Stream: Corral Creek

Executive Summary

Water Division: 5
Water District: 50
CDOW#: 19744
CWCB ID: 08/5/A-013

Segment: Confluence Smith Creek to Headgate Home Ditch # 1

Upper Terminus: CONFLUENCE WITH SMITH CREEK
(Latitude 40° 5’ 56.66”N) (Longitude 106° 11’ 7.64”W)

Lower Terminus: HEADGATE HOME DITCH # 1
(Latitude 40° 3’ 55.03”N) (Longitude 106° 11’ 7.64”W)

Watershed: Colorado headwaters (HUC#: 14010001)
Counties: Grand
Length: 2.7 miles
USGS Quad(s): Parshall
Existing ISF: 5-86CW214, 1.5 cfs (1/1-12/31)
Flow Recommendation (increase): 2.75 cfs (April 1 to October 31)
0.9 cfs (November 1 to March 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 recommended an increase to this segment of Corral Creek to the CWCB for inclusion into the Instream Flow Program. Corral Creek is being considered for an increase into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Corral Creek is 12 miles long. It begins on the southeast flank of Corral within the Arapaho National Forest at an elevation of approximately 10690 feet and terminates at the confluence with the Colorado River at an elevation of approximately 7400 feet. Approximately 91% of the land on the 2.7 mile segment addressed by this report is publicly owned. Corral Creek is located within Grand County. The total drainage area of the creek is approximately 28.12 square miles. Corral Creek generally flows in a southwesterly direction.

The subject of this report is a segment of Corral Creek beginning at the confluence with Smith Creek and extending downstream to the headgate of Home Ditch # 1. The proposed segment is located approximately 5 miles west of Hot Sulphur Springs. The staff has received only one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation(s)

BLM recommended 2.75 cfs, summer, and 0.9 cfs, winter, based on its August 30, 2006 data collection efforts.

Justification for Instream Flow Increase

The BLM believes that current irrigation and storage practices on the creek are supportive of the natural environment. Water availability analysis has demonstrated that these practices result in a consistently higher flow rate than the current instream flow right. A dramatic change in the exercise of senior water rights could threaten this management approach, so the BLM is making this recommendation with an eye toward supporting and maintaining current water management practices.

A request for an increase is also driven by physical characteristics of the creek. The creek is characterized by short riffles between numerous beaver ponds and plunge pools, so it is very

important to maintain adequate velocity and depth in the limited riffle habitat during warm temperature periods. During the cold temperature months, it is important to have sufficient flow to allow passage between beaver ponds and plunge pools, and it is important to have sufficient flow to prevent complete icing of the stream in dark, shaded canyon locations.

Cross section analysis confirmed that the current instream flow water right is significantly below the standard instream flow criteria. In the cross sections that were collected, a flow of 1.5 cfs results in average depths of only 0.14 feet, and in average velocities of only 0.75 feet per second. If the stream were managed to consistently provide flows of 1.5 cfs, the BLM anticipates that the natural environment would be stressed.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence with Smith Creek	Confluence with Colorado River	2.7	9%	91%

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

Biological Data

The BLM has conducted field surveys of the fishery resources on this stream and have found a natural environment that can be preserved. As reported in the letter from BLM to the CWCB "Corral Creek is a high gradient stream with variable substrate size, ranging from reaches dominated by gravels to reaches dominated by cobbles and boulders. Much of the reach covered by this recommendation is confined by narrow canyons. In the upper part of the reach, beaver activity is widespread, with short riffles between beaver dams. The lower part of the reach is characterized by plunge pools separated by short riffles. The riparian community provides substantial shading and nutrient supply for the creek, and it provides numerous pools and overhanging banks for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brook trout with a variety of 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	10/5/2006	2.84	7.1 – 1.1	5.49	2.64
BLM	10/05/2006	2.69	6.7 – 1.1	3.05	2.14

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 4.25 cfs (The recommended increase of 2.75 cfs, when added to the existing ISF of 1.5 cfs is equal to 4.25 cfs). The winter flow, which meets 2 or 3 criteria and is within the accuracy range of the R2Cross model is 2.4 cfs (The recommended increase of 0.9 cfs, when added to the existing ISF of 1.5 cfs is equal to 2.4 cfs). These flows were derived by averaging the results of the two data sets.

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 **Corral Creek** no such gage is available at the LT. In fact, there is no gage on Corral creek. It is thus necessary to describe the normal flow regime at Corral Creek above the LT through a "representative" gage station. The gage station selected for this purpose was TROUBLESOME CREEK NEAR PEARMONT, CO (USGS 09039000); it has a period of record (POR) of 40 years collected between 1953 and 1993. The gage is at an elevation of 8,049 ft above mean sea level (amsl) and has a drainage area of 44.6 mi^2. The hydrograph (plot of discharge over time) produced from this gage includes the consumptive uses of numerous diversions. However, the existence of these diversions does not preclude use of the data from the gage. To make the measured data transferable to Corral Creek above the LT, the consumptive portions of these diversions were added back to the measured hydrograph. The resulting "adjusted" hydrograph could then be used on Corral Creek above the LT by multiplying the "adjusted" gage discharge values by an area ratio; specifically, the area of Corral Creek above the LT (28.12 mi^2) to Troublesome Creek near Pearmont, CO (44.6 mi^2). Next, the resulting proportioned "adjusted" hydrograph was itself "adjusted" (decreased) to reflect the numerous existing consumptive irrigation depletions on Corral Creek upstream of the LT. 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 Corral Creek is to compute the Geometric Mean of the area-prorated "adjusted" data values from the Troublesome Creek near Pearmont, 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 an enlargement displayed in figure 2. The data displayed in this hydrograph follow in Table 1.

Fig. 1. Geometric Mean Daily Q Corral Cr abv LT (prop on Troublesome nr Pearmont - adjusted for irr), Adjusted for Irr, & ISFs

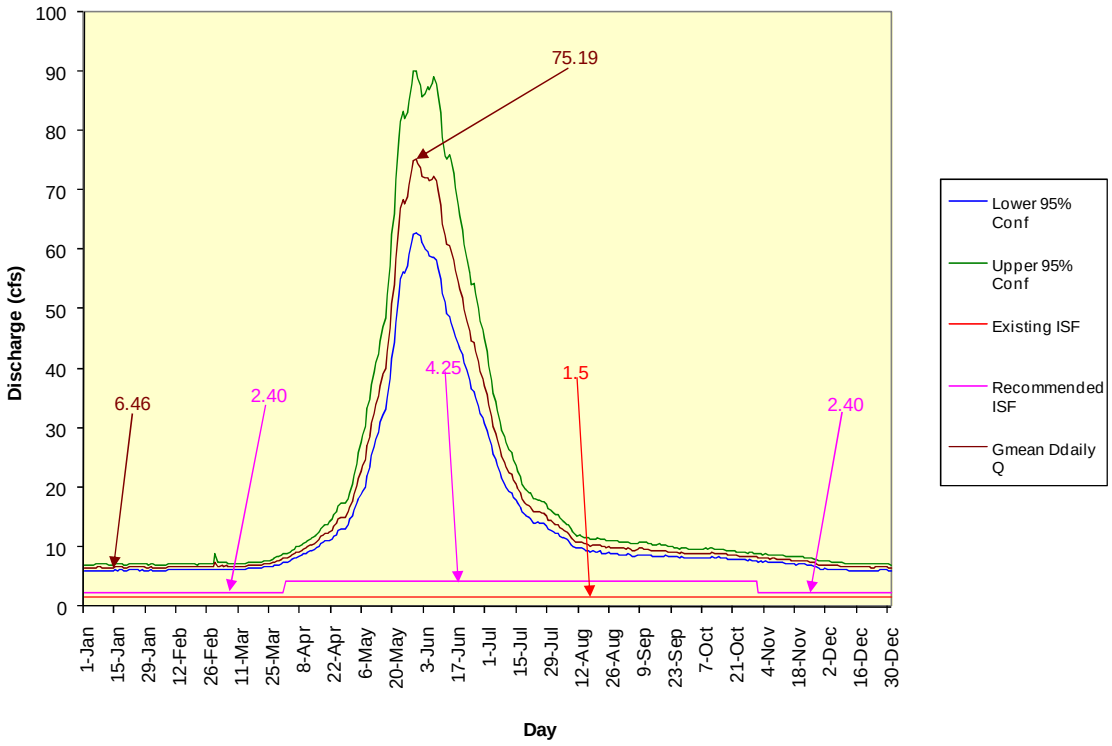


Fig. 2. Geometric Mean Daily Q Corral Cr abv LT (prop on Troublesome nr Pearmont - adjusted for irr), Adjusted for Irr, & ISFs

