Stream: Henson Creek

Executive Summary

Water Division: 4
Water District: 62
CDOW#: 40612
CWCB ID: 09/4/A-007

Segment: Confluence with the North Fork of Henson Creek to the Confluence with Nellie Creek

Upper Terminus: CONFLUNCE WITH THE NORTH FORK OF HENSON CREEK (Latitude 38° 0’ 25.1”N) (Longitude 107° 27’ 32.6”W)

Lower Terminus: CONFLUENCE WITH NELLIE CREEK (Latitude 38° 1’ 13.3”N) (Longitude 107° 24’ 4.0”W)

Watershed: Upper Gunnison (HUC#: 14020002)
Counties: Hinsdale
Length: 3.4 miles
USGS Quad(s): Uncompahgre Peak
Existing ISF: 4-82CW386, 12 cfs
Flow Recommendation (increase): 11 cfs (April 1 to October 31)

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) and the Colorado Division of Wildlife (CDOW) recommended this segment of Henson Creek to the CWCB for an increased water right under the Instream Flow Program. Henson 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.

Henson Creek is approximately18 miles long. It begins on the south flank of Wildhorse Peak at an elevation of approximately 12,260 feet and terminates at the confluence with Lake Fork Gunnison River at an elevation of approximately 8,660 feet. Approximately 79% of the land on the 3.4-mile segment addressed by this report is publicly owned. . The total drainage area of the creek is approximately 52.3 square miles. Henson Creek is located within Hinsdale County and generally flows in a northeasterly direction.

The subject of this report is a segment of Henson Creek beginning at the confluence with the North Fork of Henson Creek to the confluence with Nellie Creek. The proposed segment is located approximately 4.5 miles west of Lake City. The 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

The BLM was prompted to re-examine the instream flow on Henson Creek because of the BLM water quality management objectives in the Henson Creek and Lake Fork watersheds. Both of these stream systems are affected by historic mining activities, and the BLM has begun to initiate projects to treat and minimize acid mine runoff and heavy metals contamination. Within these watersheds, streams that are presently able to support fish are extraordinarily valuable for the habitat they provide and for their ability to dilute runoff originating in more contaminated parts of the watershed. Finally, this creek is located along the very heavily used Alpine Loop Backcountry Byway. Users of the byway seek opportunities to fish and camp along the uncontaminated streams within these watersheds.

The BLM's cross section analysis revealed that the current instream flow rate is not fully protective for several reasons. First, in locations where the stream widens out and is capable of

providing significant riffle and physical habitat, the current 11.0 cfs water right provides an average depth of only 0.25 feet. The BLM believes this is insufficient depth for a channel that averages 40 feet in diameter, because a significant percentage of the usable habitat is lost or only barely deep enough for fish passage. The BLM also notes that protecting the flows necessary to meet with the depth criteria would provide wetted perimeter in the range of 80 to 90 percent. In a watershed where water quality issues already stress fish populations, the BLM believes that the population should not also be limited by physical habitat availability. The BLM's conclusion is that it is prudent to protect a higher flow rate that is capable of supporting a larger fish population.

The BLM also believes that this reach of Henson Creek is an important fish source for the repopulation of lower reaches of Henson Creek. The BLM is undertaking a major effort to reclaim the Ute-Ulay Mine located approximately 1.5 miles downstream. As water quality improves in this section, it is anticipated that fish from this reach will move into the improved habitat. The lower reaches of Henson Creek near Lake City cannot serve as a repopulation source for the Henson Creek near the Ute-Ulay Mine. Treasure Falls, located downstream from the Ute-Ulay mine, is a natural barrier that prevents fish from moving from upstream into the reach where the mine is located.

Instream Flow Recommendation(s)

The BLM recommended an increase of 11 cfs (April 1 to October 31), based on its October 9, 2007 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
Confl. w/ North Fork Henson Creek	Confl. w/ Nellie Creek	3.4	21%	79%

100% of the public lands are owned by the BLM.

Biological Data

Overall, this portion of Henson Creek is a high gradient stream with large substrate size. In the upper portion of the reach, the canyon is sufficiently wide to allow the creek to have a well developed floodplain and wide willow riparian zone. In the lower portion of the reach, the creek is confined by a narrow canyon. Here, the bedrock restricts channel and riparian formation, but the creek has multiple pools and runs that provide excellent fish habitat. The creek supports a healthy and diverse aquatic insect community, including caddisfly, stonefly, and mayfly. Fishery surveys indicate that the creek supports a self-sustaining population brook trout of various sizes and age classes.

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	10/9/2007	33.4	83.5 – 13.4	18.86	Out of range
BLM	10/9/2007	31.71	79.3 – 12.7	27.49	Out of range

BLM = Bureau of Land Management

The summer flow, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 23 cfs. This recommendation was derived by averaging the results of the two data sets. The recommended flow of 11 cfs, when added to the existing flow of 12 cfs is equal to 23 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 **Henson Creek** no such gage is available at or above the LT. For a short period during the 1930's, there was a gage on the lowest reach of Henson Creek but it is of little value because of its short life and antiquity. It is thus necessary to describe the normal flow regime at Henson Creek above the LT through a "representative" gage station. The gage station selected for this purpose was MINERAL CREEK ABOVE SILVERTON, CO. (USGS 09358900), a gage with a 7 year period of record (POR) collected between 1968 and 1975. The gage is at an elevation of 9,980 ft above mean sea level (amsl) and has a drainage area of 11.0 mi^2. The hydrograph (plot of discharge over time) produced from this gage includes the effects of two upstream transbasin diversions. These diversions were 100% consumptive to the basin because of their transbasin character. To make the measured data from Mineral Creek transferrable to Henson Creek above the LT, these diversions were added back to the measured Mineral Creek hydrograph. The resulting "adjusted" hydrograph could then be used on Henson Creek above the LT by multiplying the "adjusted" hydrograph by an area ratio; specifically, the area of Henson Creek above the LT (52.36 mi^2 above the LT) to Mineral Creek above Silverton, CO (11.0 mi^2 above the gage). In this instance, due to the absence of existing significant upstream consumptive irrigation uses or transbasin diversions on Henson Creek above the LT, the resulting proportioned "adjusted" hydrograph was not further "adjusted" (decreased). Nevertheless, the final hydrograph represents the existing distribution of flow over time.

{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 Henson Creek above the LT was to compute the Geometric Mean of the area-prorated "adjusted" data values from the Mineral Creek above Silverton, 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. In this particular case, the short period of record lends even greater merit to the use of this statistical tool. 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 an enlargement displayed in figure 2. The data displayed in this hydrograph follow in Table 1.

Fig. 1. Geometric Mean Daily Q Henson Cr abv LT (prop on Mineral Cr adjusted for Irr) & ISF

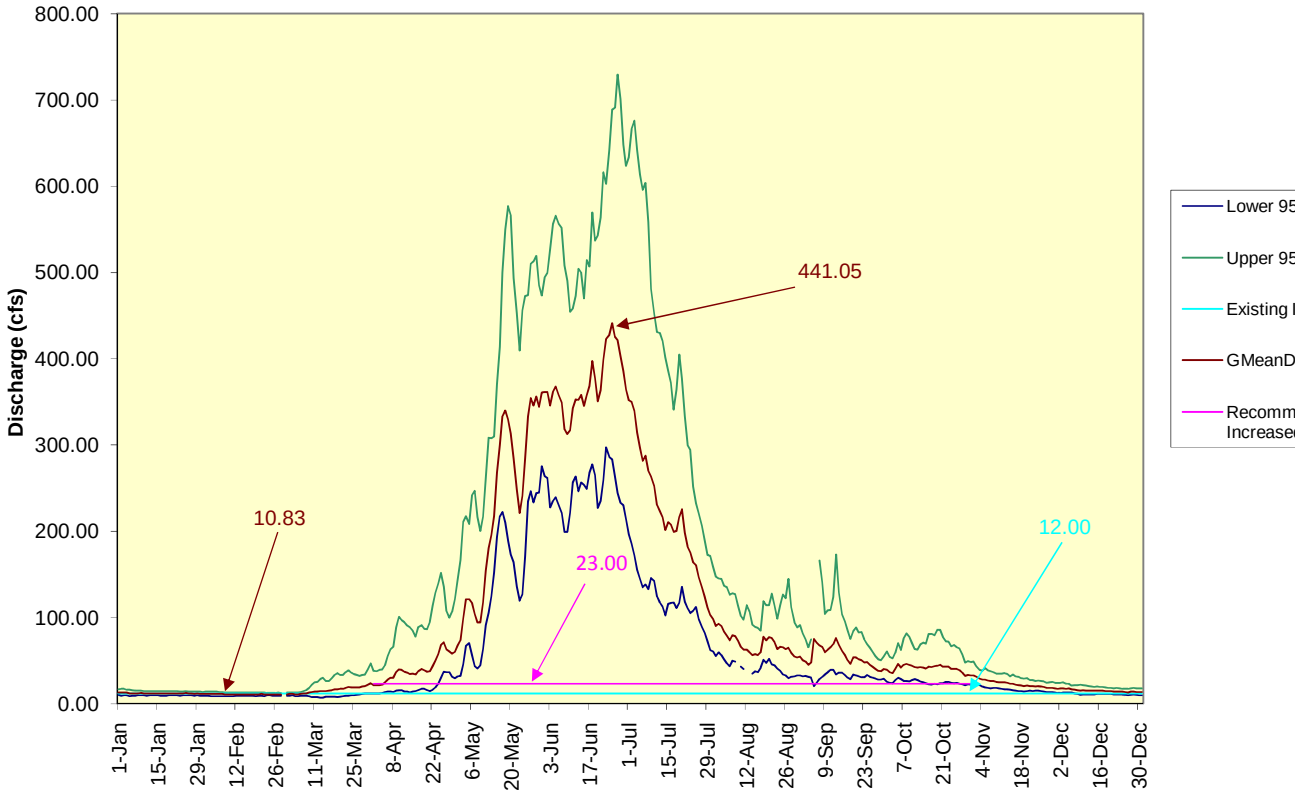


Fig. 2. Geometric Mean Daily Q Henson Cr abv LT (prop on Mineral Cr adjusted for Irr) & ISFs

