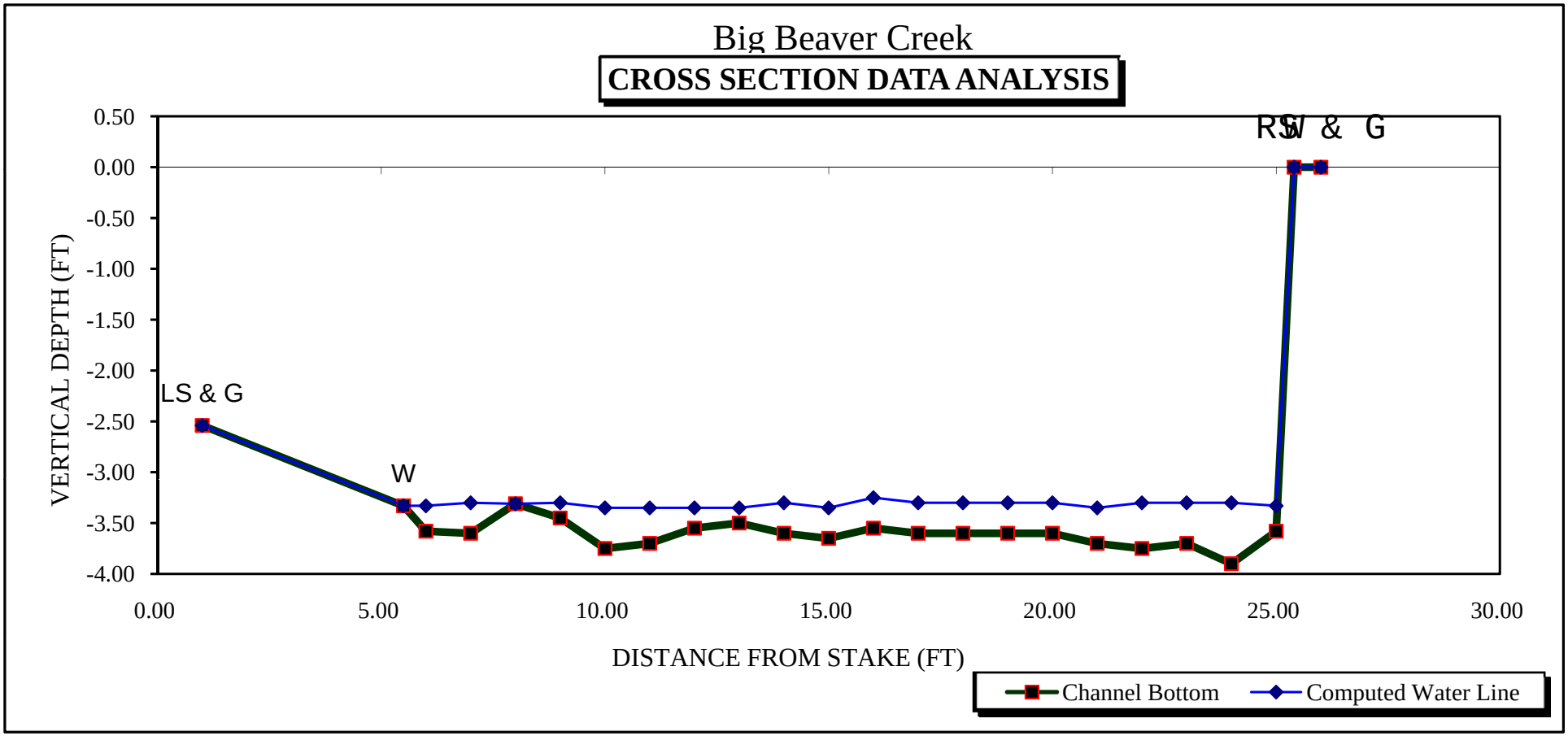
RECOMMENDED INSTREAM FLOW:
============================

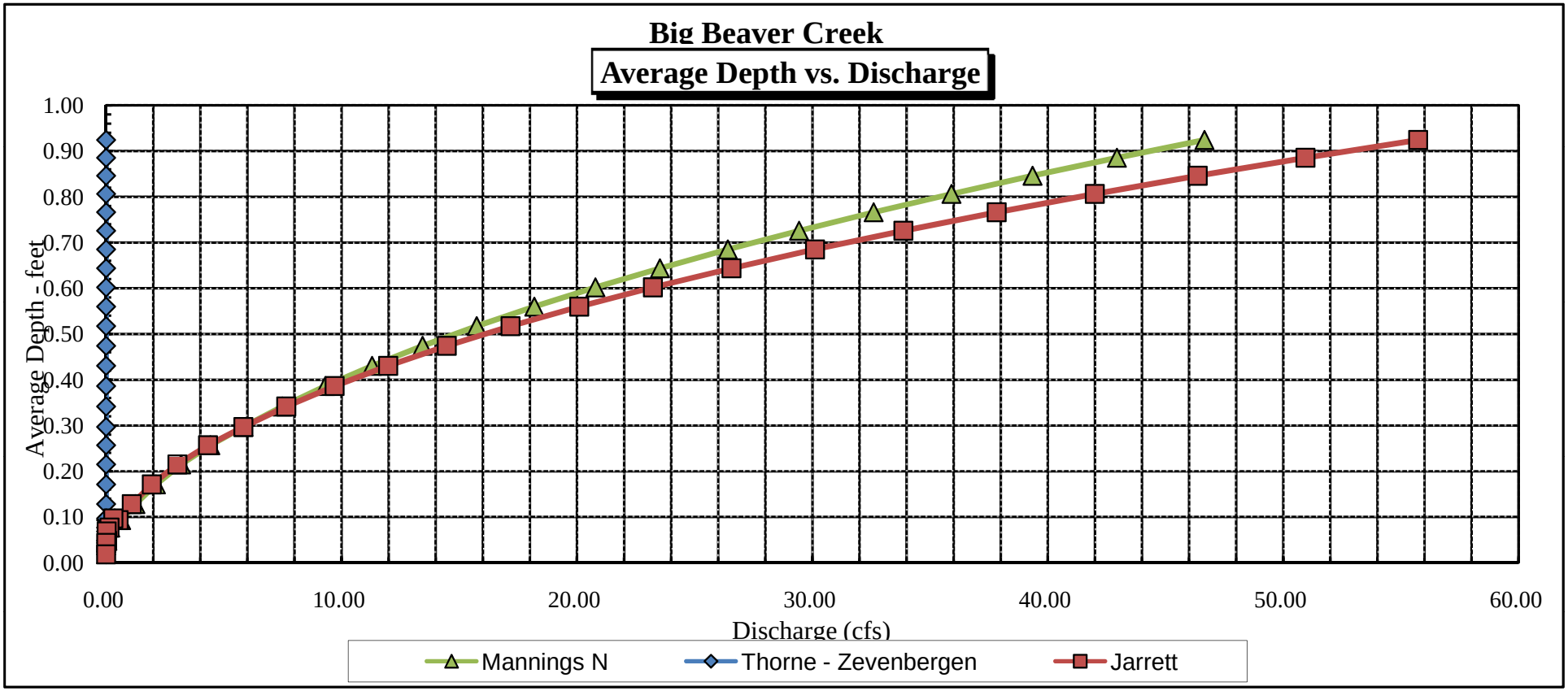
FLOW (CFS)	PERIOD
==========	========
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