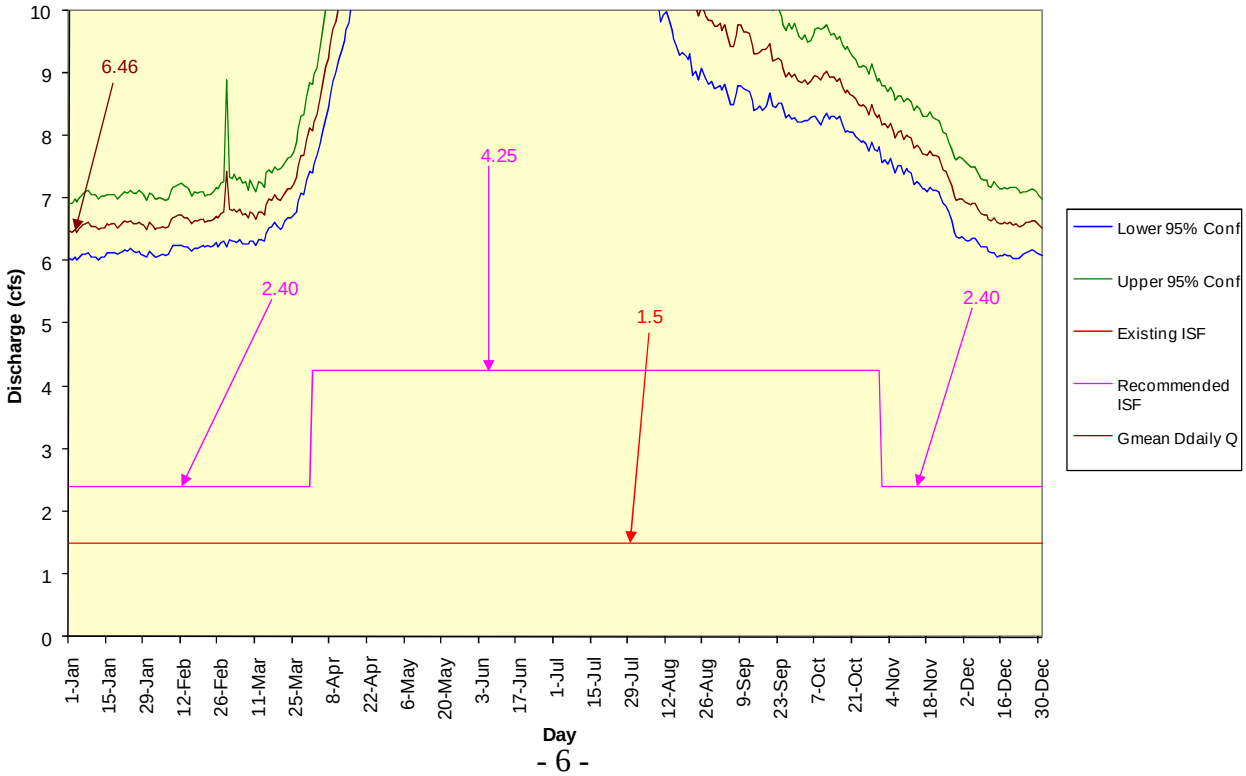


Table 1. Geometric Mean Discharge and Recommended Instream Flows			
Date	Existing ISF	Recommended ISF	Proportioned Adjusted GM (abv gage) Adj (-) for Irr & OoB in Corral Cr abv LT
1-Jan	1.5	2.4	6.474638469
2-Jan	1.5	2.4	6.455020669
3-Jan	1.5	2.4	6.512237097
4-Jan	1.5	2.4	6.461957788
5-Jan	1.5	2.4	6.525485546
6-Jan	1.5	2.4	6.568189462
7-Jan	1.5	2.4	6.589296867
8-Jan	1.5	2.4	6.612320603
9-Jan	1.5	2.4	6.542819381
10-Jan	1.5	2.4	6.553495885
11-Jan	1.5	2.4	6.544663591
12-Jan	1.5	2.4	6.491117984
13-Jan	1.5	2.4	6.534280934
14-Jan	1.5	2.4	6.528766933
15-Jan	1.5	2.4	6.590103454
16-Jan	1.5	2.4	6.582281198
17-Jan	1.5	2.4	6.585335869
18-Jan	1.5	2.4	6.583688129
19-Jan	1.5	2.4	6.535075542
20-Jan	1.5	2.4	6.572172191
21-Jan	1.5	2.4	6.608740315
22-Jan	1.5	2.4	6.63728095
23-Jan	1.5	2.4	6.61259709
24-Jan	1.5	2.4	6.650038432
25-Jan	1.5	2.4	6.600907681
26-Jan	1.5	2.4	6.597264753
27-Jan	1.5	2.4	6.622882417
28-Jan	1.5	2.4	6.593293522
29-Jan	1.5	2.4	6.562555925
30-Jan	1.5	2.4	6.497872695
31-Jan	1.5	2.4	6.606609276
1-Feb	1.5	2.4	6.571363025
2-Feb	1.5	2.4	6.508973185
3-Feb	1.5	2.4	6.518472898
4-Feb	1.5	2.4	6.536184271
5-Feb	1.5	2.4	6.539231197
6-Feb	1.5	2.4	6.518052792
7-Feb	1.5	2.4	6.536622729
8-Feb	1.5	2.4	6.657621462
9-Feb	1.5	2.4	6.690176298
10-Feb	1.5	2.4	6.709733097
11-Feb	1.5	2.4	6.725843031

12-Feb	1.5	2.4	6.729431349
13-Feb	1.5	2.4	6.693088997
14-Feb	1.5	2.4	6.688403384
15-Feb	1.5	2.4	6.660672126
16-Feb	1.5	2.4	6.585924875
17-Feb	1.5	2.4	6.649166886
18-Feb	1.5	2.4	6.638500468
19-Feb	1.5	2.4	6.655161929
20-Feb	1.5	2.4	6.661545125
21-Feb	1.5	2.4	6.62023272
22-Feb	1.5	2.4	6.645015014
23-Feb	1.5	2.4	6.63188559
24-Feb	1.5	2.4	6.663843616
25-Feb	1.5	2.4	6.71664595
26-Feb	1.5	2.4	6.677250045
27-Feb	1.5	2.4	6.750565654
28-Feb	1.5	2.4	6.783077976
29-Feb	1.5	2.4	7.438304574
1-Mar	1.5	2.4	6.81478252
2-Mar	1.5	2.4	6.798170292
3-Mar	1.5	2.4	6.833532086
4-Mar	1.5	2.4	6.775436578
5-Mar	1.5	2.4	6.827488594
6-Mar	1.5	2.4	6.740717204
7-Mar	1.5	2.4	6.749257377
8-Mar	1.5	2.4	6.68742387
9-Mar	1.5	2.4	6.791330904
10-Mar	1.5	2.4	6.752368803
11-Mar	1.5	2.4	6.659342974
12-Mar	1.5	2.4	6.782049416
13-Mar	1.5	2.4	6.789352237
14-Mar	1.5	2.4	6.742093935
15-Mar	1.5	2.4	6.901675479
16-Mar	1.5	2.4	6.978206246
17-Mar	1.5	2.4	6.976274104
18-Mar	1.5	2.4	7.048043636
19-Mar	1.5	2.4	6.982084299
20-Mar	1.5	2.4	6.976669531
21-Mar	1.5	2.4	7.001357925
22-Mar	1.5	2.4	7.092966344
23-Mar	1.5	2.4	7.158572564
24-Mar	1.5	2.4	7.161858833
25-Mar	1.5	2.4	7.225544732
26-Mar	1.5	2.4	7.325973547
27-Mar	1.5	2.4	7.502901309
28-Mar	1.5	2.4	7.679020059
29-Mar	1.5	2.4	7.683093204
30-Mar	1.5	2.4	7.947417154
31-Mar	1.5	2.4	8.117051135

1-Apr	1.5	4.25	8.083458771
2-Apr	1.5	4.25	8.227992038
3-Apr	1.5	4.25	8.342966773
4-Apr	1.5	4.25	8.567748332
5-Apr	1.5	4.25	8.846091924
6-Apr	1.5	4.25	9.092658277
7-Apr	1.5	4.25	9.244093525
8-Apr	1.5	4.25	9.458417807
9-Apr	1.5	4.25	9.706038589
10-Apr	1.5	4.25	9.816080326
11-Apr	1.5	4.25	10.07115112
12-Apr	1.5	4.25	10.26842945
13-Apr	1.5	4.25	10.41815107
14-Apr	1.5	4.25	10.65287838
15-Apr	1.5	4.25	10.84214562
16-Apr	1.5	4.25	11.30327961
17-Apr	1.5	4.25	11.82077079
18-Apr	1.5	4.25	12.08976761
19-Apr	1.5	4.25	12.38340585
20-Apr	1.5	4.25	12.29864419
21-Apr	1.5	4.25	12.54453139
22-Apr	1.5	4.25	12.89104166
23-Apr	1.5	4.25	13.55684433
24-Apr	1.5	4.25	13.88873172
25-Apr	1.5	4.25	14.64514027
26-Apr	1.5	4.25	15.04078952
27-Apr	1.5	4.25	14.94652761
28-Apr	1.5	4.25	15.0643791
29-Apr	1.5	4.25	15.85092977
30-Apr	1.5	4.25	16.69205907
1-May	1.5	4.25	17.67821948
2-May	1.5	4.25	18.92975441
3-May	1.5	4.25	20.32617018
4-May	1.5	4.25	21.60662374
5-May	1.5	4.25	22.74096732
6-May	1.5	4.25	23.6053294
7-May	1.5	4.25	24.65576596
8-May	1.5	4.25	27.07360862
9-May	1.5	4.25	28.63445678
10-May	1.5	4.25	30.78586956
11-May	1.5	4.25	32.56412936
12-May	1.5	4.25	33.89226982
13-May	1.5	4.25	35.31051675
14-May	1.5	4.25	37.15334011
15-May	1.5	4.25	39.00164287
16-May	1.5	4.25	40.05149538
17-May	1.5	4.25	42.90311176
18-May	1.5	4.25	46.83217682
19-May	1.5	4.25	51.01143602

20-May	1.5	4.25	54.06667935
21-May	1.5	4.25	58.50371648
22-May	1.5	4.25	64.07805826
23-May	1.5	4.25	66.89990028
24-May	1.5	4.25	68.45602348
25-May	1.5	4.25	67.67528543
26-May	1.5	4.25	68.97122273
27-May	1.5	4.25	70.93180247
28-May	1.5	4.25	73.38768408
29-May	1.5	4.25	75.04458823
30-May	1.5	4.25	75.19235813
31-May	1.5	4.25	74.57601076
1-Jun	1.5	4.25	73.79668325
2-Jun	1.5	4.25	72.32092216
3-Jun	1.5	4.25	72.02617304
4-Jun	1.5	4.25	72.06447178
5-Jun	1.5	4.25	71.50923297
6-Jun	1.5	4.25	71.71560523
7-Jun	1.5	4.25	72.28904634
8-Jun	1.5	4.25	71.5246808
9-Jun	1.5	4.25	70.09779804
10-Jun	1.5	4.25	67.53566068
11-Jun	1.5	4.25	64.3447068
12-Jun	1.5	4.25	62.26935745
13-Jun	1.5	4.25	60.74931601
14-Jun	1.5	4.25	60.73072019
15-Jun	1.5	4.25	59.94298942
16-Jun	1.5	4.25	58.11036756
17-Jun	1.5	4.25	56.42140922
18-Jun	1.5	4.25	54.578687
19-Jun	1.5	4.25	53.42092817
20-Jun	1.5	4.25	51.82280143
21-Jun	1.5	4.25	49.96533454
22-Jun	1.5	4.25	48.08748511
23-Jun	1.5	4.25	46.22641201
24-Jun	1.5	4.25	44.52275967
25-Jun	1.5	4.25	44.28908588
26-Jun	1.5	4.25	42.99423217
27-Jun	1.5	4.25	41.09925298
28-Jun	1.5	4.25	39.40418286
29-Jun	1.5	4.25	38.35977903
30-Jun	1.5	4.25	37.15496519
1-Jul	1.5	4.25	35.66287864
2-Jul	1.5	4.25	33.90899783
3-Jul	1.5	4.25	32.05353293
4-Jul	1.5	4.25	30.31267233
5-Jul	1.5	4.25	29.13946082
6-Jul	1.5	4.25	27.95614099
7-Jul	1.5	4.25	26.42276331

8-Jul	1.5	4.25	25.21495436
9-Jul	1.5	4.25	24.1576499
10-Jul	1.5	4.25	23.45691689
11-Jul	1.5	4.25	22.55196558
12-Jul	1.5	4.25	22.29209279
13-Jul	1.5	4.25	21.33259067
14-Jul	1.5	4.25	20.56525151
15-Jul	1.5	4.25	19.84394402
16-Jul	1.5	4.25	18.96642693
17-Jul	1.5	4.25	18.00573399
18-Jul	1.5	4.25	17.49839452
19-Jul	1.5	4.25	17.25667818
20-Jul	1.5	4.25	16.90993453
21-Jul	1.5	4.25	16.65013995
22-Jul	1.5	4.25	15.98940634
23-Jul	1.5	4.25	15.88121022
24-Jul	1.5	4.25	15.89750248
25-Jul	1.5	4.25	15.8824668
26-Jul	1.5	4.25	15.70690261
27-Jul	1.5	4.25	15.65181006
28-Jul	1.5	4.25	15.2382232
29-Jul	1.5	4.25	14.55147954
30-Jul	1.5	4.25	14.44869609
31-Jul	1.5	4.25	14.0388045
1-Aug	1.5	4.25	13.81624073
2-Aug	1.5	4.25	13.75868859
3-Aug	1.5	4.25	13.3038606
4-Aug	1.5	4.25	12.9522956
5-Aug	1.5	4.25	12.78204584
6-Aug	1.5	4.25	12.45267844
7-Aug	1.5	4.25	12.33755929
8-Aug	1.5	4.25	11.64000072
9-Aug	1.5	4.25	11.30496762
10-Aug	1.5	4.25	10.88016772
11-Aug	1.5	4.25	10.83852663
12-Aug	1.5	4.25	10.90315154
13-Aug	1.5	4.25	10.76806509
14-Aug	1.5	4.25	10.61189251
15-Aug	1.5	4.25	10.48930686
16-Aug	1.5	4.25	10.36683639
17-Aug	1.5	4.25	10.20416095
18-Aug	1.5	4.25	10.24683762
19-Aug	1.5	4.25	10.27900041
20-Aug	1.5	4.25	10.25516479
21-Aug	1.5	4.25	10.25437175
22-Aug	1.5	4.25	10.04591093
23-Aug	1.5	4.25	10.07297964
24-Aug	1.5	4.25	9.920382286
25-Aug	1.5	4.25	10.05350629