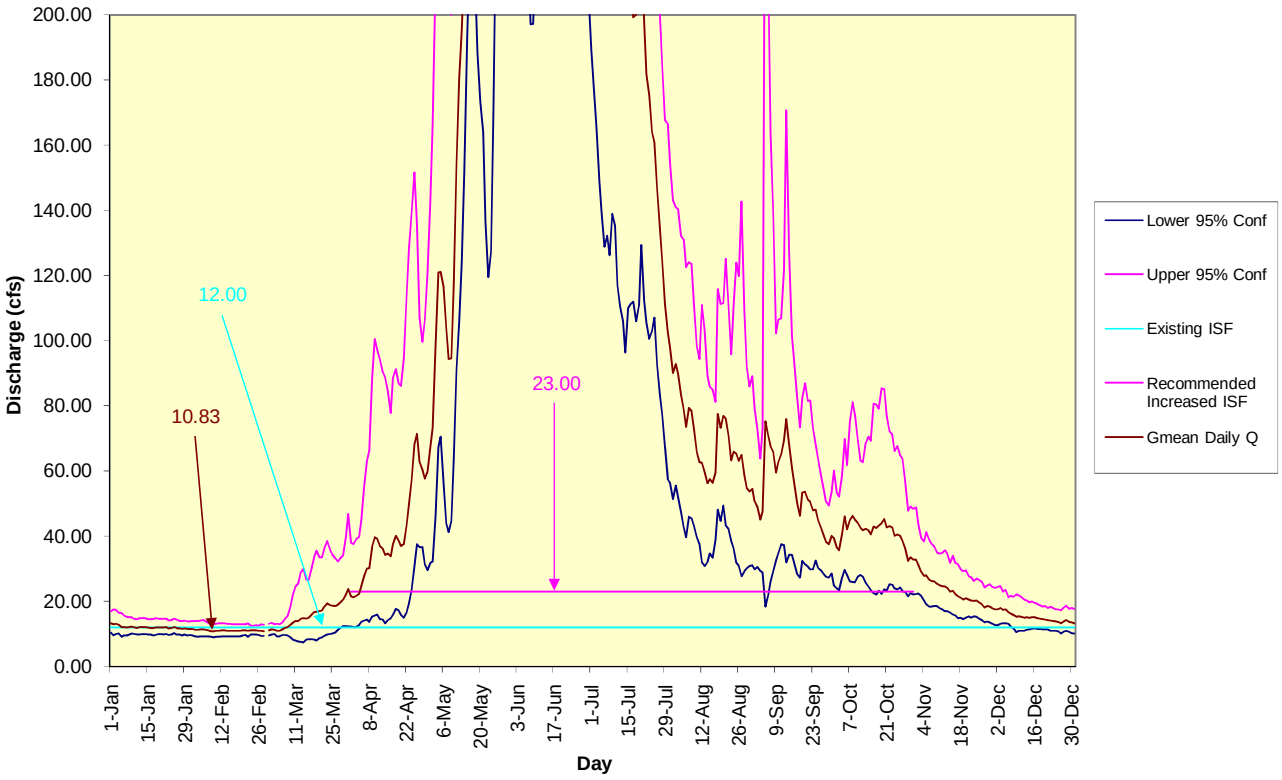


Table 1. Geometric Mean Discharge and Recommended Instream Flows			
Date	Existing ISF	Recommended ISF	Proportioned Adjusted GM (abv gage) No Adj (-) for Irr & OoB in Henson Cr abv LT
1-Jan	12.00		13.22407002
2-Jan	12.00		12.91975433
3-Jan	12.00		13.13675024
4-Jan	12.00		12.83324651
5-Jan	12.00		12.14548074
6-Jan	12.00		12.14884404
7-Jan	12.00		12.02158717
8-Jan	12.00		12.15959526
9-Jan	12.00		12.26837427
10-Jan	12.00		12.02910426
11-Jan	12.00		11.8761145
12-Jan	12.00		12.06113478
13-Jan	12.00		12.14435376
14-Jan	12.00		12.1415566
15-Jan	12.00		11.94422727
16-Jan	12.00		11.8651125

17-Jan	12.00	11.77751388
18-Jan	12.00	11.90810429
19-Jan	12.00	12.01577797
20-Jan	12.00	12.02286833
21-Jan	12.00	11.99408143
22-Jan	12.00	12.07513728
23-Jan	12.00	11.68823112
24-Jan	12.00	11.82515819
25-Jan	12.00	12.17491312
26-Jan	12.00	11.89080676
27-Jan	12.00	11.65509683
28-Jan	12.00	11.47346261
29-Jan	12.00	11.70704567
30-Jan	12.00	11.49747954
31-Jan	12.00	11.50457676
1-Feb	12.00	11.48725043
2-Feb	12.00	11.32785155
3-Feb	12.00	11.24763223
4-Feb	12.00	11.37398717
5-Feb	12.00	11.42569138
6-Feb	12.00	11.25764796
7-Feb	12.00	11.09730248
8-Feb	12.00	10.89718109
9-Feb	12.00	10.8282005
10-Feb	12.00	10.9004013
11-Feb	12.00	10.96984184
12-Feb	12.00	11.04732788
13-Feb	12.00	11.05338786
14-Feb	12.00	10.99363367
15-Feb	12.00	10.99363367
16-Feb	12.00	10.9366657
17-Feb	12.00	10.9366657
18-Feb	12.00	10.9366657
19-Feb	12.00	10.93183715
20-Feb	12.00	11.09414228
21-Feb	12.00	11.11024421
22-Feb	12.00	10.91335355
23-Feb	12.00	11.07632429
24-Feb	12.00	11.07058228
25-Feb	12.00	11.06824128
26-Feb	12.00	11.00096115
27-Feb	12.00	10.95180795
28-Feb	12.00	10.890617
29-Feb	12.00	
1-Mar	12.00	11.09132757
2-Mar	12.00	11.36047668
3-Mar	12.00	11.32507737
4-Mar	12.00	10.92367092
5-Mar	12.00	10.93145031
6-Mar	12.00	11.40918265

7-Mar	12.00		11.79749631
8-Mar	12.00		12.07048922
9-Mar	12.00		12.79612117
10-Mar	12.00		13.36481502
11-Mar	12.00		13.90454513
12-Mar	12.00		14.01282503
13-Mar	12.00		14.69910641
14-Mar	12.00		14.83021962
15-Mar	12.00		14.73998316
16-Mar	12.00		14.9339374
17-Mar	12.00		15.79567882
18-Mar	12.00		16.66653595
19-Mar	12.00		16.78209861
20-Mar	12.00		17.02025649
21-Mar	12.00		17.22251079
22-Mar	12.00		18.38232211
23-Mar	12.00		19.36205931
24-Mar	12.00		18.86665972
25-Mar	12.00		18.61943391
26-Mar	12.00		18.59153911
27-Mar	12.00		18.94950298
28-Mar	12.00		19.7498628
29-Mar	12.00		20.52833425
30-Mar	12.00		22.17145366
31-Mar	12.00		23.84715083
1-Apr	12.00	23	21.56723959
2-Apr	12.00	23	21.28064411
3-Apr	12.00	23	21.66964488
4-Apr	12.00	23	22.32879931
5-Apr	12.00	23	24.73630105
6-Apr	12.00	23	27.89228233
7-Apr	12.00	23	30.09420868
8-Apr	12.00	23	30.08966204
9-Apr	12.00	23	36.65206774
10-Apr	12.00	23	39.70237297
11-Apr	12.00	23	39.28181563
12-Apr	12.00	23	36.93949579
13-Apr	12.00	23	36.1057091
14-Apr	12.00	23	34.32398382
15-Apr	12.00	23	34.64906339
16-Apr	12.00	23	33.84378921
17-Apr	12.00	23	37.55768998
18-Apr	12.00	23	40.15534977
19-Apr	12.00	23	38.73033961
20-Apr	12.00	23	36.93667395
21-Apr	12.00	23	37.61424837
22-Apr	12.00	23	43.24878245
23-Apr	12.00	23	49.83572744
24-Apr	12.00	23	57.43953214
25-Apr	12.00	23	68.1001234

26-Apr	12.00	23	71.35428452
27-Apr	12.00	23	62.66353119
28-Apr	12.00	23	60.43154961
29-Apr	12.00	23	57.71940736
30-Apr	12.00	23	59.80331471
1-May	12.00	23	67.59698691
2-May	12.00	23	73.28781442
3-May	12.00	23	98.32990485
4-May	12.00	23	121.04496
5-May	12.00	23	121.1439744
6-May	12.00	23	116.7560175
7-May	12.00	23	104.0591864
8-May	12.00	23	94.41365964
9-May	12.00	23	94.56537368
10-May	12.00	23	117.4187613
11-May	12.00	23	154.3302162
12-May	12.00	23	180.6800252
13-May	12.00	23	195.4889799
14-May	12.00	23	217.1591213
15-May	12.00	23	267.5218664
16-May	12.00	23	299.6749719
17-May	12.00	23	333.3377418
18-May	12.00	23	339.8920336
19-May	12.00	23	329.7253942
20-May	12.00	23	313.0216325
21-May	12.00	23	284.394892
22-May	12.00	23	248.5695575
23-May	12.00	23	221.139586
24-May	12.00	23	240.9318242
25-May	12.00	23	284.273115
26-May	12.00	23	333.2200372
27-May	12.00	23	354.236601
28-May	12.00	23	345.8575281
29-May	12.00	23	355.706632
30-May	12.00	23	344.2689521
31-May	12.00	23	360.9873656
1-Jun	12.00	23	361.1634692
2-Jun	12.00	23	361.2954291
3-Jun	12.00	23	346.0189188
4-Jun	12.00	23	361.3662903
5-Jun	12.00	23	367.9713484
6-Jun	12.00	23	358.3163746
7-Jun	12.00	23	349.1127759
8-Jun	12.00	23	317.8171045
9-Jun	12.00	23	312.4531407
10-Jun	12.00	23	317.0348077
11-Jun	12.00	23	342.5243048
12-Jun	12.00	23	352.7497033
13-Jun	12.00	23	352.2117019
14-Jun	12.00	23	357.8817849