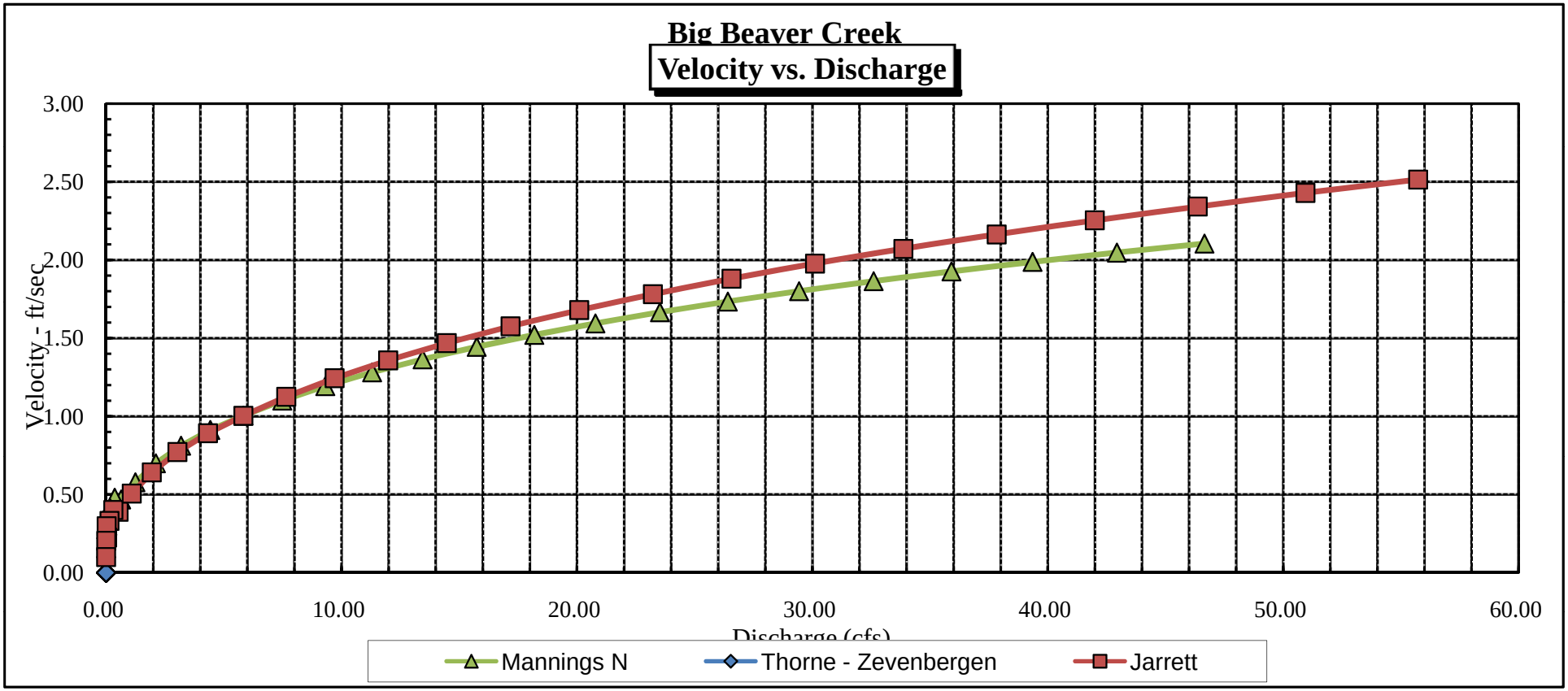
RATIONALE FOR RECOMMENDATION:
============================