26-Aug	1.5	4.25	9.975497029
27-Aug	1.5	4.25	9.923601353
28-Aug	1.5	4.25	9.833141325
29-Aug	1.5	4.25	9.841877699
30-Aug	1.5	4.25	9.749933814
31-Aug	1.5	4.25	9.761498348
1-Sep	1.5	4.25	9.789593733
2-Sep	1.5	4.25	9.687359495
3-Sep	1.5	4.25	9.778498352
4-Sep	1.5	4.25	9.589352315
5-Sep	1.5	4.25	9.429555888
6-Sep	1.5	4.25	9.436974788
7-Sep	1.5	4.25	9.619427827
8-Sep	1.5	4.25	9.782035282
9-Sep	1.5	4.25	9.766730479
10-Sep	1.5	4.25	9.666866327
11-Sep	1.5	4.25	9.655751533
12-Sep	1.5	4.25	9.626976105
13-Sep	1.5	4.25	9.454128658
14-Sep	1.5	4.25	9.314599941
15-Sep	1.5	4.25	9.302812478
16-Sep	1.5	4.25	9.328334996
17-Sep	1.5	4.25	9.382870929
18-Sep	1.5	4.25	9.376170515
19-Sep	1.5	4.25	9.394586493
20-Sep	1.5	4.25	9.481745792
21-Sep	1.5	4.25	9.195052974
22-Sep	1.5	4.25	9.211857413
23-Sep	1.5	4.25	9.229228337
24-Sep	1.5	4.25	9.182996494
25-Sep	1.5	4.25	9.080464195
26-Sep	1.5	4.25	8.940735871
27-Sep	1.5	4.25	9.016676366
28-Sep	1.5	4.25	8.944433743
29-Sep	1.5	4.25	8.994521073
30-Sep	1.5	4.25	8.902835126
1-Oct	1.5	4.25	8.8678725
2-Oct	1.5	4.25	8.848293109
3-Oct	1.5	4.25	8.891862221
4-Oct	1.5	4.25	8.832431509
5-Oct	1.5	4.25	8.874796206
6-Oct	1.5	4.25	8.929963293
7-Oct	1.5	4.25	8.971948949
8-Oct	1.5	4.25	8.9493606
9-Oct	1.5	4.25	8.901232794
10-Oct	1.5	4.25	8.975939348
11-Oct	1.5	4.25	9.028954751
12-Oct	1.5	4.25	8.930772286
13-Oct	1.5	4.25	8.939341331

14-Oct	1.5	4.25	8.949355723
15-Oct	1.5	4.25	8.875419088
16-Oct	1.5	4.25	8.920289464
17-Oct	1.5	4.25	8.783706482
18-Oct	1.5	4.25	8.684260751
19-Oct	1.5	4.25	8.720964672
20-Oct	1.5	4.25	8.655033342
21-Oct	1.5	4.25	8.627268007
22-Oct	1.5	4.25	8.58113379
23-Oct	1.5	4.25	8.490024707
24-Oct	1.5	4.25	8.463292672
25-Oct	1.5	4.25	8.500481693
26-Oct	1.5	4.25	8.454739365
27-Oct	1.5	4.25	8.339673343
28-Oct	1.5	4.25	8.490595995
29-Oct	1.5	4.25	8.361135599
30-Oct	1.5	4.25	8.292910236
31-Oct	1.5	4.25	8.342683886
1-Nov	1.5	2.4	8.171901541
2-Nov	1.5	2.4	8.192107782
3-Nov	1.5	2.4	8.120336138
4-Nov	1.5	2.4	8.188288779
5-Nov	1.5	2.4	8.061534856
6-Nov	1.5	2.4	7.974487169
7-Nov	1.5	2.4	8.063154685
8-Nov	1.5	2.4	8.071198951
9-Nov	1.5	2.4	7.938686679
10-Nov	1.5	2.4	8.01645217
11-Nov	1.5	2.4	7.994715097
12-Nov	1.5	2.4	7.963028417
13-Nov	1.5	2.4	7.801967509
14-Nov	1.5	2.4	7.84981571
15-Nov	1.5	2.4	7.801721025
16-Nov	1.5	2.4	7.70462911
17-Nov	1.5	2.4	7.710232835
18-Nov	1.5	2.4	7.685678693
19-Nov	1.5	2.4	7.761481512
20-Nov	1.5	2.4	7.688625522
21-Nov	1.5	2.4	7.681163132
22-Nov	1.5	2.4	7.659083579
23-Nov	1.5	2.4	7.597953661
24-Nov	1.5	2.4	7.463147994
25-Nov	1.5	2.4	7.438576925
26-Nov	1.5	2.4	7.318604727
27-Nov	1.5	2.4	7.193964658
28-Nov	1.5	2.4	7.013444812
29-Nov	1.5	2.4	6.972813977
30-Nov	1.5	2.4	6.988268954
1-Dec	1.5	2.4	6.984046574

2-Dec	1.5	2.4	6.944617929
3-Dec	1.5	2.4	6.912072914
4-Dec	1.5	2.4	6.899362577
5-Dec	1.5	2.4	6.914697307
6-Dec	1.5	2.4	6.918473143
7-Dec	1.5	2.4	6.830297661
8-Dec	1.5	2.4	6.749884977
9-Dec	1.5	2.4	6.736102628
10-Dec	1.5	2.4	6.731708038
11-Dec	1.5	2.4	6.669379097
12-Dec	1.5	2.4	6.634093153
13-Dec	1.5	2.4	6.677365006
14-Dec	1.5	2.4	6.615570865
15-Dec	1.5	2.4	6.604247292
16-Dec	1.5	2.4	6.60135357
17-Dec	1.5	2.4	6.626225424
18-Dec	1.5	2.4	6.600092172
19-Dec	1.5	2.4	6.607483176
20-Dec	1.5	2.4	6.580406588
21-Dec	1.5	2.4	6.591149735
22-Dec	1.5	2.4	6.55426107
23-Dec	1.5	2.4	6.549658913
24-Dec	1.5	2.4	6.581184156
25-Dec	1.5	2.4	6.609866719
26-Dec	1.5	2.4	6.618226736
27-Dec	1.5	2.4	6.650318126
28-Dec	1.5	2.4	6.629580174
29-Dec	1.5	2.4	6.612848858
30-Dec	1.5	2.4	6.559793795
31-Dec	1.5	2.4	6.516891558

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 water rights within the proposed reach. Staff has determined that water is available for appropriation on Corral Creek, between the confluence with Smith Creek and the headgate of Home Ditch #1, 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:

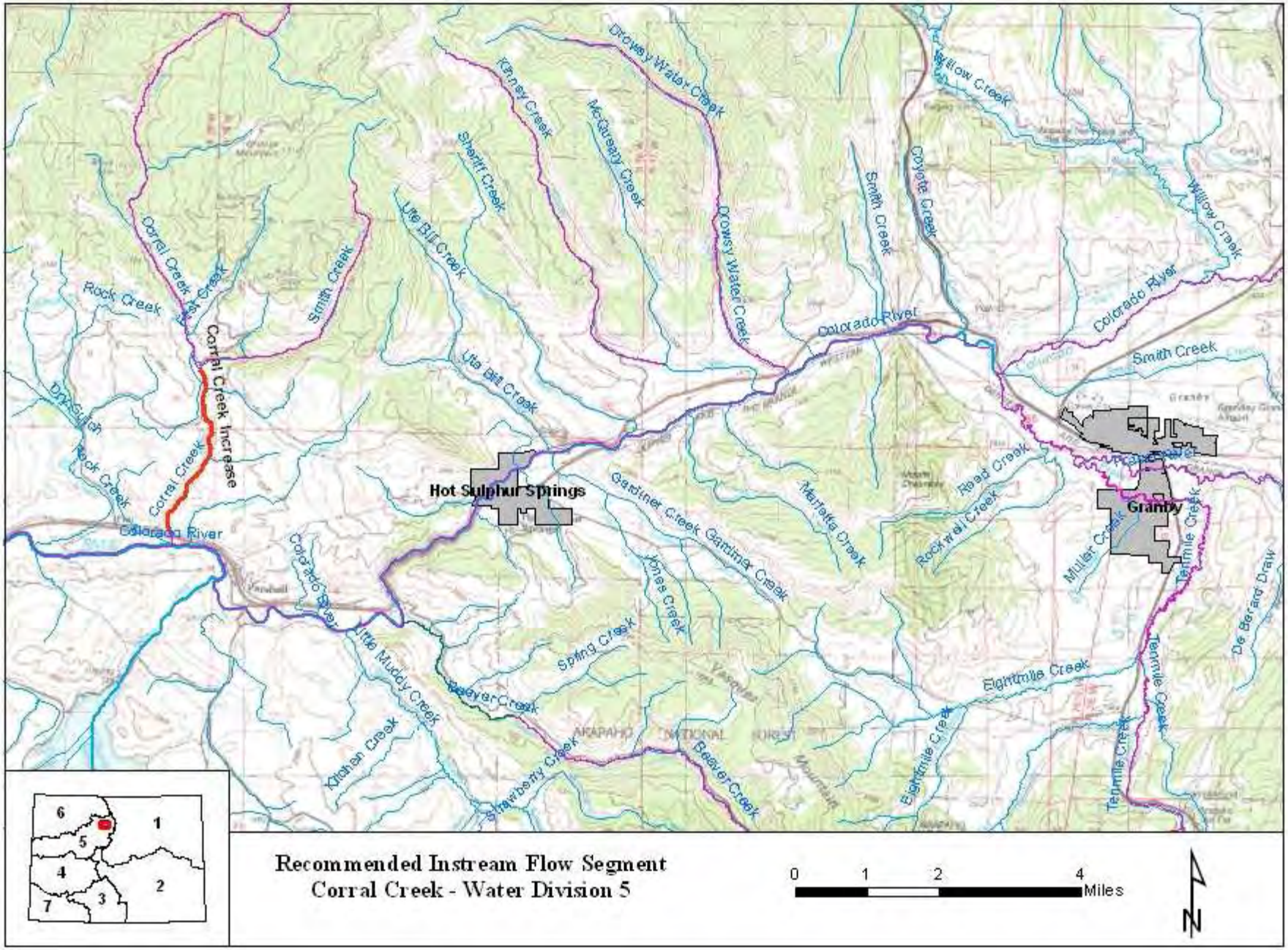
Segment: Confluence Smith Creek to Headgate Home Ditch # 1

Upper Terminus: CONFLUENCE WITH SMITH CREEK
(Latitude 40° 5' 56.66"N) (Longitude 106° 11' 7.64"W)
UTM North = 4439426.8 UTM East = 398955.1
NE NE S36 T2N R79W 6PM
1190' West of East Section Line; 935' South of the North Section Line