15-Jun	12.00	23	345.1837501
16-Jun	12.00	23	357.7921202
17-Jun	12.00	23	368.2770628
18-Jun	12.00	23	397.4173333
19-Jun	12.00	23	377.2167024
20-Jun	12.00	23	350.8593579
21-Jun	12.00	23	363.6434486
22-Jun	12.00	23	398.9098964
23-Jun	12.00	23	422.8529275
24-Jun	12.00	23	427.8547821
25-Jun	12.00	23	441.0507192
26-Jun	12.00	23	425.7358846
27-Jun	12.00	23	421.2929912
28-Jun	12.00	23	403.1124206
29-Jun	12.00	23	385.4965458
30-Jun	12.00	23	363.8570381
1-Jul	12.00	23	351.4512934
2-Jul	12.00	23	350.2054575
3-Jul	12.00	23	339.2007387
4-Jul	12.00	23	314.1156773
5-Jul	12.00	23	296.7863231
6-Jul	12.00	23	281.7417002
7-Jul	12.00	23	287.2402442
8-Jul	12.00	23	270.5553692
9-Jul	12.00	23	263.313062
10-Jul	12.00	23	252.0516772
11-Jul	12.00	23	230.0923379
12-Jul	12.00	23	223.152447
13-Jul	12.00	23	216.2625603
14-Jul	12.00	23	201.3917948
15-Jul	12.00	23	210.5217061
16-Jul	12.00	23	207.8497648
17-Jul	12.00	23	199.2407017
18-Jul	12.00	23	200.1274562
19-Jul	12.00	23	216.2909159
20-Jul	12.00	23	225.3245163
21-Jul	12.00	23	197.8726136
22-Jul	12.00	23	181.8710138
23-Jul	12.00	23	175.2803464
24-Jul	12.00	23	164.1178837
25-Jul	12.00	23	160.8946741
26-Jul	12.00	23	146.6078004
27-Jul	12.00	23	134.8434353
28-Jul	12.00	23	124.4130413
29-Jul	12.00	23	111.2594053
30-Jul	12.00	23	102.6209179
31-Jul	12.00	23	97.83367468
1-Aug	12.00	23	90.07889691
2-Aug	12.00	23	92.79387095
3-Aug	12.00	23	89.81992736

4-Aug	12.00	23	83.59870049
5-Aug	12.00	23	79.01811989
6-Aug	12.00	23	73.5948631
7-Aug	12.00	23	79.46763575
8-Aug	12.00	23	78.45698313
9-Aug	12.00	23	72.70103128
10-Aug	12.00	23	65.81962457
11-Aug	12.00	23	62.68147377
12-Aug	12.00	23	62.592479
13-Aug	12.00	23	59.67080478
14-Aug	12.00	23	56.32264236
15-Aug	12.00	23	57.56942567
16-Aug	12.00	23	56.36721597
17-Aug	12.00	23	59.49402653
18-Aug	12.00	23	77.6261737
19-Aug	12.00	23	73.28619961
20-Aug	12.00	23	76.91901315
21-Aug	12.00	23	76.09471903
22-Aug	12.00	23	71.03489922
23-Aug	12.00	23	63.23757929
24-Aug	12.00	23	65.91880124
25-Aug	12.00	23	65.2114748
26-Aug	12.00	23	63.14440659
27-Aug	12.00	23	64.95454156
28-Aug	12.00	23	58.85949752
29-Aug	12.00	23	54.77744627
30-Aug	12.00	23	53.63291727
31-Aug	12.00	23	54.59637251
1-Sep	12.00	23	50.62627655
2-Sep	12.00	23	48.98493755
3-Sep	12.00	23	45.14205509
4-Sep	12.00	23	47.49776925
5-Sep	12.00	23	75.29719473
6-Sep	12.00	23	70.99770857
7-Sep	12.00	23	67.73135521
8-Sep	12.00	23	65.77101986
9-Sep	12.00	23	59.49896698
10-Sep	12.00	23	62.79384406
11-Sep	12.00	23	65.20016749
12-Sep	12.00	23	69.39823391
13-Sep	12.00	23	76.01991643
14-Sep	12.00	23	68.07464649
15-Sep	12.00	23	60.92709082
16-Sep	12.00	23	56.28937222
17-Sep	12.00	23	50.2333077
18-Sep	12.00	23	46.28533361
19-Sep	12.00	23	53.44120185
20-Sep	12.00	23	53.7593699
21-Sep	12.00	23	51.28576566
22-Sep	12.00	23	50.57787987

23-Sep	12.00	23	47.9161255
24-Sep	12.00	23	48.06512379
25-Sep	12.00	23	44.93052208
26-Sep	12.00	23	42.71086204
27-Sep	12.00	23	40.24477581
28-Sep	12.00	23	38.27905981
29-Sep	12.00	23	37.60613495
30-Sep	12.00	23	40.09060994
1-Oct	12.00	23	39.34193842
2-Oct	12.00	23	36.51678291
3-Oct	12.00	23	35.64240918
4-Oct	12.00	23	40.46055572
5-Oct	12.00	23	46.1826198
6-Oct	12.00	23	42.12228498
7-Oct	12.00	23	44.82491007
8-Oct	12.00	23	46.31823711
9-Oct	12.00	23	45.07497095
10-Oct	12.00	23	44.10967214
11-Oct	12.00	23	42.49412924
12-Oct	12.00	23	41.86077093
13-Oct	12.00	23	42.32169975
14-Oct	12.00	23	41.87970309
15-Oct	12.00	23	40.54217522
16-Oct	12.00	23	42.98050436
17-Oct	12.00	23	42.57859384
18-Oct	12.00	23	43.28025532
19-Oct	12.00	23	43.97897426
20-Oct	12.00	23	45.2560641
21-Oct	12.00	23	42.71374254
22-Oct	12.00	23	43.12647823
23-Oct	12.00	23	42.75653205
24-Oct	12.00	23	40.15089014
25-Oct	12.00	23	40.47939614
26-Oct	12.00	23	40.10144012
27-Oct	12.00	23	38.60116456
28-Oct	12.00	23	36.1157311
29-Oct	12.00	23	32.34279679
30-Oct	12.00	23	33.49387154
31-Oct	12.00	23	32.76856789
1-Nov	12.00		32.89861037
2-Nov	12.00		31.136071
3-Nov	12.00		29.15950413
4-Nov	12.00		27.88187721
5-Nov	12.00		28.04020574
6-Nov	12.00		26.70734747
7-Nov	12.00		26.22877167
8-Nov	12.00		26.09873891
9-Nov	12.00		25.37222571
10-Nov	12.00		24.9278938
11-Nov	12.00		24.62842174

12-Nov	12.00	24.55900311
13-Nov	12.00	24.13476533
14-Nov	12.00	22.91163241
15-Nov	12.00	23.27077365
16-Nov	12.00	22.2675439
17-Nov	12.00	21.48415835
18-Nov	12.00	21.15293515
19-Nov	12.00	20.53712081
20-Nov	12.00	21.00548202
21-Nov	12.00	20.54878088
22-Nov	12.00	20.25897553
23-Nov	12.00	20.115189
24-Nov	12.00	20.21154978
25-Nov	12.00	19.70525808
26-Nov	12.00	19.1644728
27-Nov	12.00	18.10039986
28-Nov	12.00	18.48176534
29-Nov	12.00	18.43538485
30-Nov	12.00	17.77879243
1-Dec	12.00	17.48268271
2-Dec	12.00	17.59405539
3-Dec	12.00	17.95670172
4-Dec	12.00	17.43655579
5-Dec	12.00	17.54972987
6-Dec	12.00	16.65063003
7-Dec	12.00	16.28572985
8-Dec	12.00	15.80026798
9-Dec	12.00	15.27465548
10-Dec	12.00	15.38420052
11-Dec	12.00	15.28920699
12-Dec	12.00	14.98895169
13-Dec	12.00	15.05781945
14-Dec	12.00	14.94412428
15-Dec	12.00	15.13751459
16-Dec	12.00	15.07313611
17-Dec	12.00	14.88056827
18-Dec	12.00	14.65246296
19-Dec	12.00	14.48672258
20-Dec	12.00	14.46955812
21-Dec	12.00	14.23341536
22-Dec	12.00	14.10717457
23-Dec	12.00	13.99081929
24-Dec	12.00	13.81657537
25-Dec	12.00	13.73937813
26-Dec	12.00	13.19039252
27-Dec	12.00	13.81691589
28-Dec	12.00	14.24557704
29-Dec	12.00	13.6976678
30-Dec	12.00	13.51377271
31-Dec	12.00	13.32506035

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 is one decreed surface diversions within this reach of stream Casey Ditch (0.50 cfs with an 1976 appropriation). Staff has determined that water is available for appropriation on Henson Creek, between the confluence with the North Fork Henson Creek to the confluence with Nellie 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:

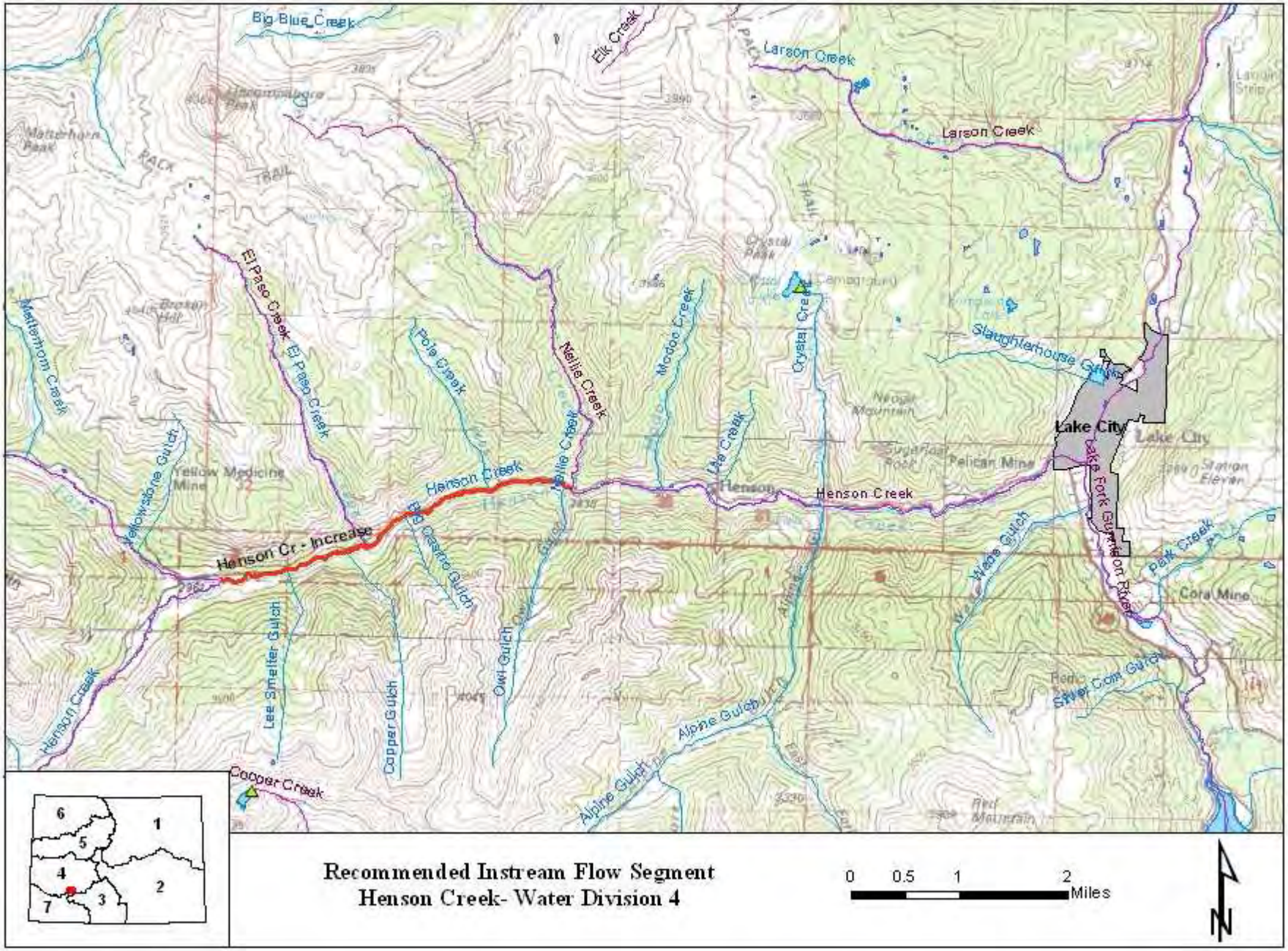
Segment: Confluence with the North Fork of Henson Creek to the Confluence with Nellie Creek