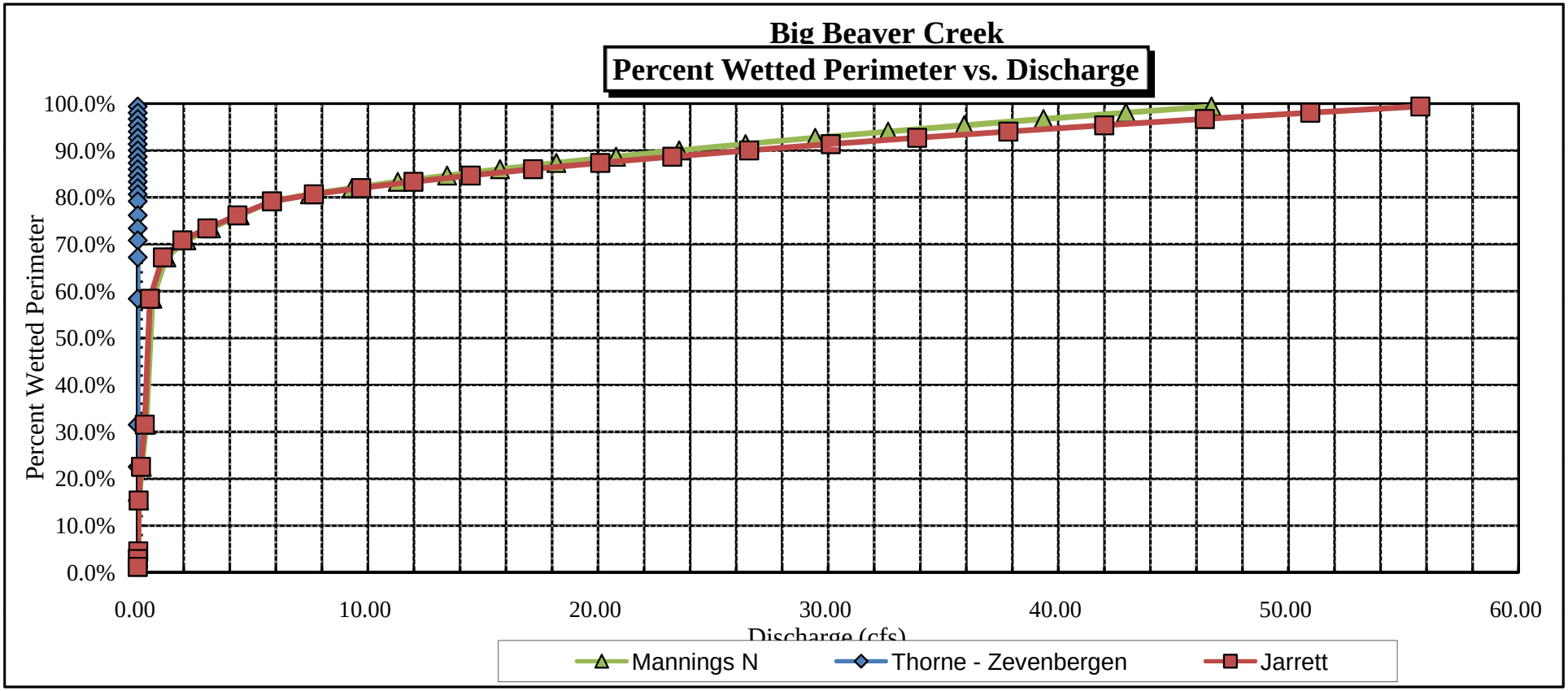
RECOMMENDATION BY: ……………………………………………………… AGENCY……………………………………………… DATE:………………………………