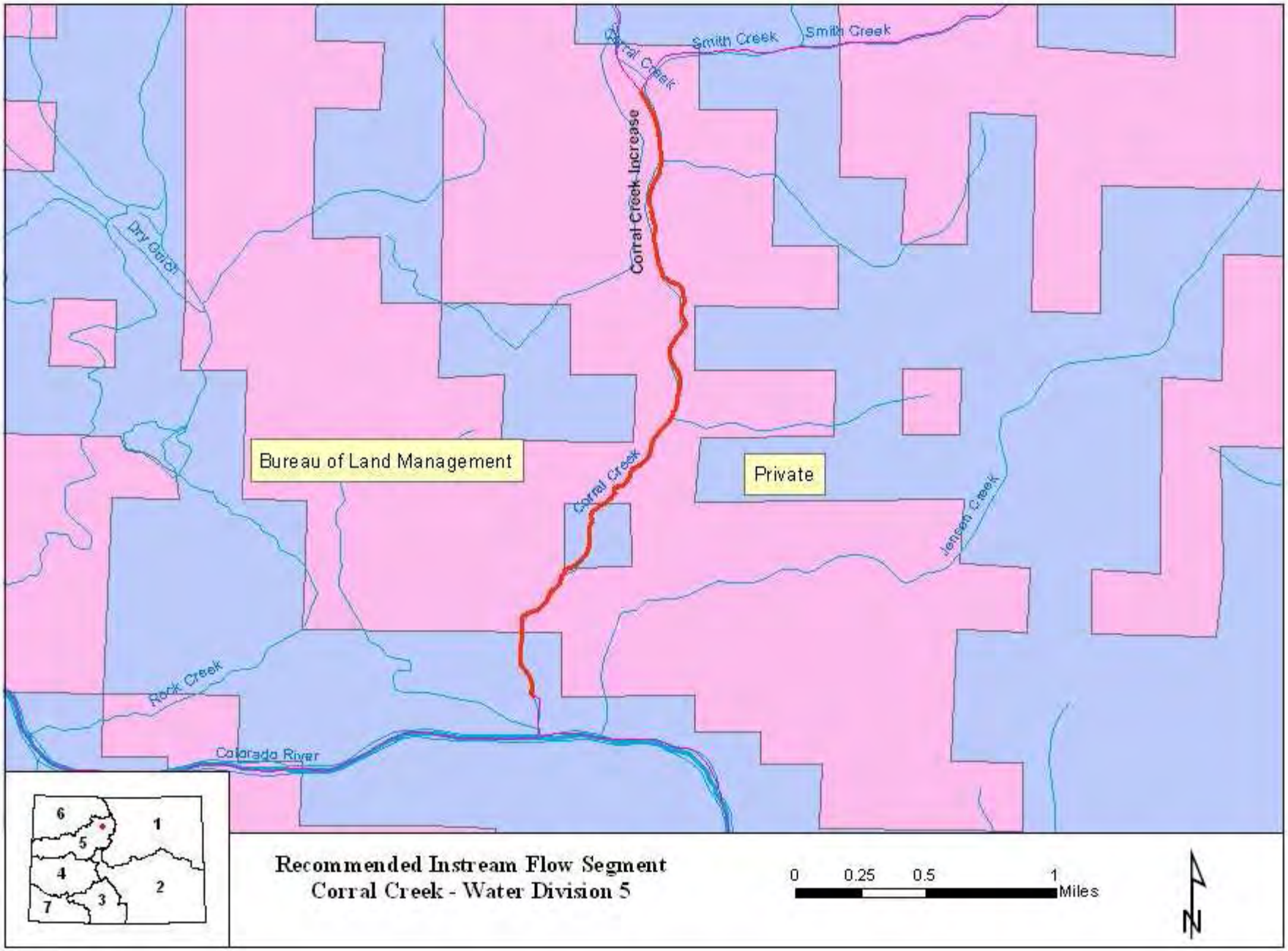
Lower Terminus: HEADGATE HOME DITCH # 1
(Latitude 40° 3' 55.03"N) (Longitude 106° 11' 7.64"W)
UTM North = 4435684.8 UTM East = 398294.4
NE SW S12 T1N R78W 6PM
2100' East of West Section Line; 2600' North of South Section Line

Watershed: Colorado headwaters (HUC#: 14010001)
Counties: Grand
Length: 2.7 miles
USGS Quad(s): Parshall
Existing ISF: 5-86CW214, 1.5 cfs (1/1-12/31)
Flow Recommendation (increase): 2.75 cfs (April 1 to October 31)
0.9 cfs (November 1 to March 31)

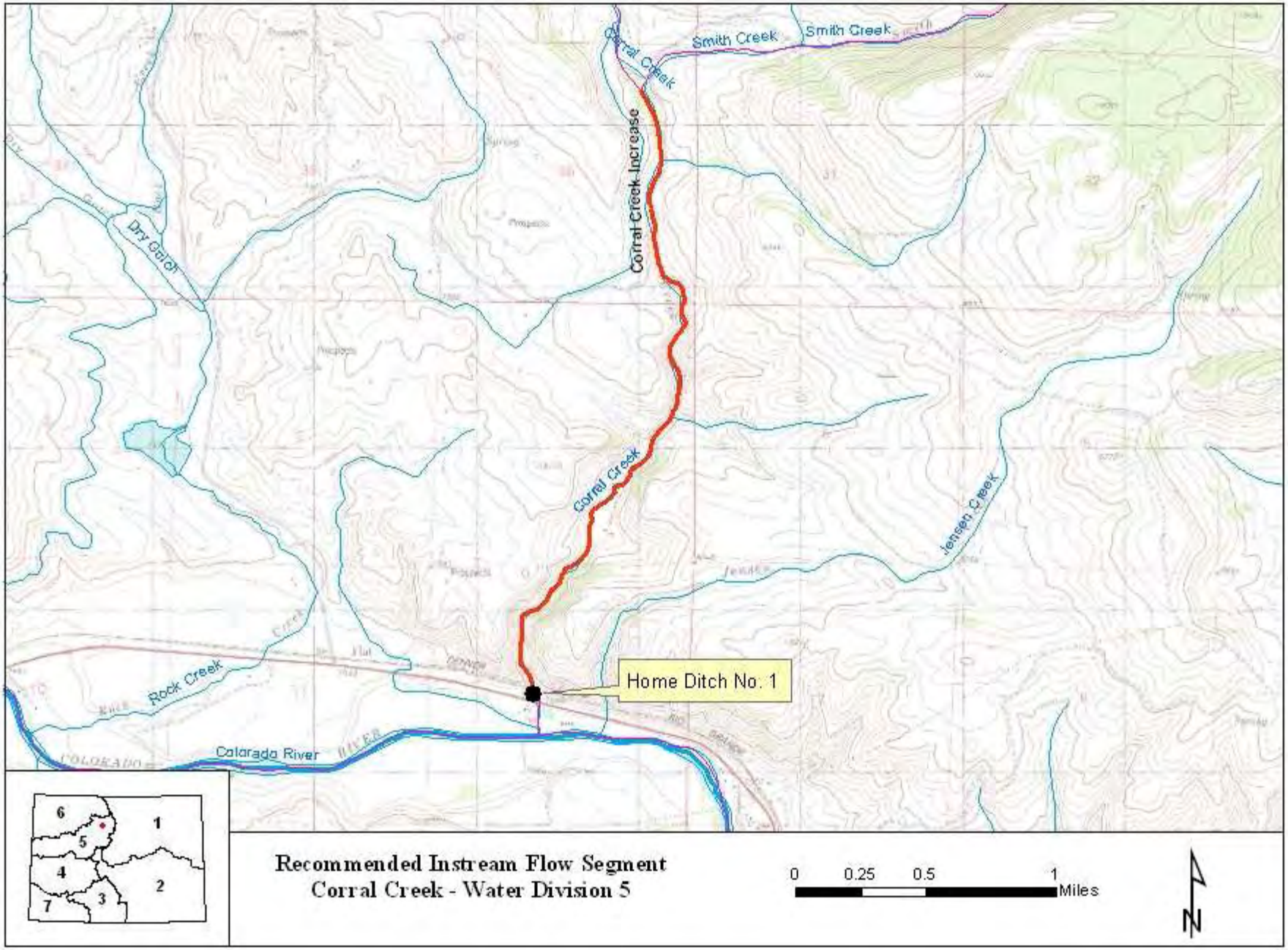
Vicinity Map



Land Use Map


Smith Creek
Smith Creek
Corral Creek
Corral Creek Increase
Dry Corral
Bureau of Land Management
Private
Corral Creek
Jensen Creek
Rock Creek
Colorado River
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Corral Creek - Water Division 5
0
0.25
0.5
1
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)

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 lower Corral Creek, located in Water Division 5. The existing instream flow water right on this creek is 1.5 cubic feet per second, year round, from the headwaters to the confluence with the Colorado River, a distance of 12 miles. The existing instream flow water right was established in 1986.

Location and Land Status: Corral Creek is tributary to the Colorado River approximately five miles west of Hot Sulphur Springs, Colorado. The creek is located within the upper Colorado River watershed in Grand County. This recommendation covers the stream reach beginning at the confluence with Smith Creek and extending downstream to the confluence with the Colorado River. All of the land along 2.75 mile reach is owned and managed by the BLM, with the exception of ¼ mile of private land.

Biological Summary: Corral Creek is a high gradient stream with variable substrate size, ranging from reaches dominated by gravels to reaches dominated by cobbles and boulders. Much of the reach covered by this recommendation is confined by narrow canyons. In the upper part of the reach, beaver activity is widespread, with short riffles between beaver dams. The lower part of the reach is characterized by plunge pools separated by short riffles. The riparian community provides substantial shading and nutrient supply for the creek, and it provides numerous pools and overhanging banks for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brook trout with a variety of 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.

- A 2.75 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 4.25 cfs. This recommendation is driven by the average velocity criteria and average depth criteria.

- A 0.9 cfs enlargement is recommended for the cold temperature period from November 1 through March 31, bringing the total instream flow water up to 2.40 cfs.

Water Availability: There are no decreed water rights within the proposed reach, but there are multiple decreed water rights located upstream. Ditch diversions located upstream include:

Scholl Reservoir – 321.8 acre feet
Musgrave Ditch – 8.55 cfs
Milton Woods Ditch 1 – 1.17 cfs
Gibbs Ditch – 4.0 cfs
Rock Creek Ditch – 8.0 cfs
Walker Ditch – 2.0 cfs (located on Smith Creek)
Weimer Ditch – 4.0 cfs (located on Smith Creek)

All of the ditches listed above are junior to Home No. 1 Ditch, which is recommended as the downstream terminus for this enlargement. Home No. 1 Ditch is decreed for 2.5 cfs, with an 1882 priority.

There is an abundance of diversion records for ditches located on Corral Creek, but unfortunately there is no historic stream gage information. For an indication of raw water availability, the BLM recommends utilizing the gage located on East Fork Troublesome Creek, near Troublesome, Colorado (USGS Gage 09040000). A calculation can be done on the relative watershed size of the two basins, and adjustments to flow rates can be made accordingly. The East Fork Troublesome Creek watershed is located immediately adjacent and to the northwest of Corral Creek, so it has similar elevation, aspect, and precipitation patterns. In addition, this gage has a 45-year period of record.

Relationship to Management Plans: The upper part of this reach is easily accessible by county road, while the lower part of the reach of Corral Creek is difficult to access for recreation use and livestock grazing. The level of historic impact on the creek tends to vary with access, with easily accessible areas more heavily used and impacted. The BLM intends to maintain the current management on the creek, with an orientation toward maintaining the functioning riparian and aquatic systems.

Justification for Instream Flow Enlargement: BLM believes that current irrigation and storage practices on the creek are supportive of the natural environment. Water availability analysis has demonstrated that these practices result in a consistently higher flow rate than the

current instream flow water right. A dramatic change in the exercise of senior water rights could threaten this management approach, so BLM is making this recommendation with an eye toward supporting and maintaining current water management practices.

A request for an enlargement is also driven by physical characteristics of the creek. The creek is characterized by short riffles between numerous beaver ponds and plunge pools, so it is very important to maintain adequate velocity and depth in the limited riffle habitat during the warm temperature months. During the cold temperature months, it is important to have sufficient flow to allow passage between beaver ponds and plunge pools, and it is important to have sufficient flow to prevent complete icing of the stream in dark, shaded canyon locations.

Cross section analysis confirmed that the current instream flow water right is significantly below the standard instream flow criteria. In the cross sections that were collected, a flow of 1.5 cfs results in average depths of only 0.14 feet, and in average velocities of only 0.75 feet per second. If the stream were managed to consistently provide flows at 1.5 cfs, the BLM anticipates that the natural environment would be stressed.