Upper Terminus: CONFLUNCE WITH THE NORTH FORK OF HENSON CREEK
(Latitude 38° 0' 25.1"N) (Longitude 107° 27' 32.6"W)
UTM North: 4209442.6 UTM East: 284104.9
S7 T43N R5W NMPM
2490' East of the West Section Line; 173' South of the North Section Line

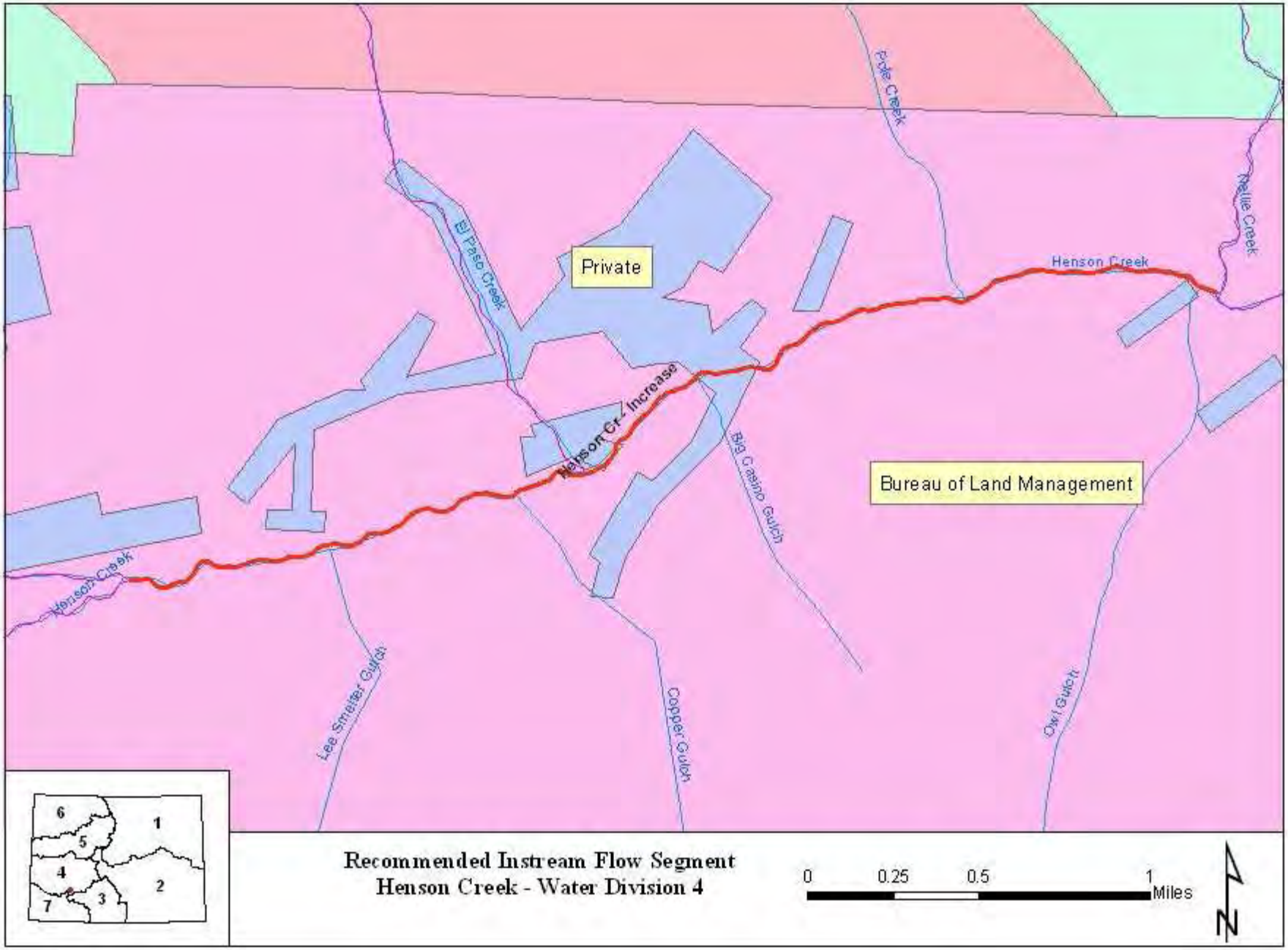
Lower Terminus: CONFLUENCE WITH NELLIE CREEK
(Latitude 38° 1' 13.3"N) (Longitude 107° 24' 4.0"W)
UTM North: 5210795.4 UTM East: 289231.4
S35 T44N R5W NMPM
1553' West of the East Section Line; 2476' North of the South Section Line

Watershed: Upper Gunnison (HUC#: 14020002)
Counties: Hinsdale
Length: 3.4 miles
USGS Quad(s): Uncompahgre Peak
Existing ISF: 4-82CW386, 12 cfs
Flow Recommendation (increase): 11 cfs (April 1 to October 31)

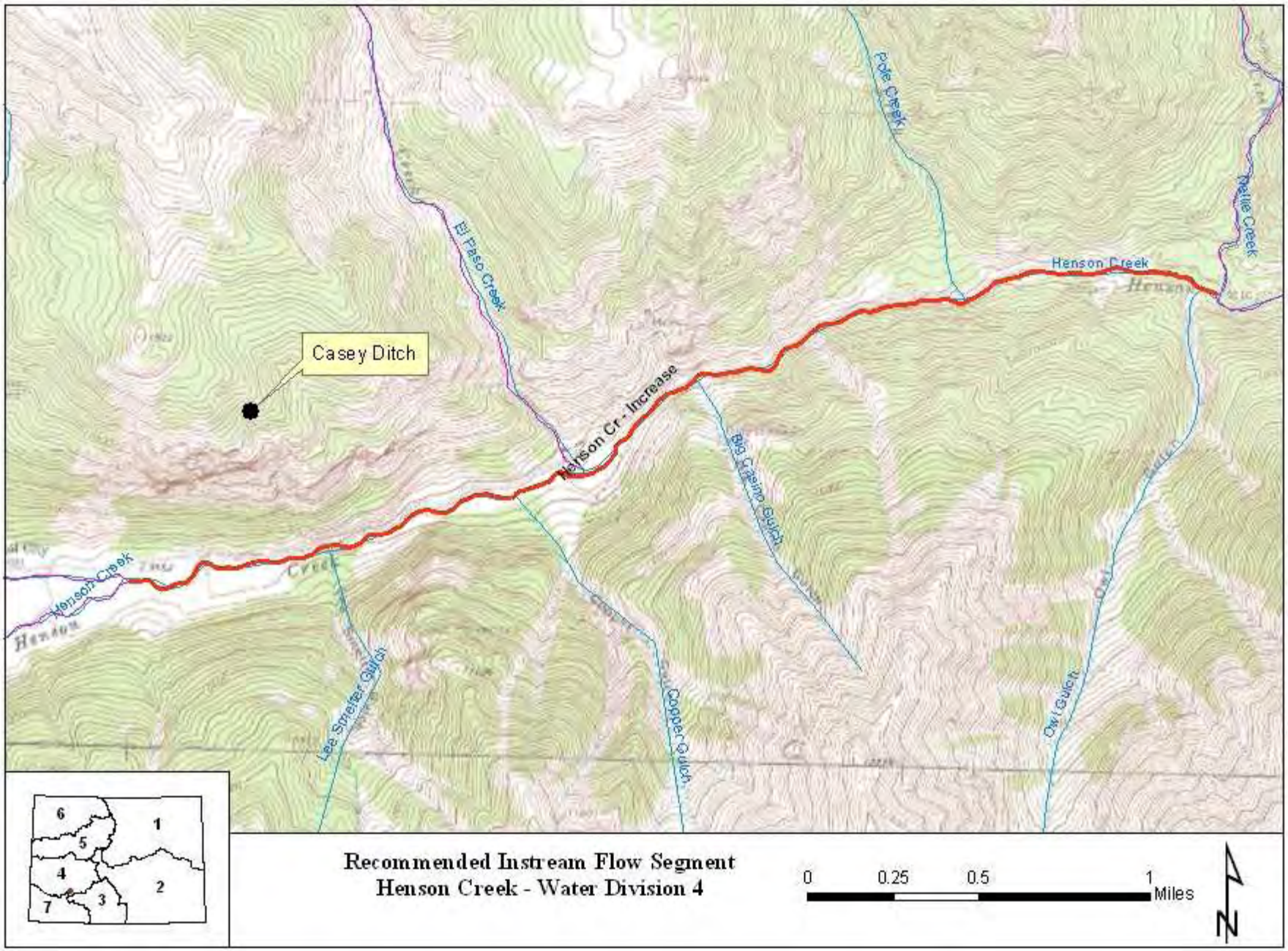
Vicinity Map



Land Use Map


Private
Bureau of Land Management
Henson Creek
Henson Cr. Increase
El Paso Creek
Pole Creek
Nellie Creek
Big Casino Gulch
Copper Gulch
Owl Gulch
Lee Smelter Gulch
Henson Creek
Recommended Instream Flow Segment
Henson Creek - Water Division 4
0
0.25
0.5
1
Miles
N
1
2
3
4
5
6
7

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)

DEC 30 2008

RECEIVED
JAN 05 2009
Colorado Water Conservation Board

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 Henson Creek, located in Water Division 4. The reach that is the subject of this recommendation begins at the confluence with the North Fork of Henson Creek and extends downstream to the confluence with Nellie Creek, a distance of 3.4 miles. The existing instream flow water right on this creek is 12 cubic feet per second, year round. The existing instream flow water right was established in 1984.

Location and Land Status: This portion of Henson Creek starts near the historic town site of Capitol City and ends approximately 4.5 miles west of Lake City. The stream reach is located within Hinsdale County. The land along this reach is comprised of approximately 2.7 miles of BLM ownership and 0.7 miles of private ownership.