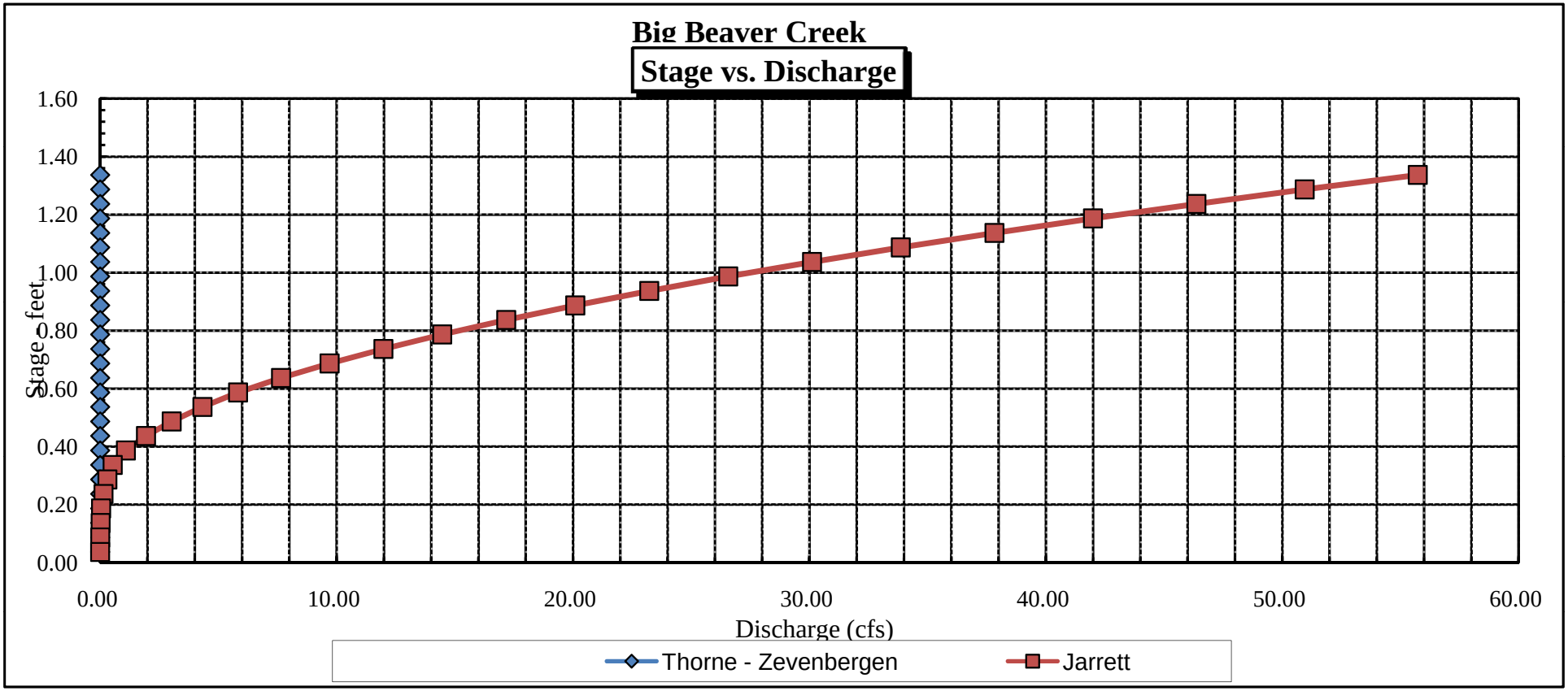
CWCB REVIEW BY: …… DATE:………………………………


Big Beaver Creek
CROSS SECTION DATA ANALYSIS
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
VERTICAL DEPTH (FT)
LS & G
W
RS
W & G
0.00
5.00
10.00
15.00
20.00
25.00
30.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Big Beaver Creek
Average Depth vs. Discharge
Average Depth - feet
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Big Beaver Creek
Velocity vs. Discharge
Velocity - ft/sec
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Big Beaver 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
10.00
20.00
30.00
40.00
50.00
60.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


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

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

LOCATION INFORMATION

STREAM NAME:	Big Beaver Creek
XS LOCATION:	At BLM-private boundary
XS NUMBER:	2
DATE:	14-Jul-08
OBSERVERS:	R. Smith, B. Lange
1/4 SEC:	NE
SECTION:	19
TWP:	1N
RANGE:	91W
PM:	Sixth
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	24935
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:	0.024

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

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

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
XS NUMBER: 2

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
1 RS & G	1.00	2.89			0.00		0.00	0.00	0.0%
W	4.00	3.71			0.00		0.00	0.00	0.0%
	5.00	3.75	0.05	0.00	1.00	0.05	0.05	0.00	0.0%
	6.00	3.80	0.10	1.11	1.00	0.10	0.10	0.11	2.2%
	7.00	3.80	0.10	0.20	1.00	0.10	0.10	0.02	0.4%
	8.00	3.90	0.20	0.97	1.00	0.20	0.20	0.19	3.8%
	9.00	4.05	0.35	0.41	1.01	0.35	0.26	0.11	2.1%
	9.50	4.15	0.45	0.97	0.51	0.45	0.23	0.22	4.3%
	10.00	4.15	0.45	1.84	0.50	0.45	0.23	0.41	8.2%
	10.50	4.10	0.40	0.92	0.50	0.40	0.20	0.18	3.6%
	11.00	4.10	0.40	0.99	0.50	0.40	0.20	0.20	3.9%
	11.50	4.15	0.40	1.25	0.50	0.40	0.20	0.25	4.9%
	12.00	4.10	0.40	2.50	0.50	0.40	0.20	0.50	9.9%
	12.50	4.20	0.50	1.54	0.51	0.50	0.25	0.39	7.6%
	13.00	4.05	0.30	0.00	0.52	0.30	0.15	0.00	0.0%
	13.50	3.95	0.20	2.22	0.51	0.20	0.10	0.22	4.4%
	14.00	4.00	0.25	2.85	0.50	0.25	0.13	0.36	7.0%
	14.50	4.05	0.30	2.33	0.50	0.30	0.15	0.35	6.9%
	15.00	4.20	0.45	1.04	0.52	0.45	0.23	0.23	4.6%
	15.50	4.05	0.30	1.92	0.52	0.30	0.15	0.29	5.7%
	16.00	4.00	0.25	1.80	0.50	0.25	0.13	0.23	4.5%
	16.50	4.10	0.35	0.50	0.51	0.35	0.18	0.09	1.7%
	17.00	3.90	0.10	0.23	0.54	0.10	0.08	0.02	0.3%
	18.00	3.85	0.10	1.28	1.00	0.10	0.10	0.13	2.5%
	19.00	4.00	0.25	1.95	1.01	0.25	0.25	0.49	9.6%
	20.00	4.05	0.30	0.16	1.00	0.30	0.30	0.05	0.9%
	21.00	3.90	0.15	0.26	1.01	0.15	0.12	0.03	0.6%
W	21.60	3.78			0.61		0.00	0.00	0.0%
1 LS & G	24.00	2.87			0.00		0.00	0.00	0.0%
TOTALS ----------					17.81	0.5 (Max.)	4.26	5.06	100.0%

Manning's n = 0.0747
Hydraulic Radius= 0.23899591

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	4.26	4.00	-6.0%
3.50	4.26	8.58	101.4%
3.52	4.26	8.19	92.5%
3.54	4.26	7.82	83.6%
3.56	4.26	7.44	74.7%
3.58	4.26	7.07	65.9%
3.60	4.26	6.69	57.2%
3.62	4.26	6.32	48.6%
3.64	4.26	5.96	40.0%
3.66	4.26	5.59	31.4%
3.68	4.26	5.23	22.9%
3.70	4.26	4.87	14.5%
3.71	4.26	4.70	10.3%
3.72	4.26	4.52	6.1%
3.73	4.26	4.34	2.0%
3.74	4.26	4.17	-2.0%
3.75	4.26	4.00	-6.0%
3.76	4.26	3.83	-9.9%
3.77	4.26	3.67	-13.8%
3.78	4.26	3.51	-17.6%
3.79	4.26	3.35	-21.4%
3.80	4.26	3.19	-25.1%
3.82	4.26	2.90	-32.0%
3.84	4.26	2.61	-38.6%
3.86	4.26	2.34	-45.1%
3.88	4.26	2.08	-51.2%
3.90	4.26	1.83	-57.0%
3.92	4.26	1.60	-62.5%
3.94	4.26	1.38	-67.7%
3.96	4.26	1.16	-72.7%
3.98	4.26	0.96	-77.4%
4.00	4.26	0.78	-81.7%