The BLM requests that the Board recognize that this recommendation is based only upon the minimum flows necessary to support cold-water and cool-water fishery values. The BLM may wish to work with the Board and/or through the Colorado water rights system to appropriate flows to optimally protect fish values and to protect other water-dependent values specified in BLM resource management plans.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section to support this recommendation were provided with BLM's draft recommendation in February 2008. 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,

for Linda Anania
Deputy State Director, Resources and Fire

cc:
David Stout, Kremmling FO
Paula Belcher, Kremmling FO
Tom Freques, Glenwood Springs FO

DRAFT INSTREAM FLOW RECOMMENDATION

Mr. Dan Merriman
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Dear Mr. Merriman:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its recommendation for an instream flow enlargement on lower Corral Creek, located in Water Division 5. The existing instream flow water right on this creek is 1.5 cubic feet per second, year round, from the headwaters to the confluence with the Colorado River, a distance of 12 miles. The existing instream flow water right was established in 1986.

Location and Land Status. Corral Creek is tributary to the Colorado River approximately five miles west of Hot Sulphur Springs, Colorado. The creek is located within the upper Colorado River watershed in Grand County. This recommendation covers the stream reach beginning at the confluence with Smith Creek and extending downstream to the confluence with the Colorado River. All of the land along 2.75 mile reach is owned and managed by the BLM, with the exception of ¼ mile of private land.

Biological Summary. Corral Creek is a high gradient stream with variable substrate size, ranging from reaches dominated by gravels to reaches dominated by cobbles and boulders. Much of the reach covered by this recommendation is confined by narrow canyons. In the upper part of the reach, beaver activity is widespread, with short riffles between beaver dams. The lower part of the reach is characterized by plunge pools separated by short riffles. The riparian community provides substantial shading and nutrient supply for the creek, and it provides numerous pools and overhanging banks for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brook trout with a variety of age classes.

R2Cross Analysis. 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.

> A 2.75 cubic feet per second enlargement is recommended during the high temperature period from April 1 through October 31, bringing the total instream flow right up to 4.25 cubic feet per second. This recommendation is driven by the average velocity criteria and average depth criteria. Because the creek is characterized by short riffles between numerous beaver ponds and plunge pools, it is very important to maintain adequate velocity and depth in the limited riffle habitat.
>
> A 0.9 cubic feet per second enlargement is recommended for the cold temperature period from November 1 through March 31, bringing the total instream flow water right up to 2.40 cubic feet per second. This flow rate should allow passage

between and beaver ponds and plunge pools during the winter and it should prevent complete icing of the stream in dark, shaded canyon locations.

Water Availability. There are no decreed water rights within the proposed reach, but there are multiple decreed water rights located upstream. Ditch diversions located upstream include:

Scholl Reservoir – 321.8 acre feet
Musgrave Ditch – 8.55 cfs
Milton Woods Ditch 1 – 1.17 cfs
Gibbs Ditch – 4.0 cfs
Rock Creek Ditch – 8.0 cfs
Walker Ditch – 2.0 cfs (located on Smith Creek)
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Relationship to Management Plans. The upper part of this reach is easily accessible by county road, while the lower part of the reach of Corral Creek is difficult to access for recreation use and livestock grazing. The level of historic impact on the creek tends to vary with access, with easily accessible areas more heavily used and impacted. BLM intends to maintain the current management on the creek, with an orientation toward maintaining the functioning riparian and aquatic systems. However, a dramatic change in the exercise of senior water rights could threaten this management approach, so BLM is making this recommendation with an eye toward maintaining current water management practices.

The BLM requests that the Board recognize that this recommendation is based only upon the minimum flows necessary to support cold-water and cool-water fishery values. BLM may wish to work with the Board and/or through the Colorado water rights system to appropriate flows to optimally protect fish values and to protect other water-dependent values specified in BLM resource management plans.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section are enclosed to support this recommendation. 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 Anania
Deputy State Director
Resources and Fire

4 Enclosures

cc: Peter McFadden, Kremmling FO
Paula Belcher, Kremmling FO
Tom Freques, Glenwood Springs FO

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Corral Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: 500 ft. upstream of County Rd. 21 crossing						
DATE: 10-5-06	OBSERVERS: R. Smith, P Belcher					
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 36	TOWNSHIP: 2 (N) S	RANGE: 79 E (W)	PM: 6th	
COUNTY: Grand	WATERSHED: Colorado	WATER DIVISION: 5	DOW WATER CODE: 19744			
MAP(S): USGS: Parshall 7.5'	GPS Zone 13 0399033					
USFS:	4438826					

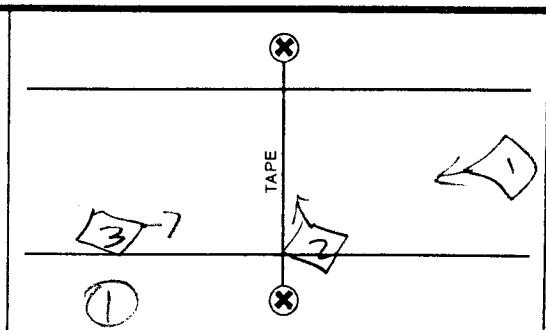
SUPPLEMENTAL DATA

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: sand to 8" cobbles	PHOTOGRAPHS TAKEN (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	7.38 / 7.38
② WS Upstream	14.0'	7.04'
③ WS Downstream	14.0'	7.18
SLOPE	0.74 / 28.0'	

SKETCH



AQUATIC SAMPLING SUMMARY

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

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

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

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

mayfly, caddisfly, stonefly

COMMENTS

TDS = 180

Ph = 7.1

temp = 7.5° C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Corral Creek | CROSS-SECTION NO.: 1 | DATE: 10-5-06 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: 0.3 ft | TIME: 10:05

Features (Stake (S), Grassline (G), Waterline (W), Rock (R))	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.0		5.89								
G	7.5		6.78								
W	8.6		7.38								
	9.0		7.57	0.2				0.99			
	9.5		7.60	0.2				1.12			
	10.0		7.68	0.3				1.78			
	10.5		7.69	0.3				1.77			
	11.0		7.83	0.45				2.37			
	11.5		7.80	0.40				1.64			
	12.0		7.49	0.10				1.[illegible]			
	12.5		7.61	0.20				2.51			
	13.0		7.66	0.30				0.41			
	13.5		7.61	0.25				1.23			
	14.0		7.56	0.20				1.49			
	14.5		7.48	0.10				0.91			
	15.0		7.49	0.10				0.29			
	15.5		7.55	0.15				0.75			
	16.0		7.55	0.15				1.06			
	16.5		7.45	0.05				1.12			
	17.0		7.54	0.15				0.66			
	17.5		7.53	0.15				0.30			
	18.0		7.52	0.15				0.33			
	18.5		7.58	0.20				0.18			
	19.0		7.59	0.20				0.21			
	19.5		7.60	0.20				0.06			
	20.0		7.59	0.20				Ø			
	20.5		7.56	0.20				0.54			
	21.0		7.44	0.05				Ø			
W	21.7		7.38								
G	22.8		6.75								
LS	29.2		4.38								
TOTALS:											

End of Measurement | Time: 10:35 | Gage Reading: 0.3 ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Corral Creek						CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: 750 ft. upstream of County Road 21 crossing						
DATE: 10-5-06	OBSERVERS: R. Smith, P Belcher					
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 36	TOWNSHIP: 2 (N)S	RANGE: 79 E(W)	PM: 6th	
COUNTY: Grand	WATERSHED: Colorado	WATER DIVISION: 5	DOW WATER CODE: 19744			
MAP(S): USGS: Parshall 7.5'						
USFS:						

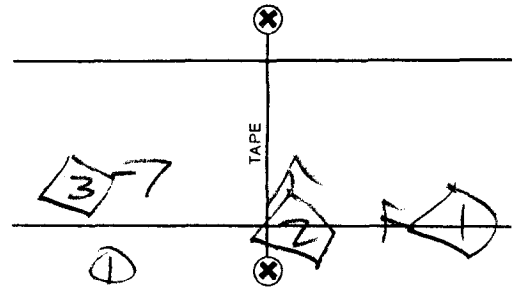
SUPPLEMENTAL DATA

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: sand to 10" cobbles	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(X) Tape @ Stake LB	0.0	surveyed
(X) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	7.02/7.05
(2) WS Upstream	10.0	6.82
(3) WS Downstream	14.0	7.34
SLOPE	0.52/24.0 =	

SKETCH



LEGEND:
Stake (X)
Station (1)
Photo (1)
Direction of Flow

AQUATIC SAMPLING SUMMARY

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

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

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

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:
mayfly, caddisfly, stonefly

COMMENTS

TDS = 180
Ph = 7.1
Temp = 7.5°C

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Corral Creek | CROSS-SECTION NO.: 2 | DATE: 10-5-00 | SHEET 1 OF 1

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: 0.2 ft | TIME: 10:15

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Obser-vation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft²)	Discharge (cfs)
RS	0.0		5.12								
G	2.6		6.42								
W	3.3		7.05								
	[illegible]										
	4		7.42	.35				0.75			
	5		7.36	.30				0.98			
	6		7.24	.2				1.42			
	7		7.41	.35				1.46			
	8		7.10	.05				1.01			
	9		7.39	.35				0.0[illegible]			
	10		7.35	.3[illegible]				0.13			
	11		7.11	.05				1.15			
	12	<12.5	7.22 7.22	[illegible]	<.15				<.[illegible]		
	13	<13.5	7.22 7.33	.5	<.[illegible]5			1.0[illegible]	<.59		
	14	<14.5	7.30 7.29	[illegible]	<.20			[illegible]	<.11		
	15		7.30	.25				1.[illegible]8			
	16		7.19	.15				[illegible]			
	17		7.27	.25				[illegible]3			
	18		7.28	.25				[illegible]3			
	19		7.13	.10				[illegible]			
	20		7.34	.30				[illegible]68			
W	20.5		7.02								
G	23.0		6.33								
LS	25.7		6.08								
TOTALS:											

End of Measurement | Time: 11:15 | Gage Reading: 0.2 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:	Corral Creek
XS LOCATION:	500 ft. upstream of County Rd. 21 crossing
XS NUMBER:	1
DATE:	5-Oct-06
OBSERVERS:	R. Smith, P. Belcher
1/4 SEC:	SE
SECTION:	36
TWP:	2N
RANGE:	79W
PM:	6th
COUNTY:	Grand
WATERSHED:	Colorado
DIVISION:	5
DOW CODE:	19744
USGS MAP:	Parshall 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:	0.026

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

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

STREAM NAME: Corral Creek
XS LOCATION: 500 ft. upstream of County Rd. 21 crossing
XS NUMBER: 1

DATA POINTS= 31

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL
	S	0.00	5.09		
1	G	2.80	5.41		
1	G	16.50	5.39	0.00	0.00
	S	16.50	5.39	0.00	0.00

TOTALS ----------

VALUES COMPUTED FROM RAW FIELD DATA

WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
0.00		0.00	0.00	#DIV/0!
0.00		0.00	0.00	#DIV/0!
0.00		0.00	0.00	#DIV/0!
0.00	0 (Max.)	0.00	0.00	#DIV/0!

Manning's n = #DIV/0!
Hydraulic Radius= #DIV/0!