Biological Summary: Overall, this portion of Henson Creek is a high gradient stream with large substrate size. In the upper portion of the reach, the canyon is sufficiently wide to allow the creek to have a well developed floodplain and wide willow riparian zone. In the lower portion of the reach, the creek is confined by a narrow canyon. Here, the bedrock restricts channel and riparian formation, but the creek has multiple pools and runs that provide excellent fish habitat. The creek supports a healthy and diverse aquatic insect community, including: caddisfly, stonefly, and mayfly. Fishery surveys indicate that the creek supports a self-sustaining population brook trout of various sizes and age classes.

R2Cross Analysis: The BLM's data analysis, coordinated with the Division of Wildlife, indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree.

- An 11 cubic feet per second (cfs) enlargement is recommended during the high temperature period from April 1 through October 31, bringing the total instream flow up to 23 cfs during this time period.

Justification for Instream Flow Enlargement: The BLM was prompted to re-examine the instream flow on Henson Creek because of BLM water quality management objectives in the Henson Creek and Lake Fork watersheds. Both of these stream systems are affected by historic mining activities, and the BLM has begun to initiate projects to treat and minimize acid mine runoff and heavy metals contamination. Within these watersheds, streams that are presently able to support fish are extraordinarily valuable for the habitat they provide and for their ability to dilute runoff originating in more contaminated parts of the watershed. Finally, this creek is located along the very heavily used Alpine Loop Backcountry Byway. Users of the byway seek opportunities to fish and camp along the uncontaminated streams within these watersheds.

The BLM's cross section analysis revealed that the current instream flow rate is not fully protective for several reasons. First, in locations where the stream widens out and is capable of providing significant riffle and physical habitat, the current 11 cfs water right provides an average depth of only 0.25 feet. The BLM believes this is insufficient depth for a channel that averages 40 feet in diameter, because a significant percentage of the usable habitat is lost or only barely deep enough for fish passage. The BLM also notes that protecting the flows necessary to meet with the depth criteria would provide wetted perimeter in the range of 80 to 90 percent. In a watershed where water quality issues already stress fish populations, the BLM believes that the population should not also be limited by physical habitat availability. The BLM's conclusion is that it is prudent to protect a higher flow rate that is capable of supporting a larger fish population.

The BLM also believes that this reach of Henson Creek is an important fish source for the repopulation of lower reaches of Henson Creek. The BLM is undertaking a major effort to reclaim the Ute-Ulay Mine located approximately 1.5 miles downstream. As water quality improves in this section, it is anticipated that fish from this reach will move into the improved habitat. The lower reaches of Henson Creek near Lake City cannot serve as a repopulation source for the Henson Creek near the Ute-Ulay Mine. Treasure Falls, located downstream from the Ute-Ulay mine, is a natural barrier that prevents fish from moving upstream into the reach where the mine is located.

Water Availability: For water availability analysis, the BLM recommends using a combination of methods. First, the BLM recommends developing a synthetic hydrograph using the equations provided in *Estimation of Natural Streamflow Characteristics in Western Colorado, USGS Water Resources Investigation Report 85-4086, 1985.* This method incorporates data about basin size and elevation. This synthetic hydrograph should then be reconciled against historic

gage data, using a basin apportionment approach. The most relevant historic gage is USGS gage 09124000 (Henson Creek at Lake City, CO). It should be noted that the gage may have been affected by icing during the winter, and may have underestimated winter flows as a result.

The BLM's search of the official water rights tabulation revealed that the Casey Ditch may be located within the stream reach proposed for an enlargement. The legal description provided for the ditch places it off of the stream channel. However, changes in the official land surveys for this area may have resulted in an erroneous description in the water right decree. Water rights located upstream from this reach include the Lucky Chance Pipeline (50 cfs – nonconsumptive), Lucky Chance Reservoir (0.59 acre feet), Yellowstone Pipeline (0.03 cfs), and PG Ditch No. 1 (0.075 cfs – conditional).

Conclusion: The BLM believes that there is strong justification for an additional instream flow appropriation. This creek is this highly accessible creek that and is located in an area where water quality issues preclude human usage and fish habitat on other streams. Our initial water availability analysis indicates there is sufficient water to support the appropriation without material injury to existing water rights. Accordingly, we urge the board to make an initial appropriation at its regular board meeting in January 2009.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section to support this recommendation were provided with the draft recommendation in February 2008. We thank the Colorado Water Conservation Board for its cooperation in this effort.

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

Sincerely,

for Linda Anania
Deputy State Director, Resources and Fire

cc:
Kenny McDaniel, Gunnison FO
Art Hayes, Gunnison FO
Tom Fresques, Glenwood Springs FO

DRAFT INSTREAM FLOW RECOMMENDATION – HENSON CREEK, WD 4

Feb. 13, 2008

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

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are presently able to support fish are extraordinarily valuable for the habitat they provide and for their ability to dilute runoff originating in more contaminated parts of the watershed. Finally, this creek is located along the very heavily used Alpine Loop Backcountry Byway. Users of the byway seek opportunities to fish and camp along the uncontaminated streams within these watersheds.

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Data sheets, R2Cross output, fishery survey information, and photographs of the cross section are enclosed to support this recommendation. We thank the Colorado Water Conservation Board for its cooperation in this effort.

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

Sincerely,

Linda Anania
Deputy State Director
Resources and Fire

4 Enclosures

cc: Kenny McDaniel, Gunnison FO
Art Hayes, Gunnison FO
Tom Fresques, Glenwood Springs FO

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: [illegible] above [illegible]						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: just above Blue Moon Mine						
DATE: 10-9-07	OBSERVERS: R. Smith, D. Murphy					
LEGAL DESCRIPTION	¼ SECTION: NE	SECTION: 7	TOWNSHIP: 43 N/S	RANGE: 5 E/W	PM: NM	
COUNTY: [illegible]	WATERSHED: [illegible] Fork	WATER DIVISION:	DOW WATER CODE: 406724			
MAP(S): USGS: Uncompahgre Creek 7.5'						
USFS:						

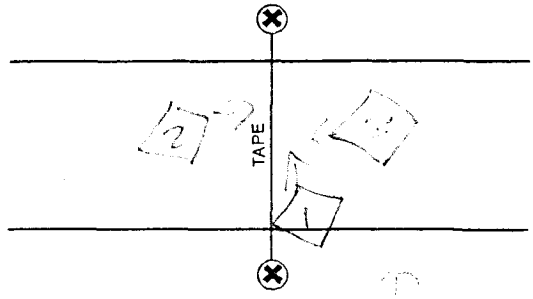
SUPPLEMENTAL DATA

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: gravel to 1 foot boulders	PHOTOGRAPHS TAKEN: YES/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	6.30 / 6.15
② WS Upstream	[illegible]	[illegible]
③ WS Downstream	15.0	[illegible]
SLOPE	[illegible] .0236	

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
see attached																	

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

mayfly & caddisfly

COMMENTS

pH: 7.9

TDS: 160

Temp: [illegible]

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO.:	DATE:	SHEET ___ OF ___

BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ft	TIME:

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)		Area (ft^2)	Discharge (cfs)
								At Point	Mean in Vertical		
LS	2.0		1.38								
	3.0		1.62								
G	5.0		5.46								
W	5.7		6.80								
	5.5		7.40	.6				2.45			
	6.0		7.55	.75				1.77			
	6.5		7.25	.45				1.78			
	7.0		7.30	.50				[illegible]			
	7.5		7.15	.35				2.10			
	8.0		7.25	.45				[illegible]			
	8.5		7.35	.55				2.57			
	16.0		7.40	.60				2.71			
	12.5		7.55	.75				2.20			
	13.0		7.30	.50				[illegible]			
	13.5		[illegible]	.70				1.34			
	22.0		7.35	[illegible]				1.52			
	23.5		7.35	.60				1.80			
	24.0		7.25	.50				2.09			
	24.5		7.35	.60				2.67			
	[illegible]		7.35	.60				1.93			
	[illegible]		7.25	.50				1.22			
	31.0		[illegible]	.20				1.73			
	32.5		[illegible]	.55				1.21			
	34.0		[illegible]	.40				.71			
	35.5		[illegible]	.10				0			
W	37.0		[illegible]								
	39.0		[illegible]								
G	[illegible]		5.55								
LS	[illegible]		[illegible]								
TOTALS:											

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

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Henson Creek - above Lee Boulder Gulch						CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: just above Blue Moon Mine						
DATE: 10-9-07	OBSERVERS: R. Smith, D Murphy					
LEGAL DESCRIPTION	¼ SECTION: NE	SECTION: 7	TOWNSHIP: 43 (N)/S	RANGE: 5 E(W)	PM: NM	
COUNTY: Hinsdale	WATERSHED: Lake Fork	WATER DIVISION: 4	DOW WATER CODE: 40624			
MAP(S): USGS: Uncompahgre Peak 7.5'		Z13 GPS 284635				
USFS:		4209302				

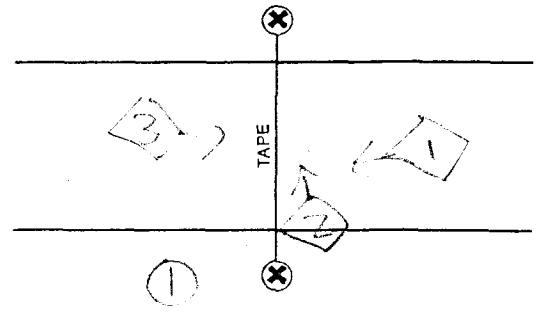
SUPPLEMENTAL DATA

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: gravel to 1-foot boulders	PHOTOGRAPHS TAKEN (YES/NO)	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	6.02
② WS Upstream	15.0	[illegible]
③ WS Downstream	15.0	[illegible].18
SLOPE	0.24/30.0 = .008	

SKETCH



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

AQUATIC SAMPLING SUMMARY

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

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

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

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

mayfly & caddisfly

COMMENTS

pH: 7.9
TDS: 180
Temp: 7°C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Henson Creek	CROSS-SECTION NO.: 2	DATE: 9-7-07	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 4:40 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)
LS	0.0		4.64								
	3.0		5.04								
	5.0		6.04								
	5.0		6.20	.2				0			
	6.0		6.35	.35				1.95			
	8		6.75	.75				1.84			
	10		6.80	.80				2.23			
	12		6.70	.70				2.16			
	14		6.50	.50				2.25			
	16		6.70	.70				2.02			
	18		6.60	.60				1.41			
	20		6.55	.55				2.61			
	22		6.50	.50				2.51			
	24		6.45	.45				1.83			
	26		6.50	.50				1.43			
	28		6.40	.40				.96			
	30		6.30	.30				1.03			
	32		6.40	.40				1.04			
	34		6.40	.40				1.35			
	36		6.45	.45				1.70			
	38		6.30	.30				1.40			
	40		6.25	.25				.20			
	42		6.10	.10				0			
RS	110.8		6.02								
C	114.7		5.04								
LS	49.0		4.18								
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:	Henson Creek
XS LOCATION:	Just u/s from Blue Moon Mine
XS NUMBER:	1
DATE:	9-Oct-07
OBSERVERS:	R. Smith, D. Murphy
1/4 SEC:	NE
SECTION:	7
TWP:	43N
RANGE:	5W
PM:	NM
COUNTY:	Hinsdale
WATERSHED:	Lake Fork Gunnison River
DIVISION:	4
DOW CODE:	40624
USGS MAP:	Uncompahgre Peak 7.5'
USFS MAP:	0

SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

SLOPE:	0.0236

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

ASSIGNED TO: ……..……DATE.....