WATERLINE AT ZERO
AREA ERROR = 3.730

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
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	2.89	22.95	0.93	1.31	21.31	23.43	100.0%	0.91	61.67	2.89
	2.93	22.70	0.90	1.27	20.39	23.17	98.9%	0.88	57.76	2.83
	2.98	22.38	0.86	1.22	19.27	22.84	97.5%	0.84	53.05	2.75
	3.03	22.07	0.82	1.17	18.16	22.51	96.0%	0.81	48.52	2.67
	3.08	21.75	0.78	1.12	17.06	22.18	94.6%	0.77	44.17	2.59
	3.13	21.44	0.75	1.07	15.98	21.85	93.2%	0.73	40.01	2.50
	3.18	21.12	0.71	1.02	14.92	21.52	91.8%	0.69	36.03	2.42
	3.23	20.81	0.67	0.97	13.87	21.19	90.4%	0.65	32.25	2.32
	3.28	20.49	0.63	0.92	12.84	20.86	89.0%	0.62	28.64	2.23
	3.33	20.18	0.59	0.87	11.82	20.52	87.6%	0.58	25.23	2.13
	3.38	19.86	0.54	0.82	10.82	20.19	86.2%	0.54	22.01	2.03
	3.43	19.55	0.50	0.77	9.83	19.86	84.8%	0.50	18.98	1.93
	3.48	19.23	0.46	0.72	8.86	19.53	83.4%	0.45	16.14	1.82
	3.53	18.92	0.42	0.67	7.91	19.20	81.9%	0.41	13.51	1.71
	3.58	18.60	0.37	0.62	6.97	18.87	80.5%	0.37	11.07	1.59
	3.63	18.29	0.33	0.57	6.05	18.54	79.1%	0.33	8.84	1.46
	3.68	17.97	0.29	0.52	5.14	18.21	77.7%	0.28	6.83	1.33
WL	3.73	17.23	0.25	0.47	4.26	17.46	74.5%	0.24	5.12	1.20
	3.78	16.00	0.21	0.42	3.43	16.21	69.2%	0.21	3.75	1.09
	3.83	14.05	0.19	0.37	2.68	14.26	60.8%	0.19	2.72	1.01
	3.88	12.50	0.16	0.32	2.01	12.70	54.2%	0.16	1.82	0.90
	3.93	10.99	0.13	0.27	1.43	11.17	47.7%	0.13	1.12	0.78
	3.98	9.42	0.10	0.22	0.92	9.57	40.8%	0.10	0.59	0.65
	4.03	6.69	0.08	0.17	0.51	6.81	29.1%	0.07	0.27	0.54
	4.08	4.70	0.05	0.12	0.23	4.78	20.4%	0.05	0.10	0.41
	4.13	2.25	0.02	0.07	0.05	2.29	9.8%	0.02	0.01	0.25
	4.18	0.30	0.01	0.02	0.00	0.31	1.3%	0.01	0.00	0.14

STREAM NAME: Big Beaver Creek
XS LOCATION: At BLM-private boundary
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	5.06	cfs
CALCULATED FLOW (Qc)=	5.12	cfs
(Qm-Qc)/Qm * 100 =	-1.4	%
MEASURED WATERLINE (WLm)=	3.75	ft
CALCULATED WATERLINE (WLc)=	3.73	ft
(WLm-WLc)/WLm * 100 =	0.4	%
MAX MEASURED DEPTH (Dm)=	0.50	ft
MAX CALCULATED DEPTH (Dc)=	0.47	ft
(Dm-Dc)/Dm * 100	6.0	%
MEAN VELOCITY=	1.20	ft/sec
MANNING'S N=	0.075	
SLOPE=	0.024	ft/ft
.4 * Qm =	2.0	cfs
2.5 * Qm=	12.6	cfs

