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**Greg Espegren**  
*Aquatics Specialist*  
*Colorado Water Project*  
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Boulder, CO 80302  
303.440.2937

February 18, 2010

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

Dear Ms. Bassi and Mr. Baessler,

Trout Unlimited in conjunction with the Colorado Division of Wildlife (CDOW) is submitting this instream flow recommendation for an unnamed tributary to Muddy Creek, located in Routt and Grand Counties, Water Division 5.

**Location and Land Status.** This unnamed tributary to Muddy Creek originates in the headwaters of the Gore Range at an elevation of approximately 9,800 feet. Over the next 1.75 miles it flows generally east through the Arapahoe National Forest as it drops to its confluence with Muddy Creek at an elevation of 8,760 feet. The proposed ISF reach covers this entire 1.75 mile segment and the entire reach is located on Forest Service Land (Fig. 1).

**Biological Summary and R2CROSS Analysis.** In September 2009, TU collected stream cross sectional data, natural environment data, and other data needed to quantify instream flow needs. Previous survey data collected by CDOW and rod and reel sampling by TU staff indicates that the stream supports healthy populations of Colorado River cutthroat trout.

Stream cross sectional data were analyzed using the R2CROSS program, and the output was evaluated using the methods described in Nehring (1979) and Espegren (1996). The R2CROSS models how average depth, percent wetted perimeter and average velocity vary with discharge. According to the criteria established by Nehring (1979), the relevant minimum requirements are an average depth of 0.2 feet, a wetted perimeter of 50%, and an average velocity of 1.0 ft/sec. Protecting salmonids during the summer season is accomplished by insuring all three criteria are met while during the winter protection can be accomplished by protecting 2 of three criteria. Thus, R2CROSS indicates that the fishery of this unnamed tributary to Muddy Creek can be protected with minimum summer flows of 1.25 cfs and minimum winter flows of 0.40 cfs.

**Water Availability.** There are no stream gages on this unnamed tributary to Muddy Creek so we used the USGS StreamStats methodology to estimate the discharge passing through the

proposed ISF reach. This allowed us to estimate how much water would have flowed through this unnamed tributary to Muddy Creek in the absence of any diversions.

The Colorado State Engineer's CDSS Diversion Structures, Division 5, Database (version 20090701) indicates that there are no diversion structures located within this unnamed tributary to Muddy Creek watershed. Therefore, no adjustments to the StreamStats modeled flows were necessary.

We used this water availability analysis to adjust the recommended ISF so that our estimate of average monthly flows through this unnamed tributary to Muddy Creek typically exceeded the recommended flows (Fig. 2).

**Preliminary ISF Recommendation.** Our StreamStats water availability analysis indicates that streamflows are available to satisfy the flows that resulted from our R2CROSS analysis. Therefore, TU makes a preliminary recommendation for the following flow amounts to preserve the natural environment of this unnamed tributary to Muddy Creek to a reasonable degree:

- From **April 15 through October 15** a flow appropriation of **1.25 cfs** is recommended to maintain the three principal criteria of average depth, average velocity, and percent wetted perimeter;
- From **October 16 through April 14**, a flow appropriation of **0.40 cfs** is recommended to maintain the wetted perimeter and average depth criteria.

We understand that the CWCB staff will evaluate water availability in more detail during the coming months and the seasonality of these flow recommendations may change as a result of the CWCB staffs' analysis.

**Relationship to Existing State Policy.** TU is forwarding this stream flow recommendation to the CWCB to meet the State of Colorado's policy "that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors ... and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities." C.R.S. 33-1-101(1). Further, the CDOW Strategic Plan states "Healthy aquatic environments are essential to maintain healthy and viable fisheries, and critical for self-sustaining populations. The Division desires to protect and enhance the quality and quantity of aquatic habitats." TU recommends that this unnamed tributary to Muddy Creek be considered for inclusion in the Instream Flow Program because doing so would help meet these stated policies. Specifically, establishing minimum flows through this reach would preserve the natural environment of the stream to a reasonable degree.

Attached in Appendix A, please find copies of the field data sheets, the R2CROSS modeling runs, and stream photographs. If you have any questions regarding the attached information or the instream flow recommendations, please feel free to contact me at (303) 440-2937.