STREAM NAME: Henson Creek
XS LOCATION: Just u/s from Blue Moon Mine
XS NUMBER: 1

DATA POINTS= 29

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	0.00	4.38			0.00		0.00	0.00	0.0%
		3.00	4.62			0.00		0.00	0.00	0.0%
1	G	5.00	5.46			0.00		0.00	0.00	0.0%
	W	5.40	6.80			0.00		0.00	0.00	0.0%
		5.50	7.40	0.60	2.45	0.61	0.60	0.48	1.18	3.5%
		7.00	7.55	0.75	1.99	1.51	0.75	1.13	2.24	6.7%
		8.50	7.25	0.45	1.78	1.53	0.45	0.68	1.20	3.6%
		10.00	7.30	0.50	3.25	1.50	0.50	0.75	2.44	7.3%
		11.50	7.15	0.35	2.72	1.51	0.35	0.53	1.43	4.3%
		13.00	7.25	0.45	2.74	1.50	0.45	0.68	1.85	5.5%
		14.50	7.35	0.55	2.59	1.50	0.55	0.83	2.14	6.4%
		16.00	7.40	0.60	2.71	1.50	0.60	0.90	2.44	7.3%
		17.50	7.55	0.75	2.20	1.51	0.75	1.13	2.48	7.4%
		19.00	7.30	0.50	3.05	1.52	0.50	0.75	2.29	6.8%
		20.50	7.45	0.70	1.34	1.51	0.70	1.05	1.41	4.2%
		22.00	7.35	0.60	1.52	1.50	0.60	0.90	1.37	4.1%
		23.50	7.35	0.60	1.80	1.50	0.60	0.90	1.62	4.9%
		25.00	7.25	0.50	2.69	1.50	0.50	0.75	2.02	6.0%
		26.50	7.35	0.60	2.87	1.50	0.60	0.90	2.58	7.7%
		28.00	7.35	0.60	1.95	1.50	0.60	0.90	1.76	5.3%
		29.50	7.25	0.50	1.22	1.50	0.50	0.75	0.92	2.7%
		31.00	6.95	0.20	1.73	1.53	0.20	0.30	0.52	1.6%
		32.50	7.30	0.55	1.21	1.54	0.55	0.83	1.00	3.0%
		34.00	7.15	0.40	0.91	1.51	0.40	0.60	0.55	1.6%
		35.50	6.85	0.10	0.00	1.53	0.10	0.15	0.00	0.0%
	W	37.00	6.75			1.50		0.00	0.00	0.0%
		39.00	6.45			0.00		0.00	0.00	0.0%
1	G	42.00	5.55			0.00		0.00	0.00	0.0%
	RS	45.00	5.12			0.00		0.00	0.00	0.0%
	TOTALS ----------					32.32	0.75 (Max.)	15.86	33.40	100.0%

Manning's n = 0.0674
Hydraulic Radius= 0.490551629

STREAM NAME: Henson Creek
XS LOCATION: Just u/s from Blue Moon Mine
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	15.86	15.79	-0.4%
6.53	15.86	23.86	50.5%
6.55	15.86	23.20	46.3%
6.57	15.86	22.54	42.2%
6.59	15.86	21.88	38.0%
6.61	15.86	21.23	33.9%
6.63	15.86	20.58	29.8%
6.65	15.86	19.93	25.7%
6.67	15.86	19.29	21.6%
6.69	15.86	18.64	17.6%
6.71	15.86	18.00	13.5%
6.73	15.86	17.37	9.5%
6.74	15.86	17.05	7.5%
6.75	15.86	16.73	5.5%
6.76	15.86	16.42	3.5%
6.77	15.86	16.10	1.5%
6.78	15.86	15.79	-0.4%
6.79	15.86	15.48	-2.4%
6.80	15.86	15.17	-4.3%
6.81	15.86	14.86	-6.3%
6.82	15.86	14.55	-8.2%
6.83	15.86	14.25	-10.2%
6.85	15.86	13.64	-14.0%
6.87	15.86	13.04	-17.8%
6.89	15.86	12.44	-21.6%
6.91	15.86	11.84	-25.3%
6.93	15.86	11.25	-29.1%
6.95	15.86	10.65	-32.8%
6.97	15.86	10.06	-36.5%
6.99	15.86	9.48	-40.2%
7.01	15.86	8.90	-43.9%
7.03	15.86	8.33	-47.5%

WATERLINE AT ZERO
AREA ERROR = 6.773

STREAM NAME: Henson Creek
XS LOCATION: Just u/s from Blue Moon Mine
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	5.55	36.97	1.57	2.00	58.18	38.78	100.0%	1.50	258.20	4.44
	5.77	36.16	1.38	1.78	50.03	37.77	97.4%	1.32	204.34	4.08
	5.82	35.98	1.34	1.73	48.22	37.55	96.8%	1.28	192.98	4.00
	5.87	35.80	1.30	1.68	46.43	37.32	96.2%	1.24	181.89	3.92
	5.92	35.62	1.25	1.63	44.64	37.09	95.7%	1.20	171.07	3.83
	5.97	35.44	1.21	1.58	42.87	36.87	95.1%	1.16	160.53	3.74
	6.02	35.26	1.17	1.53	41.10	36.64	94.5%	1.12	150.27	3.66
	6.07	35.07	1.12	1.48	39.34	36.41	93.9%	1.08	140.28	3.57
	6.12	34.89	1.08	1.43	37.59	36.19	93.3%	1.04	130.58	3.47
	6.17	34.71	1.03	1.38	35.85	35.96	92.7%	1.00	121.17	3.38
	6.22	34.53	0.99	1.33	34.12	35.74	92.2%	0.95	112.05	3.28
	6.27	34.35	0.94	1.28	32.40	35.51	91.6%	0.91	103.22	3.19
	6.32	34.17	0.90	1.23	30.69	35.28	91.0%	0.87	94.69	3.09
	6.37	33.98	0.85	1.18	28.98	35.06	90.4%	0.83	86.46	2.98
	6.42	33.80	0.81	1.13	27.29	34.83	89.8%	0.78	78.54	2.88
	6.47	33.55	0.76	1.08	25.60	34.53	89.0%	0.74	71.03	2.77
	6.52	33.20	0.72	1.03	23.93	34.14	88.0%	0.70	63.97	2.67
	6.57	32.85	0.68	0.98	22.28	33.75	87.0%	0.66	57.22	2.57
	6.62	32.50	0.64	0.93	20.65	33.36	86.0%	0.62	50.79	2.46
	6.67	32.15	0.59	0.88	19.03	32.97	85.0%	0.58	44.69	2.35
	6.72	31.80	0.55	0.83	17.43	32.58	84.0%	0.54	38.91	2.23
WL	6.77	31.27	0.51	0.78	15.85	32.01	82.5%	0.50	33.62	2.12
	6.82	30.50	0.47	0.73	14.31	31.20	80.5%	0.46	28.82	2.01
	6.87	29.97	0.43	0.68	12.80	30.63	79.0%	0.42	24.24	1.89
	6.92	29.72	0.38	0.63	11.31	30.32	78.2%	0.37	19.85	1.75
	6.97	29.24	0.34	0.58	9.83	29.80	76.8%	0.33	15.90	1.62
	7.02	28.52	0.29	0.53	8.39	29.02	74.8%	0.29	12.42	1.48
	7.07	27.80	0.25	0.48	6.98	28.24	72.8%	0.25	9.31	1.33
	7.12	27.08	0.21	0.43	5.61	27.46	70.8%	0.20	6.59	1.17
	7.17	25.67	0.17	0.38	4.28	25.99	67.0%	0.16	4.36	1.02
	7.22	23.45	0.13	0.33	3.05	23.71	61.1%	0.13	2.64	0.86
	7.27	19.51	0.10	0.28	1.96	19.71	50.8%	0.10	1.42	0.73
	7.32	14.41	0.08	0.23	1.12	14.55	37.5%	0.08	0.69	0.61
	7.37	7.70	0.07	0.18	0.56	7.77	20.0%	0.07	0.33	0.59
	7.42	4.62	0.06	0.13	0.26	4.66	12.0%	0.06	0.13	0.49
	7.47	2.39	0.04	0.08	0.09	2.41	6.2%	0.04	0.04	0.38
	7.52	0.84	0.01	0.03	0.01	0.85	2.2%	0.01	0.00	0.19

STREAM NAME: Henson Creek
XS LOCATION: Just u/s from Blue Moon Mine
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	33.40	cfs
CALCULATED FLOW (Qc)=	33.62	cfs
(Qm-Qc)/Qm * 100 =	-0.7	%
MEASURED WATERLINE (WLm)=	6.78	ft
CALCULATED WATERLINE (WLc)=	6.77	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.75	ft
MAX CALCULATED DEPTH (Dc)=	0.78	ft
(Dm-Dc)/Dm * 100	-3.6	%
MEAN VELOCITY=	2.12	ft/sec
MANNING'S N=	0.067	
SLOPE=	0.0236	ft/ft
.4 * Qm =	13.4	cfs
2.5 * Qm=	83.5	cfs