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

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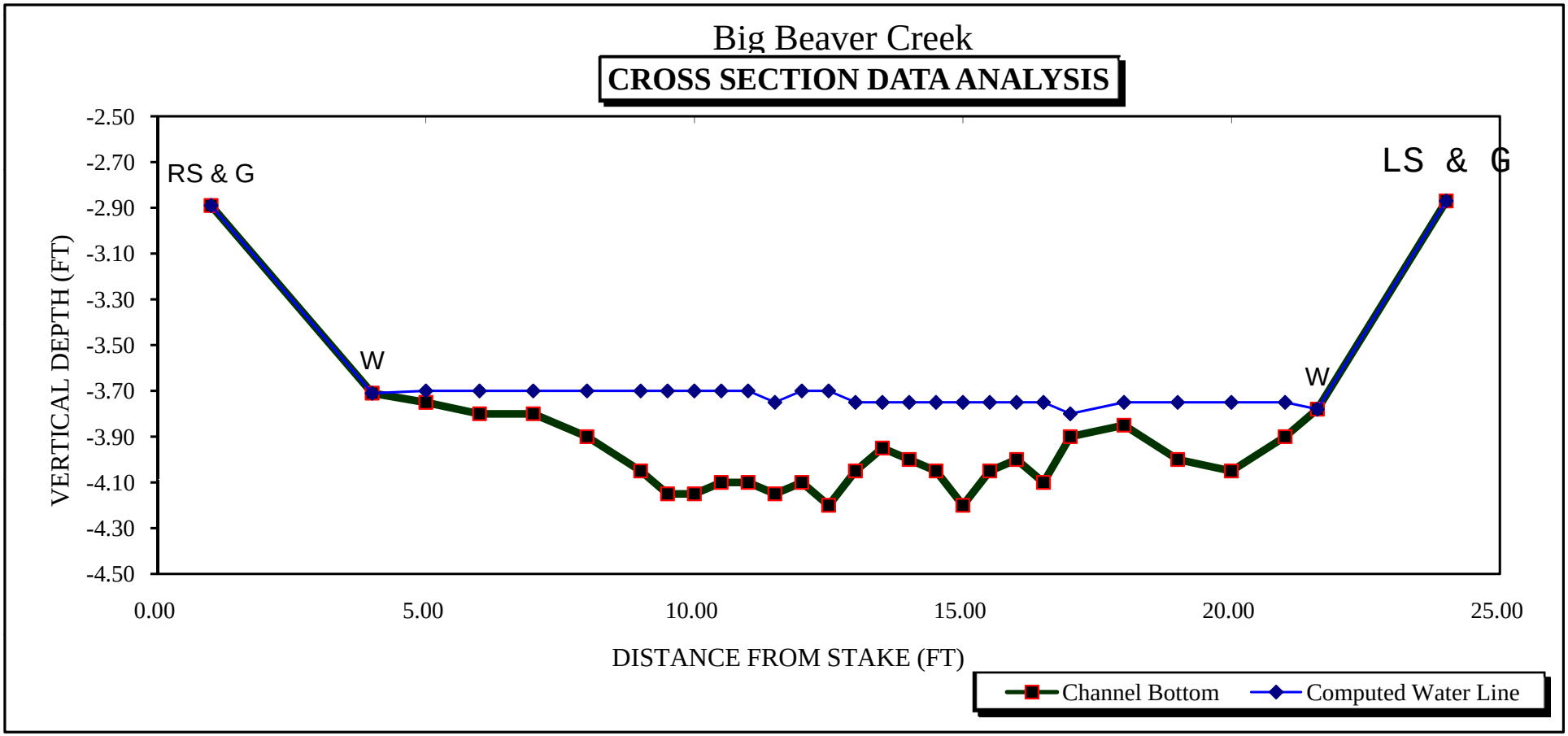
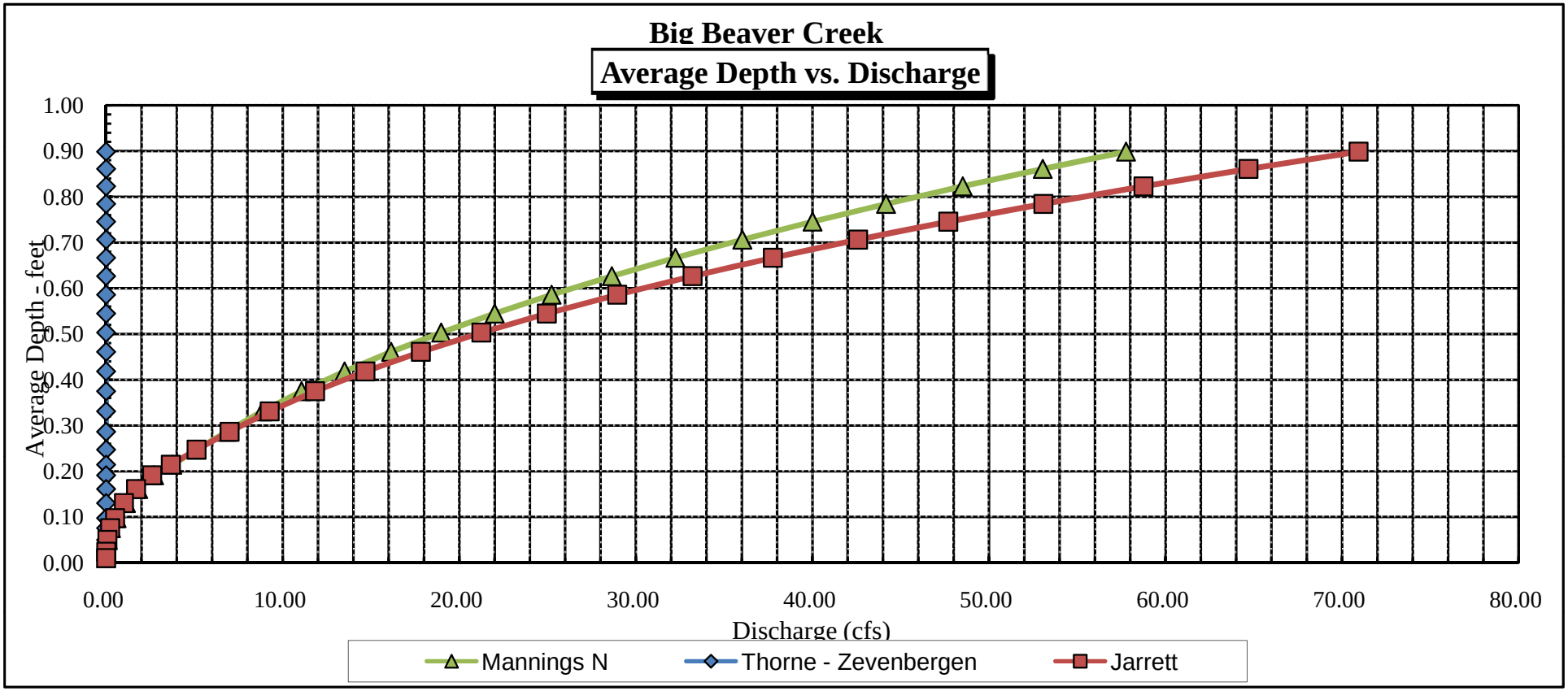