STREAM NAME: Corral Creek
XS LOCATION: 500 ft. upstream of County Rd. 21 crossing
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.00	14.70	#DIV/0!
-0.25	0.00	15.40	#DIV/0!
-0.23	0.00	15.34	#DIV/0!
-0.21	0.00	15.29	#DIV/0!
-0.19	0.00	15.23	#DIV/0!
-0.17	0.00	15.18	#DIV/0!
-0.15	0.00	15.12	#DIV/0!
-0.13	0.00	15.06	#DIV/0!
-0.11	0.00	15.01	#DIV/0!
-0.09	0.00	14.95	#DIV/0!
-0.07	0.00	14.90	#DIV/0!
-0.05	0.00	14.84	#DIV/0!
-0.04	0.00	14.81	#DIV/0!
-0.03	0.00	14.78	#DIV/0!
-0.02	0.00	14.76	#DIV/0!
-0.01	0.00	14.73	#DIV/0!
0.00	0.00	14.70	#DIV/0!
0.01	0.00	14.67	#DIV/0!
0.02	0.00	14.64	#DIV/0!
0.03	0.00	14.62	#DIV/0!
0.04	0.00	14.59	#DIV/0!
0.05	0.00	14.56	#DIV/0!
0.07	0.00	14.50	#DIV/0!
0.09	0.00	14.45	#DIV/0!
0.11	0.00	14.39	#DIV/0!
0.13	0.00	14.34	#DIV/0!
0.15	0.00	14.28	#DIV/0!
0.17	0.00	14.22	#DIV/0!
0.19	0.00	14.17	#DIV/0!
0.21	0.00	14.11	#DIV/0!
0.23	0.00	14.06	#DIV/0!
0.25	0.00	14.00	#DIV/0!

WATERLINE AT ZERO
AREA ERROR = #DIV/0!

STREAM NAME: Corral Creek
XS LOCATION: 500 ft. upstream of County Rd. 21 crossing
XS NUMBER: 1

Constant Manning's n

STAGING TABLE

"GL" = lowest Grassline elevation corrected for sag
"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	5.41	0.00	#DIV/0!	0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
WL	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Corral Creek
XS LOCATION: 500 ft. upstream of County Rd. 21 crossing
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.00	cfs
CALCULATED FLOW (Qc)=	#DIV/0!	cfs
(Qm-Qc)/Qm * 100 =	#DIV/0!	%
MEASURED WATERLINE (WLm)=	0.00	ft
CALCULATED WATERLINE (WLc)=	#DIV/0!	ft
(WLm-WLc)/WLm * 100 =	#DIV/0!	%
MAX MEASURED DEPTH (Dm)=	0.00	ft
MAX CALCULATED DEPTH (Dc)=	#DIV/0!	ft
(Dm-Dc)/Dm * 100	#DIV/0!	%
MEAN VELOCITY=	#DIV/0!	ft/sec
MANNING'S N=	#DIV/0!	
SLOPE=	0.026	ft/ft
.4 * Qm =	0.0	cfs
2.5 * Qm=	0.0	cfs

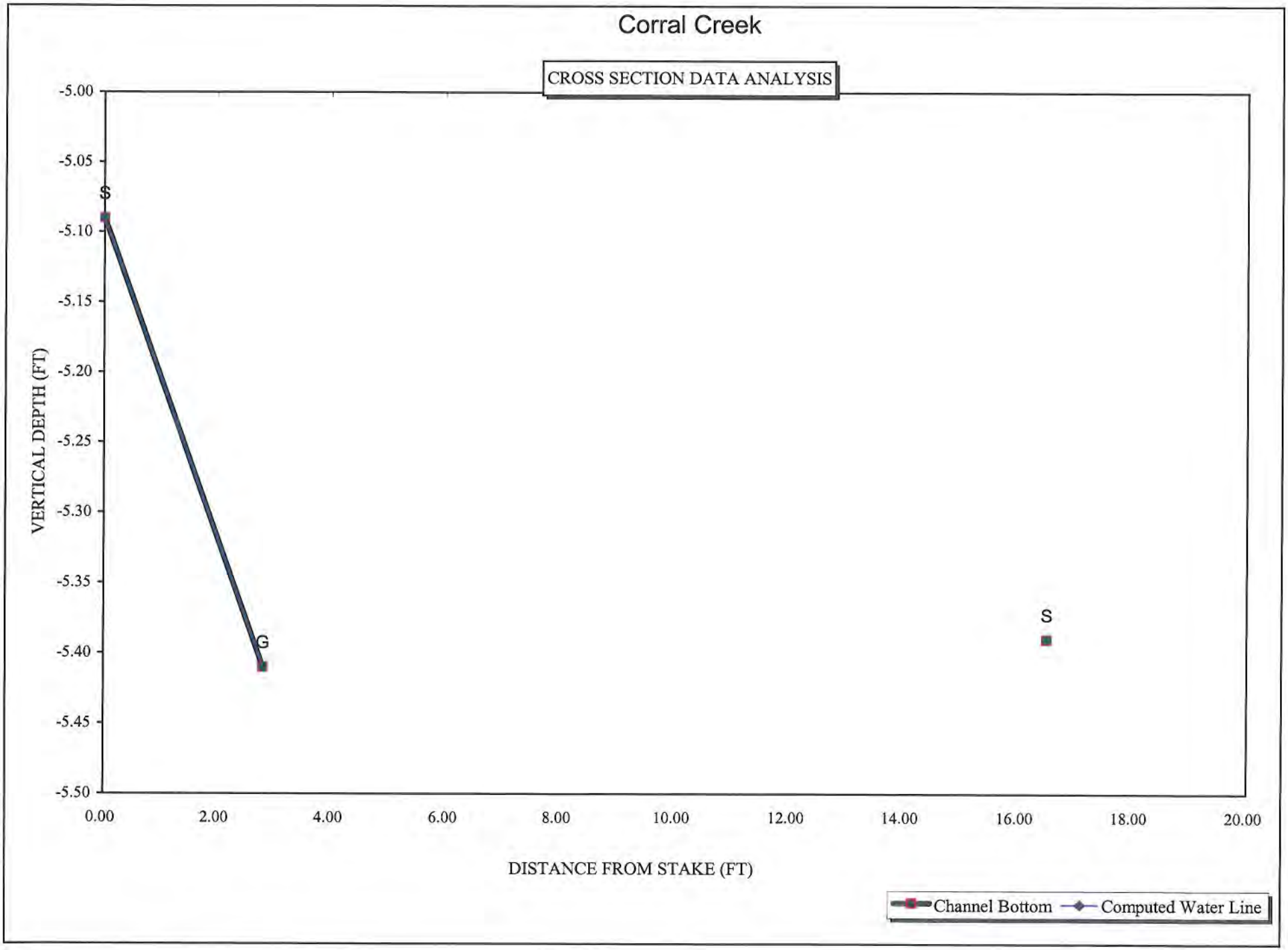
RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD

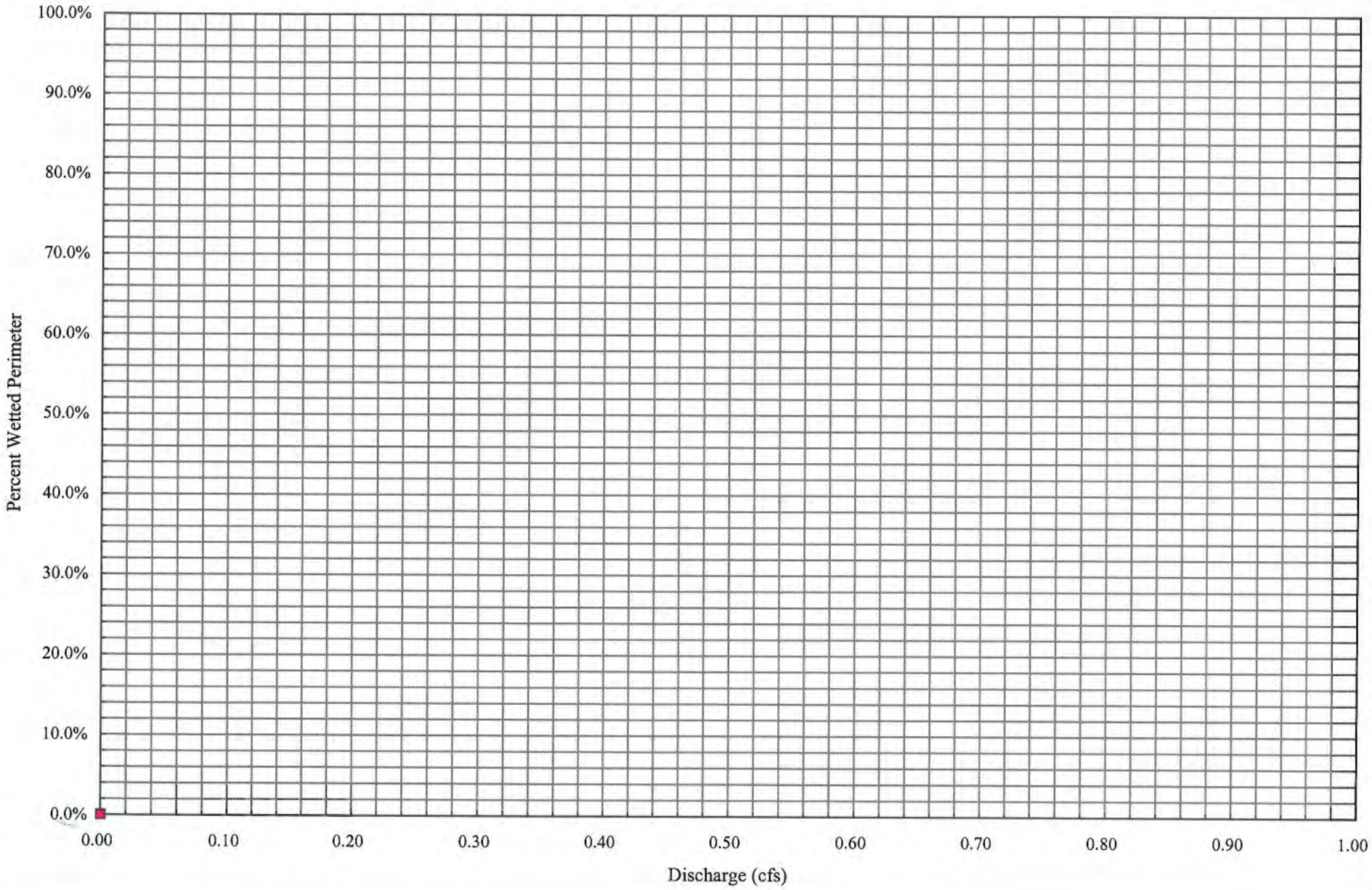
RATIONALE FOR RECOMMENDATION:

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

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


Corral Creek
CROSS SECTION DATA ANALYSIS
-5.00
-5.05
-5.10
-5.15
-5.20
-5.25
-5.30
-5.35
-5.40
-5.45
-5.50
VERTICAL DEPTH (FT)
S
G
S
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
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:	Corral Creek
XS LOCATION:	150' upstream from culvert under railroads
XS NUMBER:	2
DATE:	30-Aug-06
OBSERVERS:	R. Smith, P. Belcher
1/4 SEC:	NW
SECTION:	12
TWP:	1N
RANGE:	79W
PM:	6th
COUNTY:	Grand
WATERSHED:	Colorado
DIVISION:	5
DOW CODE:	19744
USGS MAP:	Parshall 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:	0.029

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

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

STREAM NAME: Corral Creek
XS LOCATION: 150' upstream from culvert under railroads
XS NUMBER: 2

DATA POINTS= 27

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	S	0.50	4.56			0.00		0.00	0.00	0.0%
1	G	3.00	4.92			0.00		0.00	0.00	0.0%
	W	4.50	5.52			0.00		0.00	0.00	0.0%
		5.00	5.60	0.10	0.92	0.51	0.10	0.05	0.05	2.1%
		5.50	5.61	0.10	0.85	0.50	0.10	0.05	0.04	1.9%
		6.00	5.69	0.20	1.31	0.51	0.20	0.10	0.13	5.9%
		6.50	5.73	0.25	0.69	0.50	0.25	0.13	0.09	3.9%
		7.00	5.79	0.30	0.26	0.50	0.30	0.15	0.04	1.8%
		7.50	5.75	0.25	0.89	0.50	0.25	0.13	0.11	5.0%
		8.00	5.74	0.25	0.75	0.50	0.25	0.13	0.09	4.3%
		8.50	5.76	0.25	0.58	0.50	0.25	0.13	0.07	3.3%
		9.00	5.80	0.30	0.72	0.50	0.30	0.15	0.11	4.9%
		9.50	5.72	0.20	0.90	0.51	0.20	0.10	0.09	4.1%
		10.00	6.02	0.50	0.31	0.58	0.50	0.25	0.08	3.5%
		10.50	5.96	0.45	0.72	0.50	0.45	0.23	0.16	7.3%
		11.00	5.91	0.40	0.60	0.50	0.40	0.20	0.12	5.5%
		11.50	5.99	0.50	1.40	0.51	0.50	0.25	0.35	15.9%
		12.00	6.18	0.70	1.38	0.53	0.70	0.35	0.48	21.9%
		12.50	6.10	0.60	0.17	0.51	0.60	0.30	0.05	2.3%
		13.00	6.01	0.50	0.24	0.51	0.50	0.25	0.06	2.7%
		13.50	5.88	0.40	0.25	0.52	0.40	0.20	0.05	2.3%
		14.00	5.87	0.40	0.17	0.50	0.40	0.20	0.03	1.5%
		14.50	5.85	0.35		0.50	0.35	0.18	0.00	0.0%
		15.00	5.56	0.05		0.58	0.05	0.03	0.00	0.0%
	W	15.50	5.48			0.51		0.00	0.00	0.0%
1	G	16.30	4.84			0.00		0.00	0.00	0.0%
	S	17.00	4.21			0.00		0.00	0.00	0.0%
	TOTALS ----------					11.27	0.7 (Max.)	3.53	2.21	100.0%

Manning's n = 0.1862
Hydraulic Radius= 0.312656088

STREAM NAME: Corral Creek
XS LOCATION: 150' upstream from culvert under railroads
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	3.53	3.51	-0.4%
5.25	3.53	6.38	81.1%
5.27	3.53	6.15	74.3%
5.29	3.53	5.91	67.6%
5.31	3.53	5.67	60.9%
5.33	3.53	5.44	54.3%
5.35	3.53	5.21	47.7%
5.37	3.53	4.98	41.2%
5.39	3.53	4.75	34.6%
5.41	3.53	4.52	28.2%
5.43	3.53	4.29	21.8%
5.45	3.53	4.07	15.4%
5.46	3.53	3.95	12.2%
5.47	3.53	3.84	9.0%
5.48	3.53	3.73	5.9%
5.49	3.53	3.62	2.7%
5.50	3.53	3.51	-0.4%
5.51	3.53	3.40	-3.5%
5.52	3.53	3.30	-6.5%
5.53	3.53	3.19	-9.6%
5.54	3.53	3.08	-12.6%
5.55	3.53	2.98	-15.5%
5.57	3.53	2.77	-21.3%
5.59	3.53	2.57	-27.1%
5.61	3.53	2.37	-32.6%
5.63	3.53	2.19	-37.9%
5.65	3.53	2.00	-43.1%
5.67	3.53	1.82	-48.2%
5.69	3.53	1.65	-53.3%
5.71	3.53	1.47	-58.2%
5.73	3.53	1.31	-62.9%
5.75	3.53	1.15	-67.3%

WATERLINE AT ZERO
AREA ERROR = 5.499

STREAM NAME: Corral Creek
XS LOCATION: 150' upstream from culvert under railroads
XS NUMBER: 2

Constant Manning's n

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

STAGING TABLE

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	4.92	13.20	0.80	1.26	10.54	13.79	100.0%	0.76	11.97	1.14
	4.95	13.09	0.78	1.23	10.16	13.66	99.1%	0.74	11.33	1.12
	5.00	12.90	0.74	1.18	9.51	13.45	97.5%	0.71	10.25	1.08
	5.05	12.72	0.70	1.13	8.87	13.23	96.0%	0.67	9.23	1.04
	5.10	12.53	0.66	1.08	8.24	13.02	94.4%	0.63	8.25	1.00
	5.15	12.34	0.62	1.03	7.61	12.80	92.9%	0.59	7.32	0.96
	5.20	12.15	0.58	0.98	7.00	12.59	91.3%	0.56	6.43	0.92
	5.25	11.97	0.53	0.93	6.40	12.37	89.8%	0.52	5.60	0.88
	5.30	11.78	0.49	0.88	5.80	12.16	88.2%	0.48	4.82	0.83
	5.35	11.59	0.45	0.83	5.22	11.95	86.6%	0.44	4.09	0.78
	5.40	11.40	0.41	0.78	4.65	11.73	85.1%	0.40	3.40	0.73
	5.45	11.22	0.36	0.73	4.08	11.52	83.5%	0.35	2.78	0.68
WL	5.50	10.94	0.32	0.68	3.52	11.21	81.3%	0.31	2.21	0.63
	5.55	10.39	0.29	0.63	2.99	10.66	77.3%	0.28	1.74	0.58
	5.60	9.94	0.25	0.58	2.48	10.19	73.9%	0.24	1.32	0.53
	5.65	9.10	0.22	0.53	2.02	9.34	67.7%	0.22	0.99	0.49
	5.70	8.65	0.18	0.48	1.57	8.87	64.3%	0.18	0.67	0.43
	5.75	7.13	0.16	0.43	1.16	7.32	53.1%	0.16	0.46	0.40
	5.80	4.98	0.17	0.38	0.87	5.13	37.2%	0.17	0.36	0.41
	5.85	4.79	0.13	0.33	0.62	4.91	35.6%	0.13	0.21	0.34
	5.90	3.63	0.11	0.28	0.42	3.74	27.1%	0.11	0.13	0.31
	5.95	2.72	0.09	0.23	0.25	2.81	20.4%	0.09	0.07	0.27
	6.00	1.73	0.08	0.18	0.14	1.79	13.0%	0.08	0.04	0.25
	6.05	1.13	0.07	0.13	0.08	1.16	8.4%	0.06	0.02	0.22
	6.10	0.72	0.04	0.08	0.03	0.74	5.4%	0.04	0.00	0.16
	6.15	0.28	0.02	0.03	0.00	0.29	2.1%	0.02	0.00	0.08

STREAM NAME: Corral Creek
XS LOCATION: 150' upstream from culvert under railroads
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	2.21	cfs
CALCULATED FLOW (Qc)=	2.21	cfs
(Qm-Qc)/Qm * 100 =	-0.4	%
MEASURED WATERLINE (WLm)=	5.50	ft
CALCULATED WATERLINE (WLc)=	5.50	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.70	ft
MAX CALCULATED DEPTH (Dc)=	0.68	ft
(Dm-Dc)/Dm * 100	2.7	%
MEAN VELOCITY=	0.63	ft/sec
MANNING'S N=	0.186	
SLOPE=	0.029	ft/ft
.4 * Qm =	0.9	cfs
2.5 * Qm=	5.5	cfs

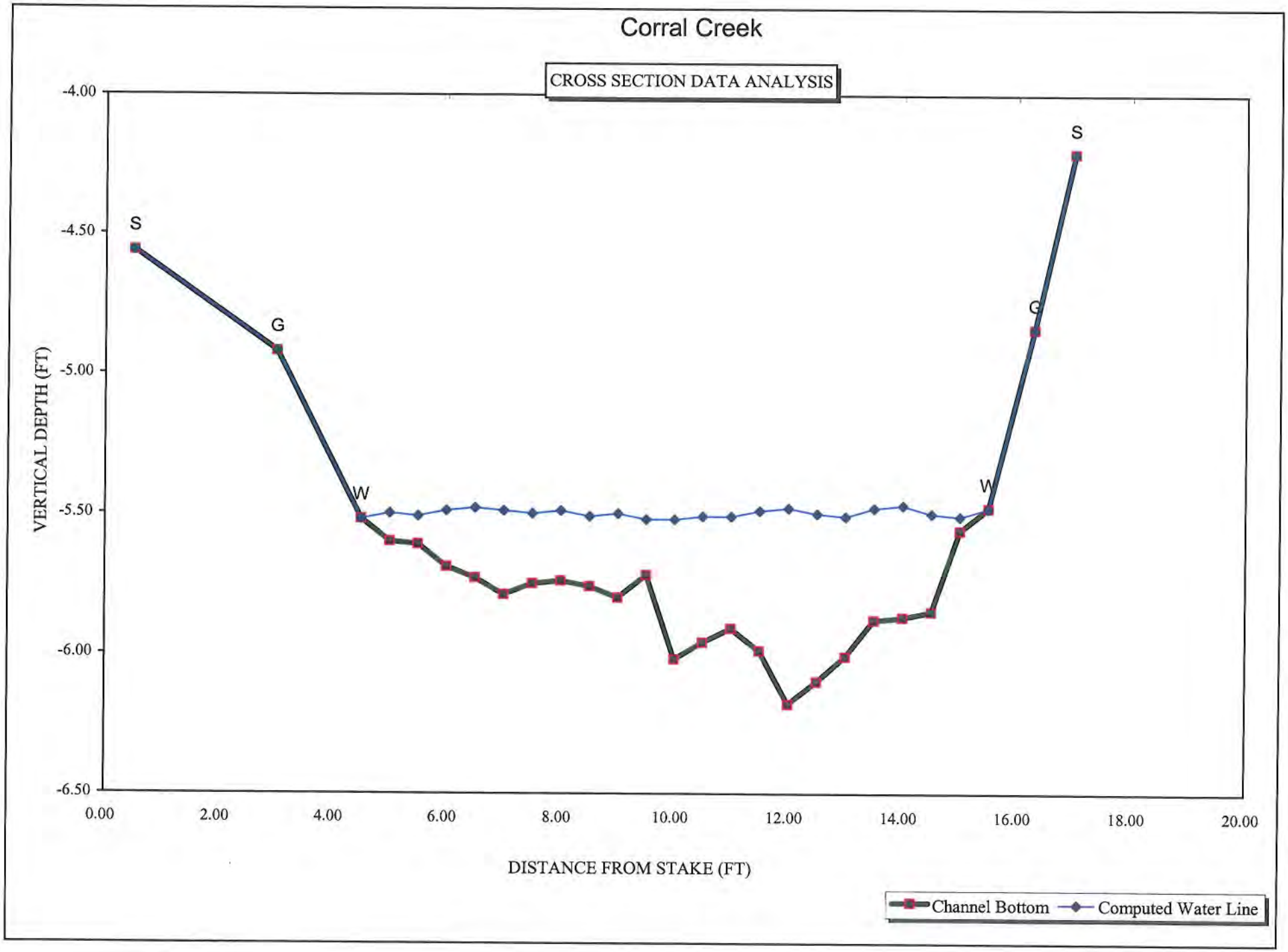
RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD

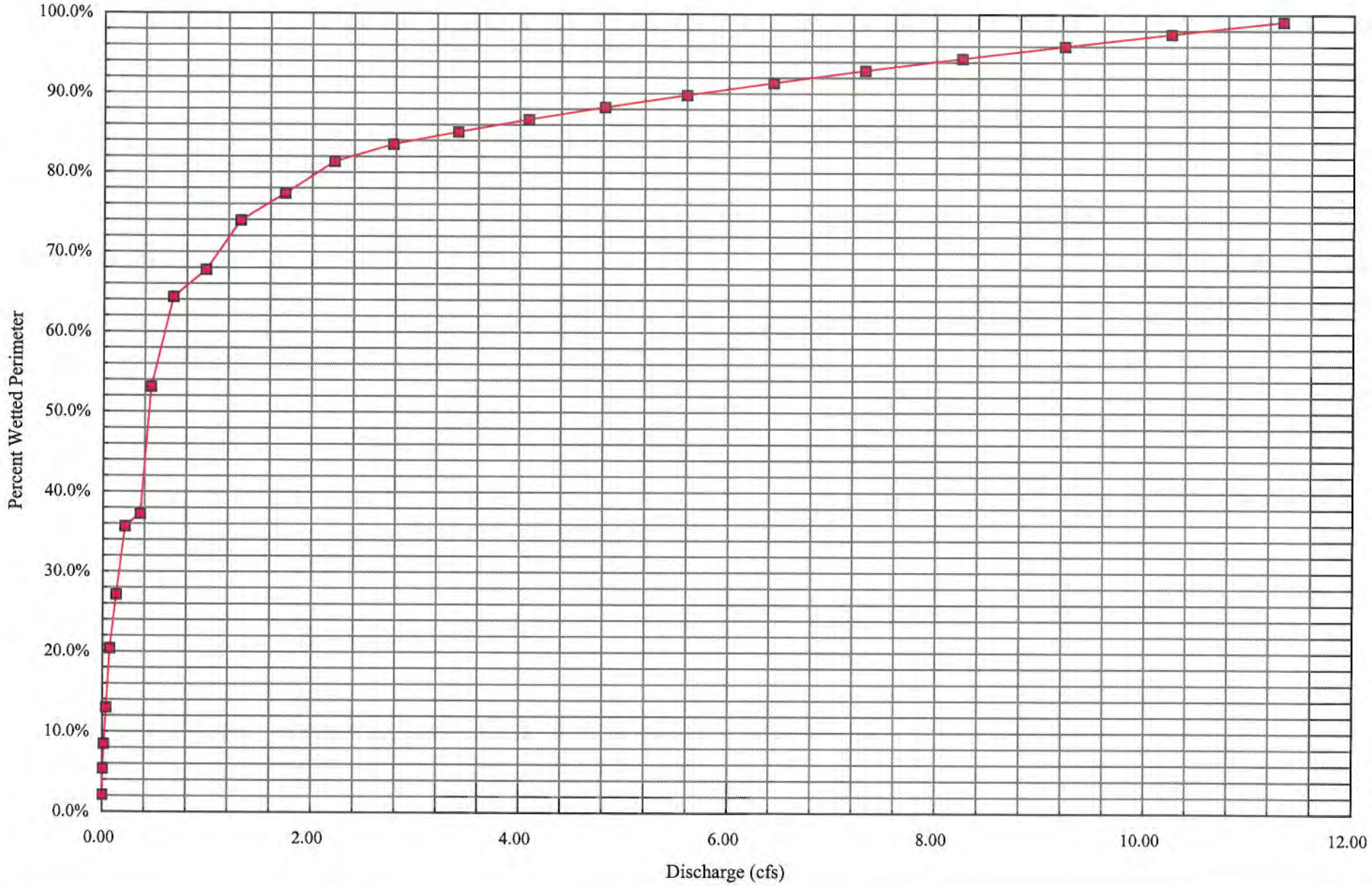
RATIONALE FOR RECOMMENDATION:

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

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


Corral Creek
CROSS SECTION DATA ANALYSIS
-4.00
-4.50
-5.00
-5.50
-6.00
-6.50
VERTICAL DEPTH (FT)
S
G
W
W
G
S
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line

Percent Wetted Perimeter vs. Discharge

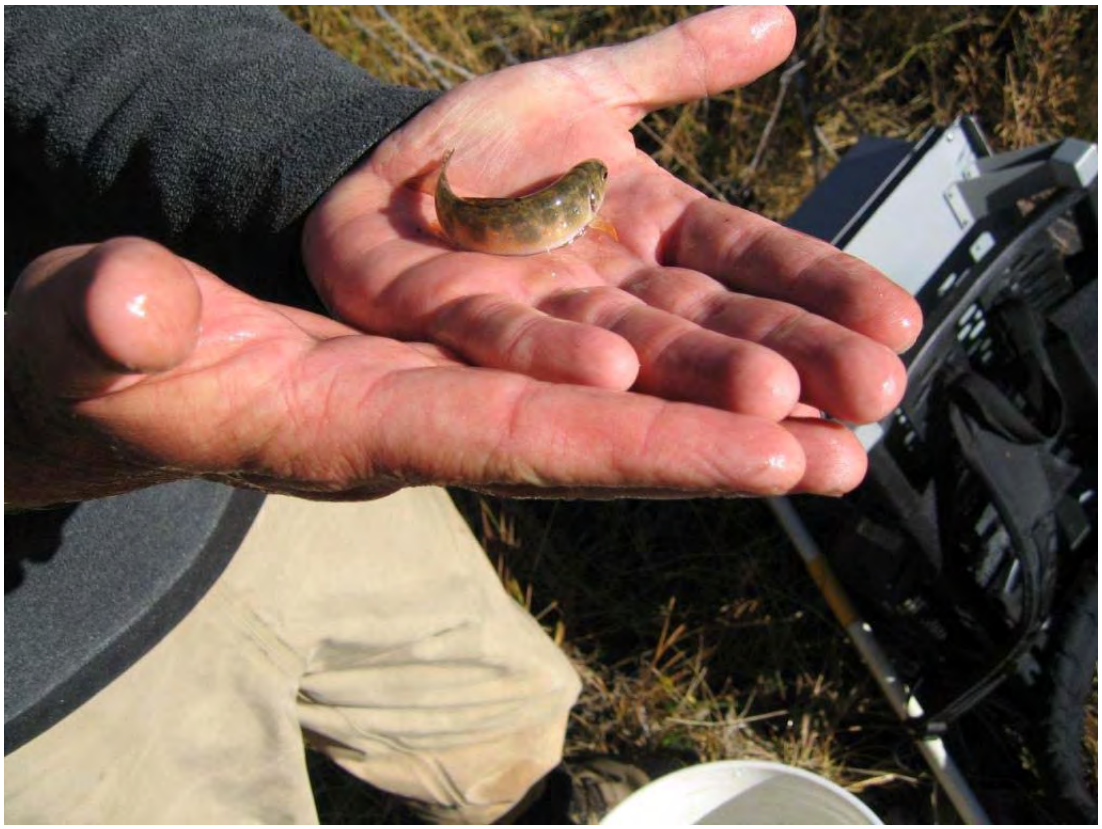


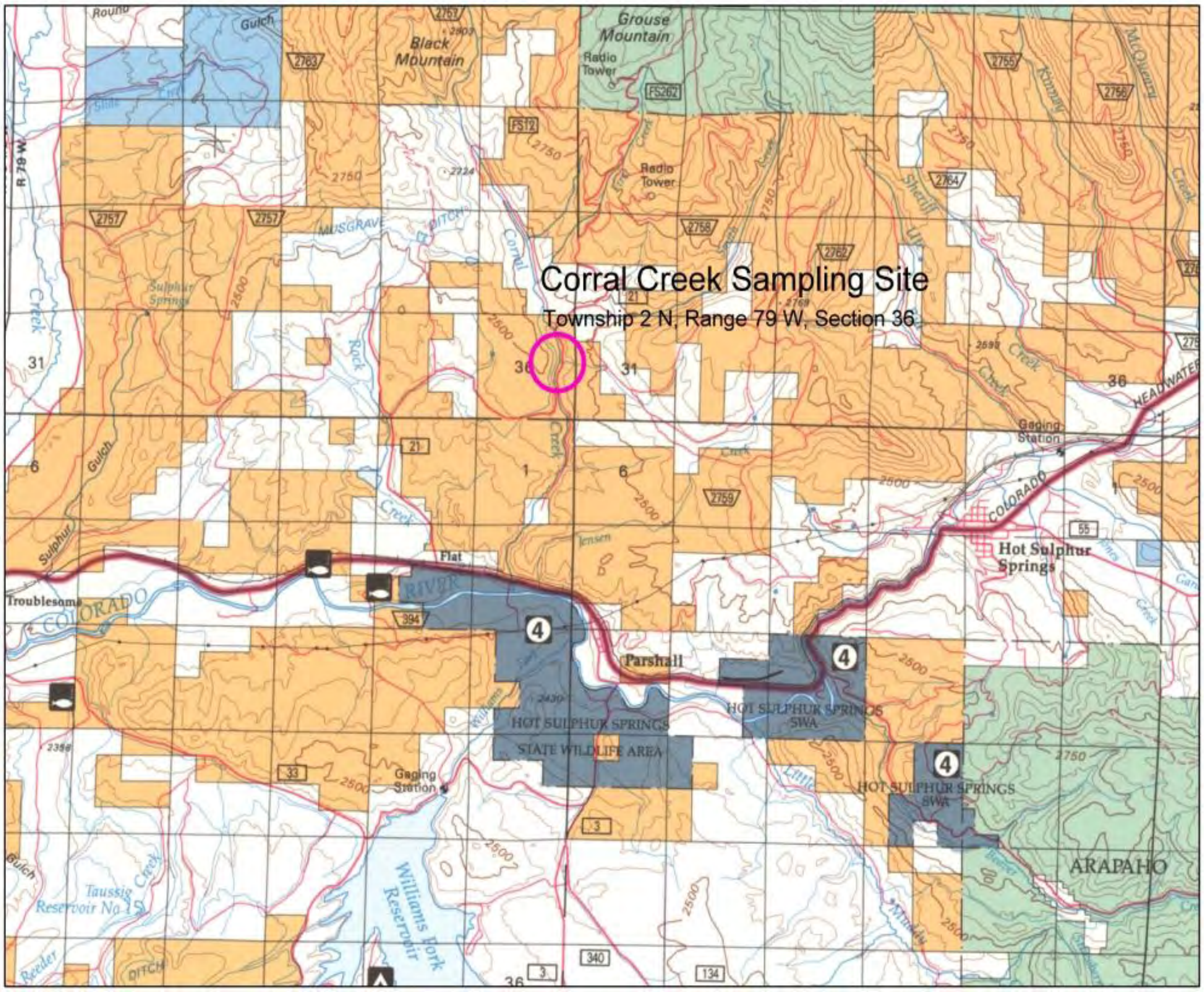
Kremmling Field Office Stream Surveys
October 2006

Corral Creek - Water Code #19744

Corral Creek, located west of Hot Sulphur Springs, CO and located on BLM lands managed by the Kremmling Field Office was sampled on October 12, 2006. Corral Creek is tributary to the Colorado River. Presence/absence sampling was done in support of the Colorado BLM in-stream flow program. Sampling was conducted via backpack electro-shocker and approximately 150 feet of stream was sampled. Personnel present were Paula Belcher, KRFO, Hydrologist, Tom Fresques, BLM West Slope Fisheries Biologist, and Malia Boyum, Biological Technician, GSFO.

A total of 10 fish were collected, and all fish were brook trout. See the data sheet below for size class distributions.




Corral Creek Sampling Site
Township 2 N, Range 79 W, Section 36
Grouse Mountain
Black Mountain
Radio Tower
MUSGRAVE DITCH
Sulphur Springs
Troublesome
COLORADO RIVER
Flat
Parshall
Hot Sulphur Springs
HOT SULPHUR SPRINGS STATE WILDLIFE AREA
HOT SULPHUR SPRINGS SWA
Gaging Station
Williams Fork Reservoir
Taussig Reservoir No 1
ARAPAHO

FISH SAMPLING FORM

WATER Corral Creek CODE 19744 DATE 10-12-06

GEAR backpack shocker EFFORT 150 ft STATION #___ PASS #__

(mm)

species	length	weight	mark		species	length	weight	mark
BRK	200							
BRK	193							
BRK	195							
BRK	231							
BRK	192							
BRK	191							
BRK	206							
BRK	185							
BRK	85							
BRK	89							

GPS Location:

Notes (water temp, etc.):

10 total fish, all brook trout (*Salvelinus fontinalis*)