Trout Unlimited thanks the Colorado Division of Wildlife and the Colorado Water Conservation Board Staff for their support in preparing this recommendation.

Sincerely,

*Greg Espegren*

Greg Espegren  
Trout Unlimited  
Aquatic Specialist

Cc: Jay Skinner, CDOW Water Unit Program Manager – w/o attachments  
Mark Uppendahl, CDOW Instream Flow Program Coordinator

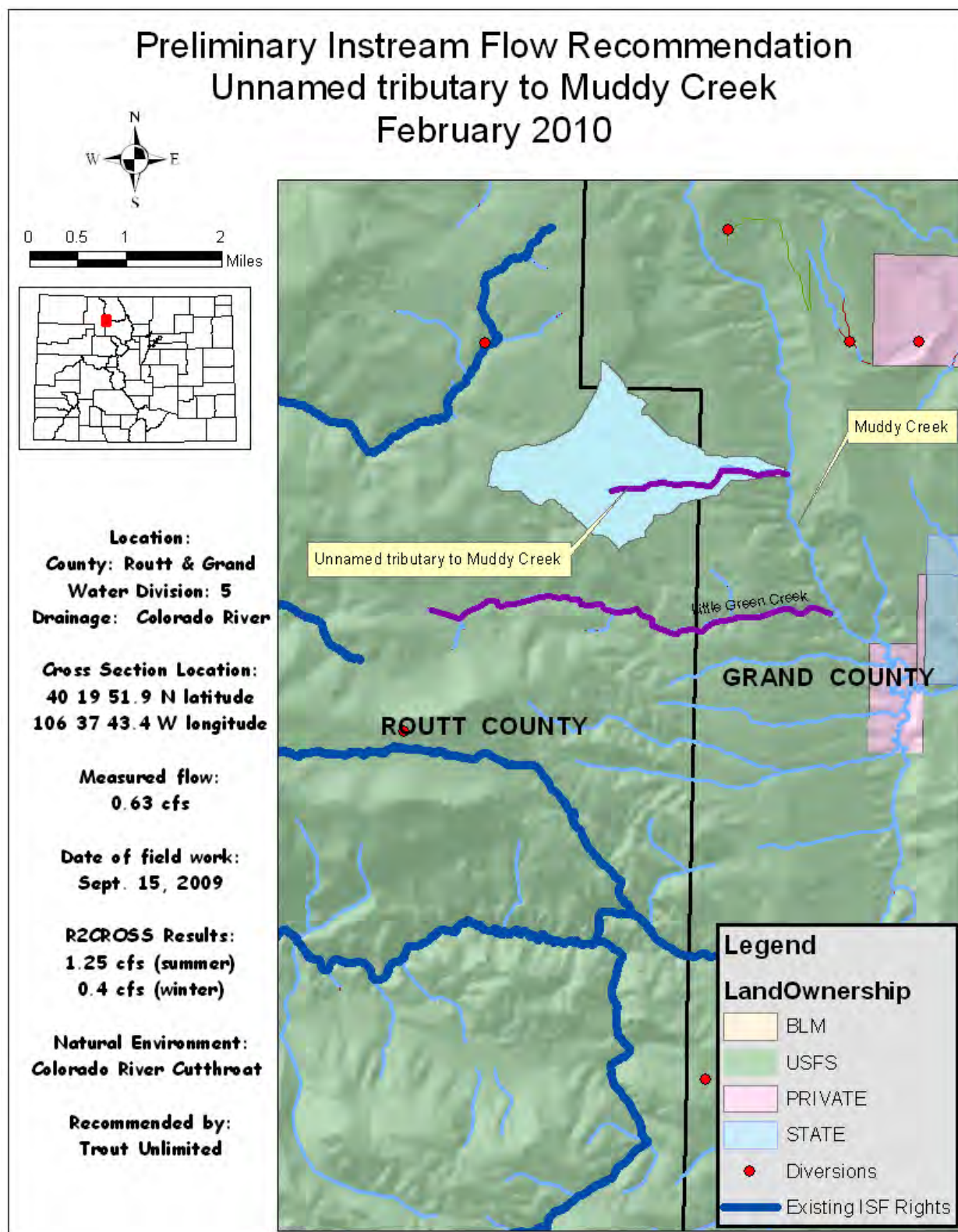
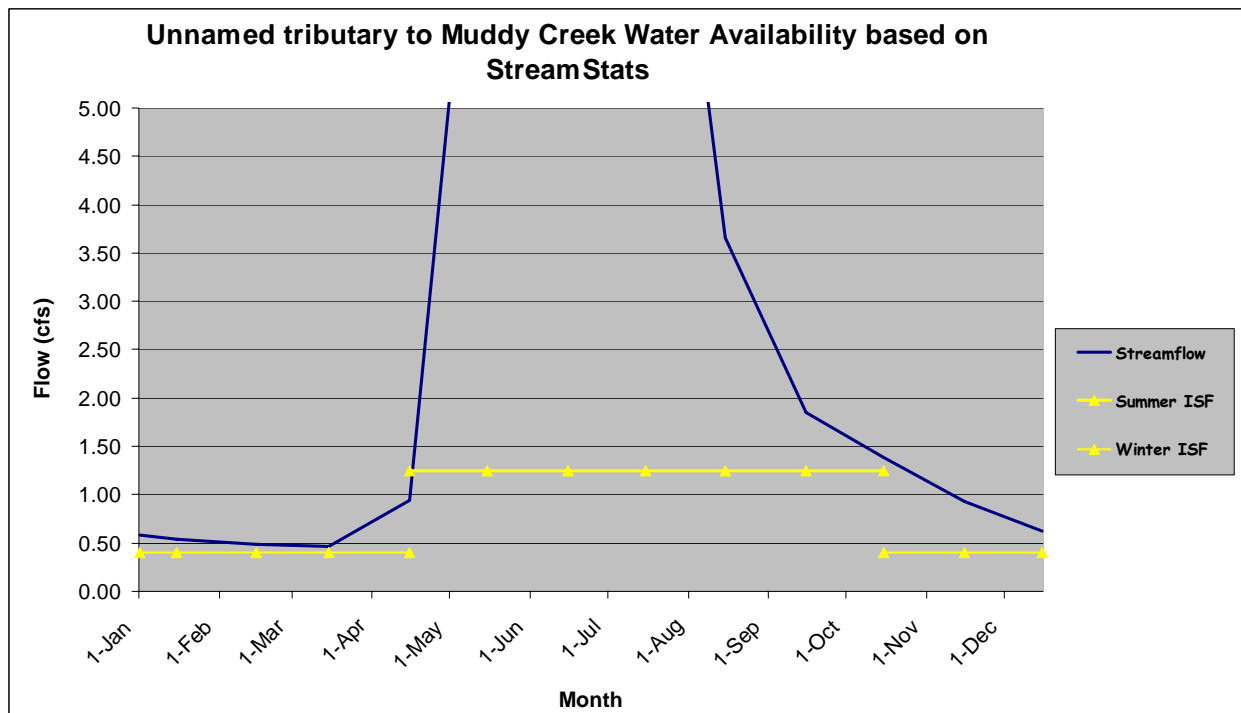
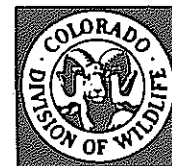