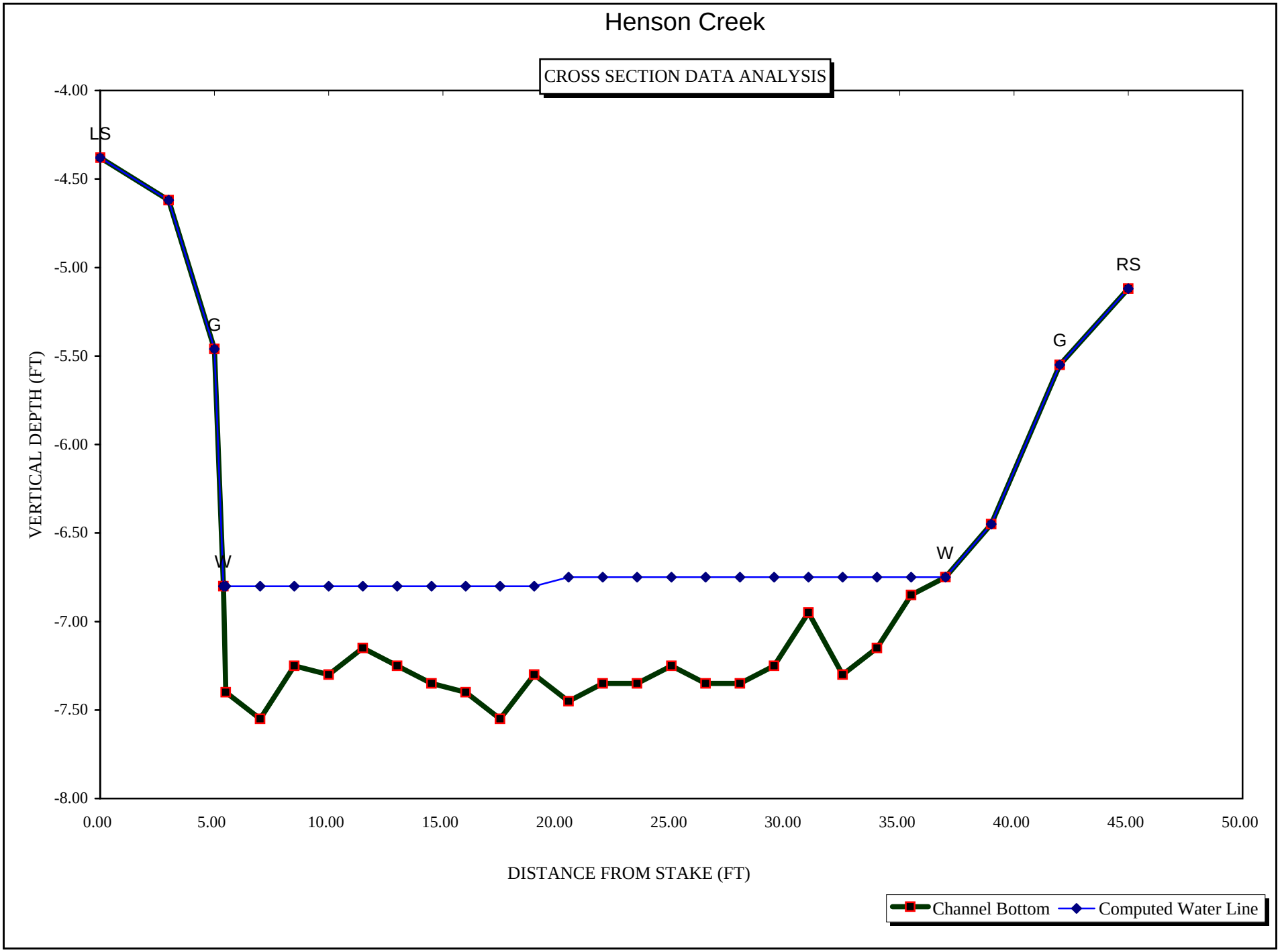
RECOMMENDED INSTREAM FLOW:
=============================

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

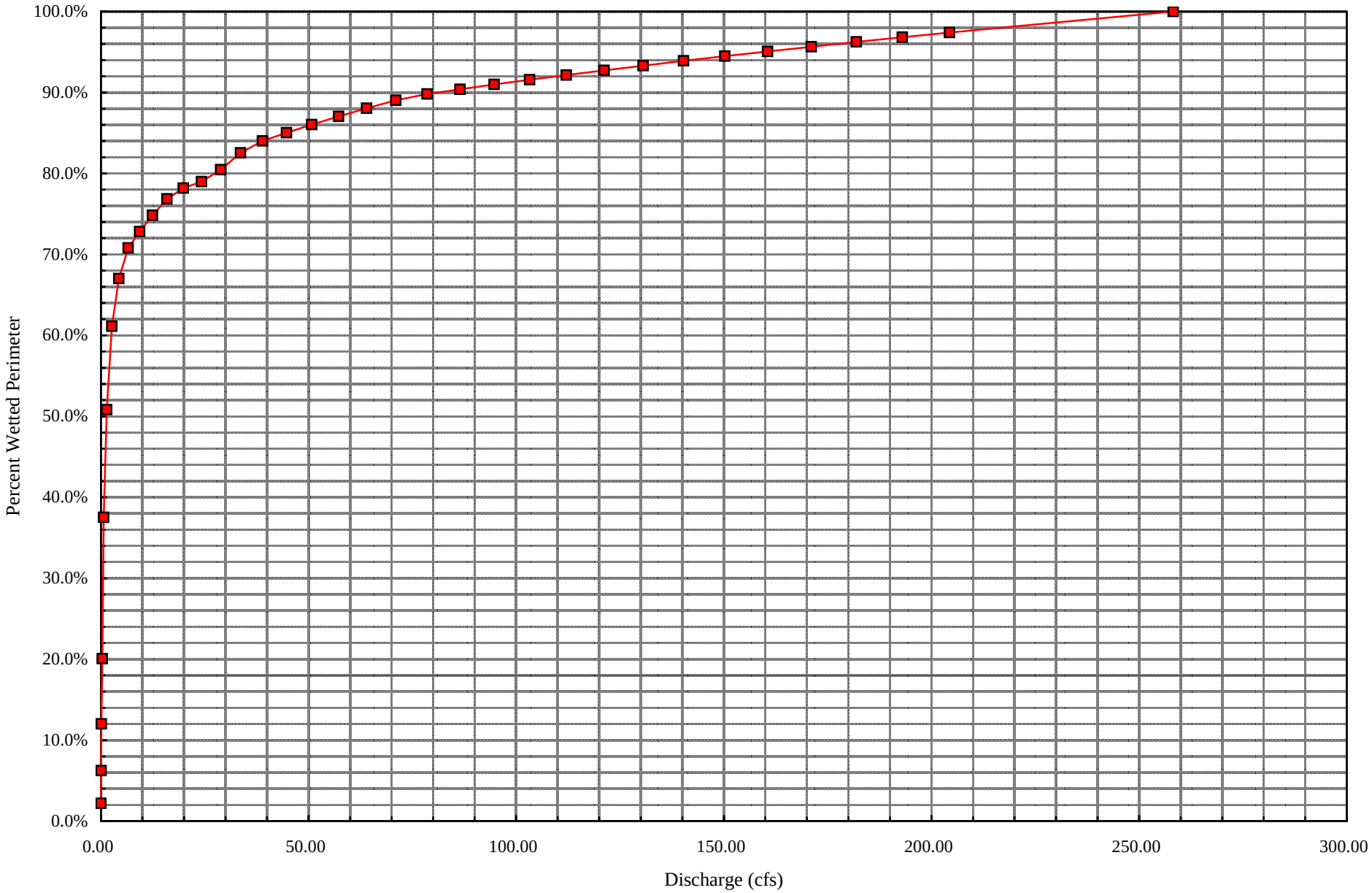
RATIONALE FOR RECOMMENDATION:
=============================

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

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


Henson Creek
CROSS SECTION DATA ANALYSIS
LS
G
W
W
G
RS
-4.00
-4.50
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
-8.00
VERTICAL DEPTH (FT)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line

Percent Wetted Perimeter vs. Discharge



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

LOCATION INFORMATION

STREAM NAME:	Henson Creek
XS LOCATION:	Just upstream from Blue Moon Mine
XS NUMBER:	2
DATE:	9-Oct-07
OBSERVERS:	R. Smith, D. Murphy
1/4 SEC:	NE
SECTION:	7
TWP:	43N
RANGE:	5W
PM:	NM
COUNTY:	Hinsdale
WATERSHED:	Lake Fork Gunnison River
DIVISION:	4
DOW CODE:	40624
USGS MAP:	Uncompahgre Peak 7.5'
USFS MAP:	0

SUPPLEMENTAL DATA

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

TAPE WT:	0.0106
TENSION:	99999

CHANNEL PROFILE DATA

SLOPE:	0.008

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

ASSIGNED TO: ….....……….....DATE.....

STREAM NAME: Henson Creek
XS LOCATION: Just upstream from Blue Moon Mine
XS NUMBER: 2

DATA POINTS= 26

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	0.00	4.64			0.00		0.00	0.00	0.0%
1	G	2.50	5.04			0.00		0.00	0.00	0.0%
	W	3.00	6.02			0.00		0.00	0.00	0.0%
		4.00	6.20	0.20	0.00	1.02	0.20	0.30	0.00	0.0%
		6.00	6.35	0.35	1.95	2.01	0.35	0.70	1.37	4.3%
		8.00	6.75	0.75	1.84	2.04	0.75	1.50	2.76	8.7%
		10.00	6.80	0.80	2.23	2.00	0.80	1.60	3.57	11.3%
		12.00	6.70	0.70	2.16	2.00	0.70	1.40	3.02	9.5%
		14.00	6.50	0.50	2.25	2.01	0.50	1.00	2.25	7.1%
		16.00	6.70	0.70	2.02	2.01	0.70	1.40	2.83	8.9%
		18.00	6.60	0.60	1.41	2.00	0.60	1.20	1.69	5.3%
		20.00	6.55	0.55	2.61	2.00	0.55	1.10	2.87	9.1%
		22.00	6.50	0.50	2.51	2.00	0.50	1.00	2.51	7.9%
		24.00	6.45	0.45	1.83	2.00	0.45	0.90	1.65	5.2%
		26.00	6.50	0.50	1.43	2.00	0.50	1.00	1.43	4.5%
		28.00	6.40	0.40	0.96	2.00	0.40	0.80	0.77	2.4%
		30.00	6.30	0.30	1.03	2.00	0.30	0.60	0.62	1.9%
		32.00	6.40	0.40	1.04	2.00	0.40	0.80	0.83	2.6%
		34.00	6.40	0.40	1.35	2.00	0.40	0.80	1.08	3.4%
		36.00	6.45	0.45	1.70	2.00	0.45	0.90	1.53	4.8%
		38.00	6.30	0.30	1.40	2.01	0.30	0.60	0.84	2.6%
		40.00	6.25	0.25	0.20	2.00	0.25	0.50	0.10	0.3%
		42.00	6.10	0.10	0.00	2.01	0.10	0.14	0.00	0.0%
	W	42.80	6.02			0.80		0.00	0.00	0.0%
1	G	44.70	5.04			0.00		0.00	0.00	0.0%
	RS	49.00	4.18			0.00		0.00	0.00	0.0%
	TOTALS ----------					39.91	0.8 (Max.)	18.24	31.71	100.0%