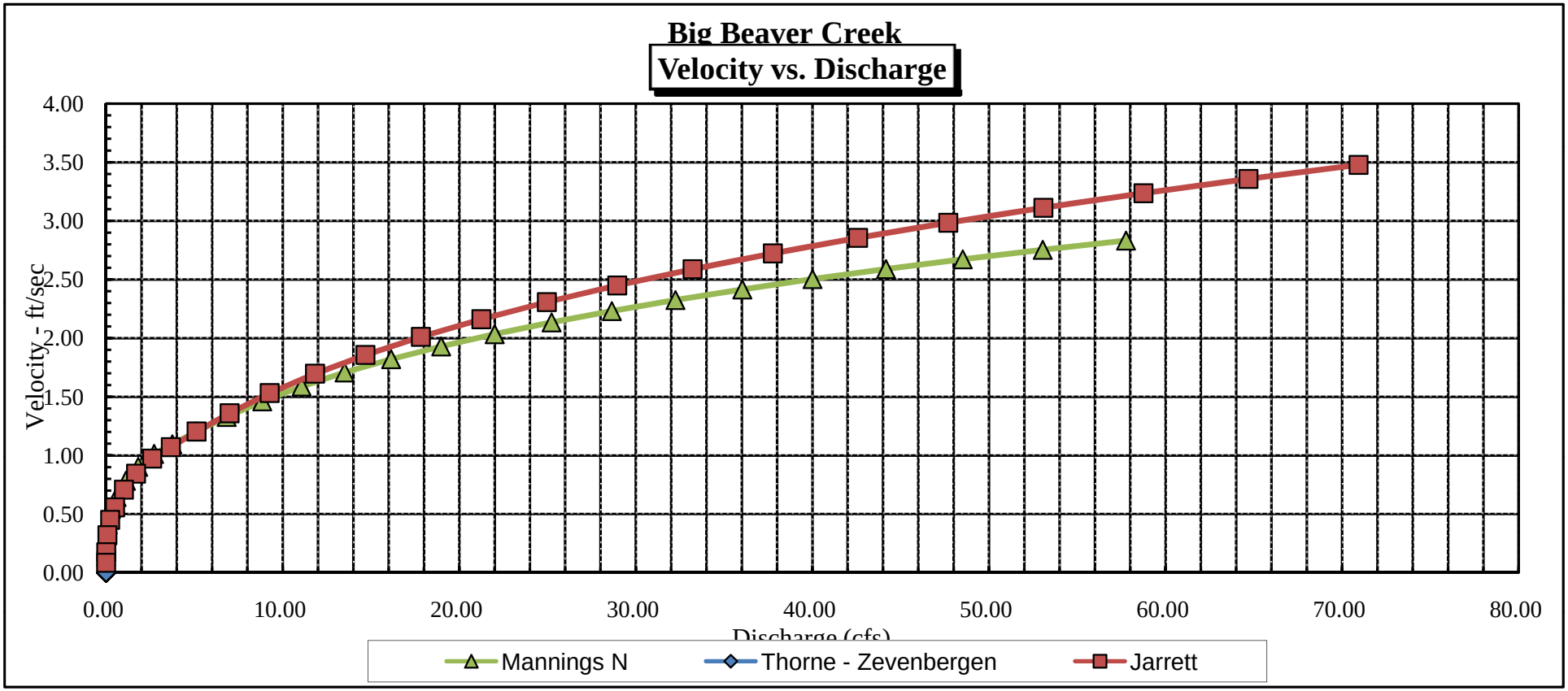
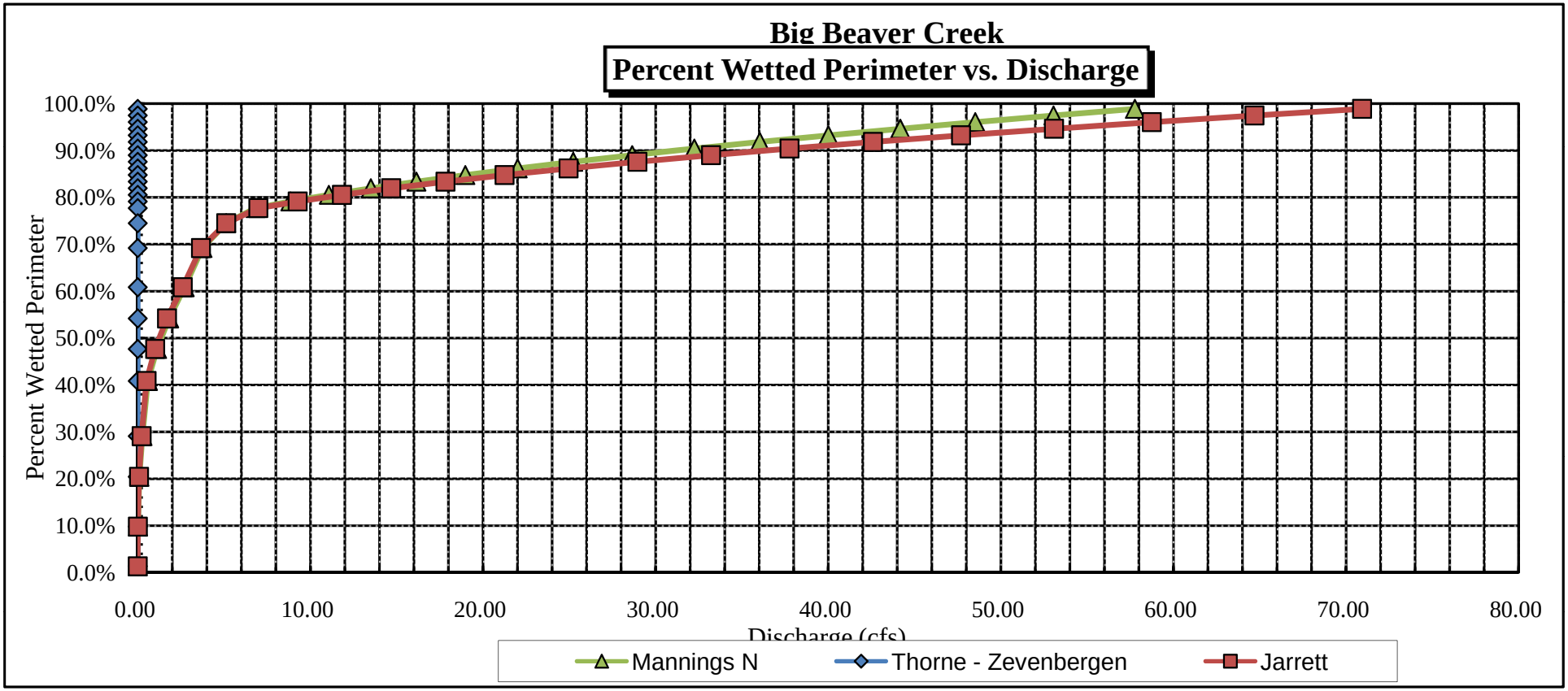
RECOMMENDATION BY: ………………...………..……............................... AGENCY...……………………......…....…...…….…...... DATE:......…...…......……………