Figure 1.. Map of unnamed tributary to Muddy Creek watershed. The watershed's location within Division 5 is indicated by the red box on the inset map of Colorado



**Figure 2. Recommended instream flow appropriations (yellow lines) as compared to estimated average monthly discharge at Lower Terminus of proposed ISF reach on unnamed tributary of Muddy Creek.**



## LOCATION INFORMATION

STREAM NAME: Unnamed Trib to Little Muddy Creek		CROSS-SECTION NO.: 1	
CROSS-SECTION LOCATION: Downstream of Forest Road 100 Crossing Parallel to Road N 40° 19' 51.9" W 106° 37' 43.4"			
DATE: 9-15	OBSERVERS: Gregg Espygreen + Drew Peterson		
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 7	TOWNSHIP: 4 (N/S)
			RANGE: 82 (E/W)
COUNTY: ROVTT	WATERSHED: Colorado	WATER DIVISION: 3	DOW WATER CODE:
MAP(S):	USGS: WALTON PARK		
	USFS: ARAPAHOE		

## SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION:		YES / NO		METER TYPE:	
METER NUMBER:		DATE RATED:		CALIB/SPIN: _____ sec	
				TAPE WEIGHT: _____ lbs/foot	
CHANNEL BED MATERIAL SIZE RANGE:				TAPE TENSION: _____ lbs	
		PHOTOGRAPHS TAKEN: YES/NO		NUMBER OF PHOTOGRAPHS: 3	

### CHANNEL PROFILE DATA

STATION		DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗	Tape @ Stake LB	0.0	
⊗	Tape @ Stake RB	0.0	
①	WS @ Tape LB/RB	0.0	RB=6.84 LB=6.89
②	WS Upstream	3.5'	6.70
③	WS Downstream	2'	6.96
SLOPE			

SKETCH

LEGEND:

Stake ⊗

Station ①

Photo ◇ →

Direction of Flow

## AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO <input checked="" type="radio"/>	DISTANCE ELECTROFISHED: _____ ft	FISH CAUGHT: YES/NO <input checked="" type="radio"/> FLY ROD	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
CR CT					<del>  </del>	<del>  </del>											
AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:																	

## COMMENTS

NO BROOK TROUT!

### 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: 2:00 PM					
Features	Stake Grassline (S) 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 <sup>2</sup> )	Discharge (cfs)
									At Point	Mean in Vertical		
S		0		5.51								
		0.7		5.79								
G		1.0		6.04								
W		1.3		6.90	0							
		1.5		7.12	0.2					0.06		
		1.8		7.10	0.2					0.10		
Below Rock		2		7.15	0.25					0.0		
		2.2		7.25	0.35					0.05		
		2.4		7.26	0.35					0.24		
		2.6		7.16	0.25					1.25		
		2.8		7.42	0.52					1.53		
		3		7.35	0.45					1.07		
		3.2		7.43	0.55					1.69		
		3.4		7.10	0.20					0.89		
		3.6		7.09	0.20					0.28		
		3.8		7.04	0.15					0.17		
		4		7.03	0.15					0.26		
W		4.3		6.87	ø							
		5.0		6.58								
G		6.7		6.48								
		7.4		5.70								
S		8.2		4.60								
TOTALS:												
End of Measurement	Time: 2:15	Gage Reading: _____ ft	CALCULATIONS PERFORMED BY:					CALCULATIONS CHECKED BY:				

### Data Input & Proofing

STREAM NAME:	Unnamed trib to Muddy Creek		
XS LOCATION:	downstream of FS Road 100		
XS NUMBER:	1		
DATE:	9/15/2009		
OBSERVERS:	Espegren, Peternell		
1/4 SEC:	NW		
SECTION:	7		
TWP:	4N		
RANGE:	82W		
PM:	6th		
COUNTY:	Routt		
WATERSHED:	Muddy Creek, Colorado River		
DIVISION:	5		
DOW CODE:			
USGS MAP:	Walton Peak, Lake Agnes		
USFS MAP:	Arapahoe		
TAPE WT:	0.0106	Level and Rod Survey	lbs / ft
TENSION:	99999		lbs
SLOPE:	0.047272727 ft / ft		

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
Total Data Points = 22								
1	Stake	0.00	5.51			0.00	0.00	0.00
		0.70	5.79			0.00	0.00	0.00
	G	1.00	6.04			0.00	0.00	0.00
	W	1.30	6.90	0.00		0.00	0.00	0.00
		1.50	7.12	0.20	0.06	0.05	0.00	6.92
		1.80	7.10	0.20	0.10	0.05	0.01	6.90
		2.00	7.15	0.25	0.00	0.05	0.00	6.90
		2.20	7.25	0.35	0.05	0.07	0.00	6.90
		2.40	7.26	0.35	0.74	0.07	0.05	6.91
		2.60	7.16	0.25	1.25	0.05	0.06	6.91
		2.80	7.42	0.52	1.53	0.10	0.16	6.90
		3.00	7.35	0.45	1.07	0.09	0.10	6.90
		3.20	7.43	0.55	1.69	0.11	0.19	6.88
		3.40	7.10	0.20	0.89	0.04	0.04	6.90
		3.60	7.09	0.20	0.28	0.04	0.01	6.89
1		3.80	7.04	0.15	0.17	0.03	0.01	6.89
		4.00	7.03	0.15	0.26	0.04	0.01	6.88
	W	4.30	6.87	0.00		0.00	0.00	0.00
		5.00	6.58			0.00	0.00	0.00
	G	6.70	6.48			0.00	0.00	0.00
		7.40	5.70			0.00	0.00	0.00
	Stake	8.20	4.60			0.00	0.00	0.00

CHECKED BY:.....DATE.....

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

Totals	0.79	0.63
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COLORADO WATER CONSERVATION BOARD  
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM  
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME: Unnamed trib to Muddy Creek  
XS LOCATION: downstream of FS Road 100  
XS NUMBER: 1

DATE: 15-Sep-09  
OBSERVERS: Espegren, Peterneil

1/4 SEC: NW  
SECTION: 7  
TWP: 4N  
RANGE: 82W  
PM: 6th

COUNTY: Routt  
WATERSHED: Muddy Creek, Colorado River  
DIVISION: 5  
DOW CODE: 0

USGS MAP: Walton Peak, Lake Agnes  
USFS MAP: Arapahoe

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: 0.04727273

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

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

STREAM NAME: Unnamed trib to Muddy Creek  
 XS LOCATION: downstream of FS Road 100  
 XS NUMBER: 1

# DATA POINTS= 22

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL
Stake	0.00	5.51		
	0.70	5.79		
1 G	1.00	6.04		
W	1.30	6.90	0.00	
	1.50	7.12	0.20	0.06
	1.80	7.10	0.20	0.10
	2.00	7.15	0.25	0.00
	2.20	7.25	0.35	0.05
	2.40	7.26	0.35	0.74
	2.60	7.16	0.25	1.25
	2.80	7.42	0.52	1.53
	3.00	7.35	0.45	1.07
	3.20	7.43	0.55	1.69
	3.40	7.10	0.20	0.89
	3.60	7.09	0.20	0.28
	3.80	7.04	0.15	0.17
	4.00	7.03	0.15	0.26
W	4.30	6.87	0.00	
	5.00	6.58		
1 G	6.70	6.48		
	7.40	5.70		
Stake	8.20	4.60		

TOTALS -----

VALUES COMPUTED FROM RAW FIELD DATA

WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.30	0.20	0.05	0.00	0.5%
0.30	0.20	0.05	0.01	0.8%
0.21	0.25	0.05	0.00	0.0%
0.22	0.35	0.07	0.00	0.6%
0.20	0.35	0.07	0.05	8.2%
0.22	0.25	0.05	0.06	9.9%
0.33	0.52	0.10	0.16	25.3%
0.21	0.45	0.09	0.10	15.3%
0.22	0.55	0.11	0.19	29.6%
0.39	0.20	0.04	0.04	5.7%
0.20	0.20	0.04	0.01	1.8%
0.21	0.15	0.03	0.01	0.8%
0.20	0.15	0.04	0.01	1.6%
0.34		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%

3.54 0.55 0.79 0.63 100.0%  
 (Max.)

Manning's n = 0.1498  
 Hydraulic Radius= 0.223621442

STREAM NAME: Unnamed trib to Muddy Creek  
 XS LOCATION: downstream of FS Road 100  
 XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.79	0.83	4.6%
6.64	0.79	1.66	109.3%
6.66	0.79	1.58	100.2%
6.68	0.79	1.51	91.1%
6.70	0.79	1.44	82.2%
6.72	0.79	1.37	73.5%
6.74	0.79	1.30	64.8%
6.76	0.79	1.24	56.4%
6.78	0.79	1.17	48.0%
6.80	0.79	1.11	39.8%
6.82	0.79	1.04	31.8%
6.84	0.79	0.98	23.8%
6.85	0.79	0.95	19.9%
6.86	0.79	0.92	16.1%
6.87	0.79	0.89	12.2%
6.88	0.79	0.86	8.4%
6.89	0.79	0.83	4.6%
6.90	0.79	0.80	0.9%
6.91	0.79	0.77	-2.8%
6.92	0.79	0.74	-6.5%
6.93	0.79	0.71	-10.2%
6.94	0.79	0.68	-13.8%
6.96	0.79	0.63	-20.9%
6.98	0.79	0.57	-27.9%
7.00	0.79	0.52	-34.7%
7.02	0.79	0.46	-41.4%
7.04	0.79	0.41	-47.9%
7.06	0.79	0.36	-53.9%
7.08	0.79	0.32	-59.6%
7.10	0.79	0.28	-65.0%
7.12	0.79	0.24	-69.6%
7.14	0.79	0.21	-73.4%

WATERLINE AT ZERO  
 AREA ERROR = 6.897

STREAM NAME: Unnamed trib to Muddy Creek  
 XS LOCATION: downstream of FS Road 100  
 XS NUMBER: 1

Constant Manning's n

\*GL\* = lowest Grassline elevation corrected for sag

STAGING TABLE

\*WL\* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
*GL*	6.48	5.55	0.42	0.95	2.33	6.44	100.0%	0.36	2.55	1.09
	6.50	5.24	0.43	0.93	2.24	6.13	95.1%	0.36	2.46	1.10
	6.55	4.38	0.46	0.88	2.00	5.23	81.1%	0.38	2.27	1.14
	6.60	3.76	0.48	0.83	1.80	4.57	70.9%	0.39	2.08	1.16
	6.65	3.63	0.44	0.78	1.61	4.39	68.1%	0.37	1.78	1.11
	6.70	3.49	0.41	0.73	1.43	4.20	65.2%	0.34	1.51	1.05
	6.75	3.35	0.38	0.68	1.26	4.02	62.4%	0.31	1.26	1.00
	6.80	3.21	0.34	0.63	1.10	3.84	59.5%	0.29	1.03	0.94
	6.85	3.07	0.31	0.58	0.94	3.65	56.7%	0.26	0.82	0.87
*WL*	6.90	2.95	0.27	0.53	0.79	3.48	54.1%	0.23	0.64	0.80
	6.95	2.81	0.23	0.48	0.65	3.31	51.4%	0.20	0.47	0.73
	7.00	2.67	0.19	0.43	0.51	3.14	48.7%	0.16	0.33	0.64
	7.05	2.34	0.16	0.38	0.38	2.77	43.0%	0.14	0.22	0.58
	7.10	1.97	0.14	0.33	0.27	2.38	36.9%	0.11	0.14	0.51
	7.15	1.38	0.14	0.28	0.19	1.74	27.1%	0.11	0.10	0.50
	7.20	1.14	0.11	0.23	0.13	1.44	22.3%	0.09	0.06	0.43
	7.25	0.87	0.09	0.18	0.08	1.09	17.0%	0.07	0.03	0.38
	7.30	0.57	0.08	0.13	0.05	0.74	11.4%	0.06	0.02	0.34
	7.35	0.51	0.04	0.08	0.02	0.62	9.5%	0.03	0.00	0.22
	7.40	0.18	0.01	0.03	0.00	0.22	3.5%	0.01	0.00	0.11

1.25

0.4

STREAM NAME: Unnamed trib to Muddy Creek  
XS LOCATION: downstream of FS Road 100  
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)= 0.63 cfs  
CALCULATED FLOW (Qc)= 0.64 cfs  
(Qm-Qc)/Qm \* 100 = -1.1 %  
  
MEASURED WATERLINE (Wlm)= 6.89 ft  
CALCULATED WATERLINE (Wlc)= 6.90 ft  
(Wlm-Wlc)/Wlm \* 100 = -0.2 %  
  
MAX MEASURED DEPTH (Dm)= 0.55 ft  
MAX CALCULATED DEPTH (Dc)= 0.53 ft  
(Dm-Dc)/Dm \* 100 = 3.2 %  
  
MEAN VELOCITY= 0.80 ft/sec  
MANNING'S N= 0.150  
SLOPE= 0.04727273 ft/ft  
  
.4 \* Qm = 0.3 cfs  
2.5 \* Qm = 1.6 cfs

RECOMMENDED INSTREAM FLOW:

=====

FLOW (CFS)

PERIOD

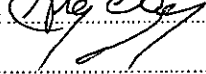
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1.25 (3:3)  
0.40 (2:3)

RATIONALE FOR RECOMMENDATION:

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RECOMMENDATION BY:  AGENCY: T. J. U. DATE: 1/29/10  
CWCB REVIEW BY: \_\_\_\_\_ DATE: \_\_\_\_\_



