Manning's n = 0.0454
Hydraulic Radius= 0.456990105

STREAM NAME: Henson Creek
XS LOCATION: Just upstream from Blue Moon Mine
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	18.24	17.46	-4.3%
5.77	18.24	27.49	50.7%
5.79	18.24	26.68	46.3%
5.81	18.24	25.87	41.9%
5.83	18.24	25.07	37.4%
5.85	18.24	24.26	33.0%
5.87	18.24	23.46	28.6%
5.89	18.24	22.66	24.2%
5.91	18.24	21.86	19.8%
5.93	18.24	21.05	15.4%
5.95	18.24	20.25	11.0%
5.97	18.24	19.46	6.7%
5.98	18.24	19.06	4.5%
5.99	18.24	18.66	2.3%
6.00	18.24	18.26	0.1%
6.01	18.24	17.86	-2.1%
6.02	18.24	17.46	-4.3%
6.03	18.24	17.07	-6.4%
6.04	18.24	16.67	-8.6%
6.05	18.24	16.28	-10.8%
6.06	18.24	15.88	-12.9%
6.07	18.24	15.49	-15.1%
6.09	18.24	14.71	-19.3%
6.11	18.24	13.94	-23.6%
6.13	18.24	13.18	-27.7%
6.15	18.24	12.42	-31.9%
6.17	18.24	11.68	-36.0%
6.19	18.24	10.93	-40.1%
6.21	18.24	10.20	-44.1%
6.23	18.24	9.48	-48.0%
6.25	18.24	8.77	-51.9%
6.27	18.24	8.07	-55.7%

WATERLINE AT ZERO
AREA ERROR = 6.000

STREAM NAME: Henson Creek
XS LOCATION: Just upstream from Blue Moon Mine
XS NUMBER: 2

Constant Manning's n

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

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.04	42.20	1.37	1.76	57.64	43.15	100.0%	1.34	204.90	3.55
	5.05	42.17	1.36	1.75	57.20	43.12	99.9%	1.33	202.39	3.54
	5.10	42.05	1.31	1.70	55.09	42.95	99.5%	1.28	190.61	3.46
	5.15	41.93	1.26	1.65	53.00	42.79	99.2%	1.24	179.12	3.38
	5.20	41.81	1.22	1.60	50.90	42.62	98.8%	1.19	167.92	3.30
	5.25	41.68	1.17	1.55	48.81	42.46	98.4%	1.15	157.00	3.22
	5.30	41.56	1.12	1.50	46.73	42.29	98.0%	1.11	146.39	3.13
	5.35	41.44	1.08	1.45	44.66	42.13	97.6%	1.06	136.07	3.05
	5.40	41.32	1.03	1.40	42.59	41.96	97.2%	1.01	126.06	2.96
	5.45	41.19	0.98	1.35	40.53	41.80	96.9%	0.97	116.35	2.87
	5.50	41.07	0.94	1.30	38.47	41.63	96.5%	0.92	106.96	2.78
	5.55	40.95	0.89	1.25	36.42	41.46	96.1%	0.88	97.89	2.69
	5.60	40.83	0.84	1.20	34.38	41.30	95.7%	0.83	89.14	2.59
	5.65	40.70	0.79	1.15	32.34	41.13	95.3%	0.79	80.72	2.50
	5.70	40.58	0.75	1.10	30.30	40.97	94.9%	0.74	72.64	2.40
	5.75	40.46	0.70	1.05	28.28	40.80	94.6%	0.69	64.90	2.30
	5.80	40.34	0.65	1.00	26.26	40.64	94.2%	0.65	57.51	2.19
	5.85	40.22	0.60	0.95	24.24	40.47	93.8%	0.60	50.49	2.08
	5.90	40.09	0.55	0.90	22.24	40.31	93.4%	0.55	43.83	1.97
	5.95	39.97	0.51	0.85	20.24	40.14	93.0%	0.50	37.56	1.86
WL	6.00	39.85	0.46	0.80	18.24	39.98	92.6%	0.46	31.68	1.74
	6.05	39.33	0.41	0.75	16.26	39.44	91.4%	0.41	26.39	1.62
	6.10	38.55	0.37	0.70	14.31	38.65	89.6%	0.37	21.62	1.51
	6.15	37.60	0.33	0.65	12.41	37.70	87.4%	0.33	17.33	1.40
	6.20	36.65	0.29	0.60	10.55	36.74	85.2%	0.29	13.45	1.28
	6.25	35.31	0.25	0.55	8.75	35.39	82.0%	0.25	10.10	1.15
	6.30	32.64	0.22	0.50	7.05	32.72	75.8%	0.22	7.43	1.05
	6.35	29.31	0.19	0.45	5.50	29.38	68.1%	0.19	5.28	0.96
	6.40	24.38	0.17	0.40	4.11	24.45	56.7%	0.17	3.67	0.89
	6.45	20.45	0.15	0.35	2.99	20.51	47.5%	0.15	2.43	0.81
	6.50	15.22	0.14	0.30	2.10	15.27	35.4%	0.14	1.64	0.78
	6.55	11.97	0.12	0.25	1.42	12.01	27.8%	0.12	1.00	0.71
	6.60	8.73	0.10	0.20	0.90	8.76	20.3%	0.10	0.58	0.64
	6.65	6.48	0.08	0.15	0.52	6.50	15.1%	0.08	0.28	0.55
	6.70	4.24	0.06	0.10	0.25	4.25	9.8%	0.06	0.11	0.45
	6.75	2.97	0.02	0.05	0.07	2.97	6.9%	0.02	0.02	0.25

STREAM NAME: Henson Creek
XS LOCATION: Just upstream from Blue Moon Mine
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	31.71	cfs
CALCULATED FLOW (Qc)=	31.68	cfs
(Qm-Qc)/Qm * 100 =	0.1	%
MEASURED WATERLINE (WLm)=	6.02	ft
CALCULATED WATERLINE (WLc)=	6.00	ft
(WLm-WLc)/WLm * 100 =	0.3	%
MAX MEASURED DEPTH (Dm)=	0.80	ft
MAX CALCULATED DEPTH (Dc)=	0.80	ft
(Dm-Dc)/Dm * 100	0.1	%
MEAN VELOCITY=	1.74	ft/sec
MANNING'S N=	0.045	
SLOPE=	0.008	ft/ft
.4 * Qm =	12.7	cfs
2.5 * Qm=	79.3	cfs

RECOMMENDED INSTREAM FLOW:
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FLOW (CFS)	PERIOD
___________	________
___________	________
___________	________
___________	________

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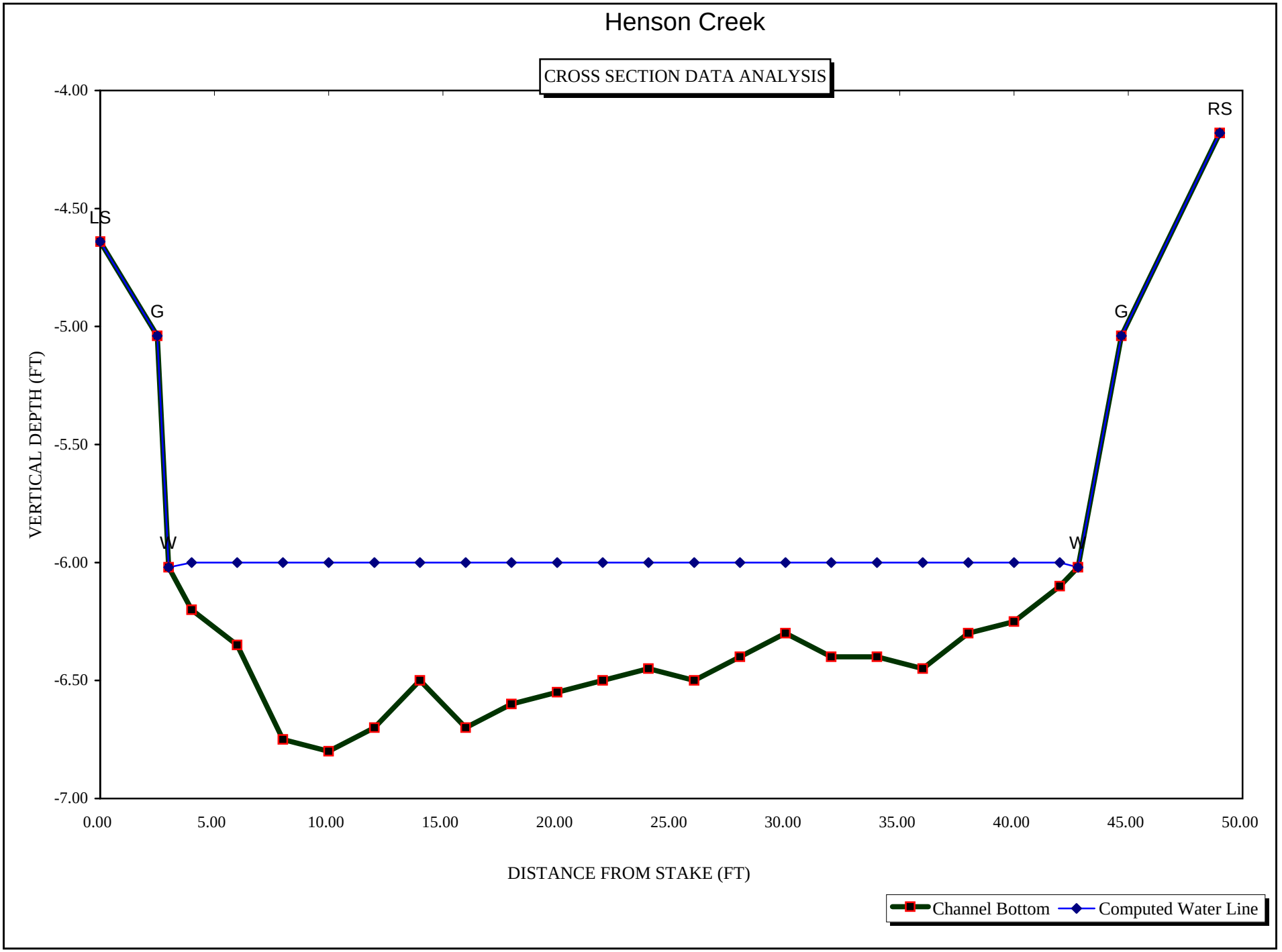
RECOMMENDATION BY: ………………...……….……............................... AGENCY..……………………......…....…...….…...... DATE:......…...…......……………

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


Henson Creek
CROSS SECTION DATA ANALYSIS
-4.00
-4.50
-5.00
-5.50
-6.00
-6.50
-7.00
VERTICAL DEPTH (FT)
LS
G
W
W
G
RS
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line

Percent Wetted Perimeter vs. Discharge