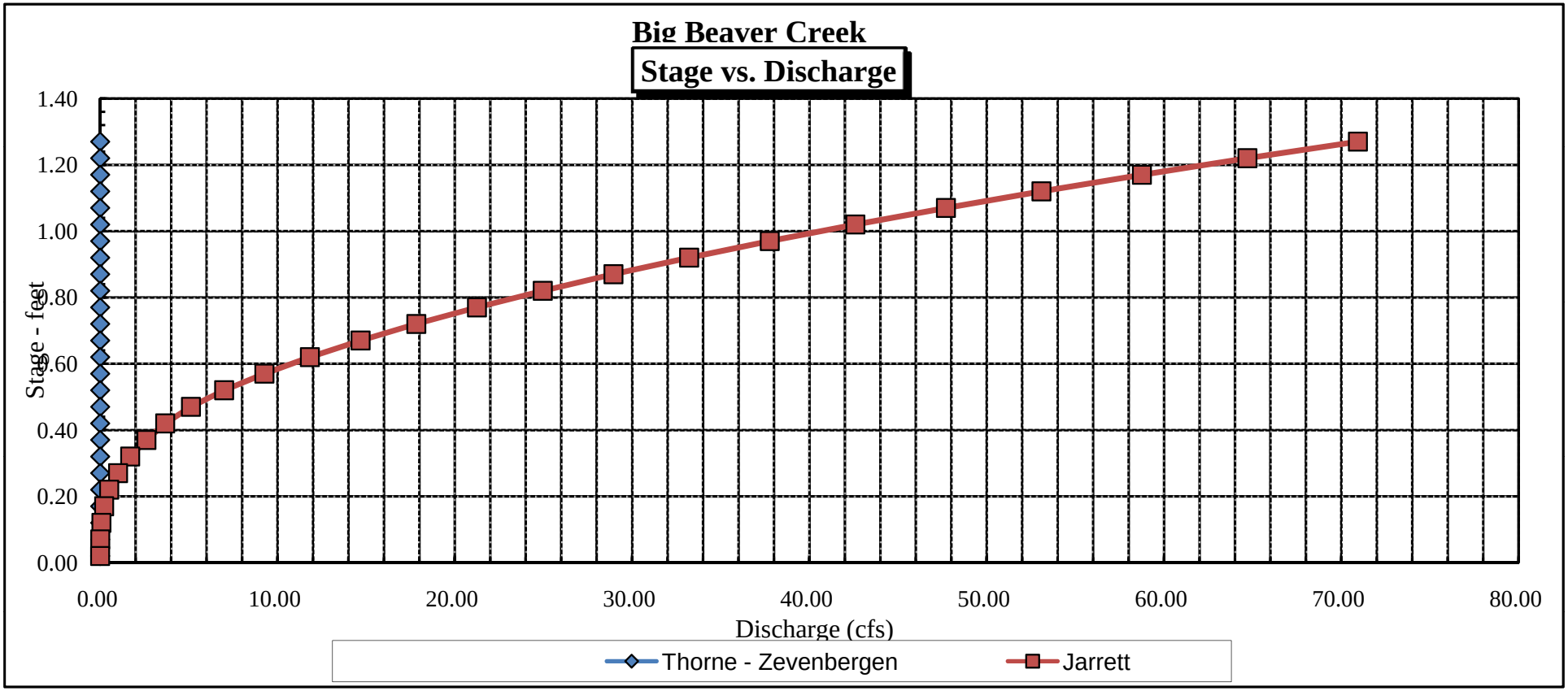
CWCB REVIEW BY: ..…………………………....………………………………………………….....................................….............. DATE:.................…………….....


Big Beaver Creek
CROSS SECTION DATA ANALYSIS
RS & G
W
W
LS & G
-2.50
-2.70
-2.90
-3.10
-3.30
-3.50
-3.70
-3.90
-4.10
-4.30
-4.50
VERTICAL DEPTH (FT)
0.00
5.00
10.00
15.00
20.00
25.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Big Beaver Creek
Average Depth vs. Discharge
Average Depth - feet
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Big Beaver Creek
Velocity vs. Discharge
Velocity - ft/sec
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Big Beaver 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
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Big Beaver Creek
Stage vs. Discharge
Stage - feet
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett