Stream: East Willow Creek

Executive Summary

Water Division: 6
Water District: 43
CDOW#: 23961
CWCB ID: 08/6/A-006

Segment: Confl. Bull Fork East Willow Creek to Confl. West Willow Creek

Upper Terminus: CONFLUENCE WITH BULL FORK EAST WILLOW CREEK AT (Latitude 39° 41’ 32.68”N) (Longitude 108° 16’ 58.85”W)

Lower Terminus: CONFLUENCE WITH WEST WILLOW CREEK AT (Latitude 39° 43’ 42.08”N) (Longitude 108° 16’ 55.27”W)

Watershed: Piceance-Yellow (HUC#: 14050006)
Counties: Garfield, Rio Blanco
Length: 2.69 miles
USGS Quad(s): Bull Fork
Flow Recommendation: 0.8 cfs (May 1 - October 31)
0.6 cfs (November 1 - April 30)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated instream flow appendices (see CD entitled 2008 Instream Flow Recommendations) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

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

East Willow Creek is approximately 7 miles long. It begins on the north flank of Sleepy Ridge on BLM lands at an elevation of approximately 8400 feet and terminates at the confluence with West Willow Creek at an elevation of approximately 7150 feet. Approximately 82% of the land on the 2.69 mile segment addressed by this report is publicly owned. East Willow Creek is located within Rio Blanco County. The total drainage area of the creek is approximately 18.83 square miles. Willow Creek generally flows in a northeasterly direction.

The subject of this report is a segment of East Willow Creek beginning at the confluence with Bull Fork East Willow Creek and extending downstream to the confluence with West Willow Creek. The proposed segment is located approximately 20 miles southwest of Meeker. 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 0.8 cfs, summer, and 0.6 cfs, winter, based on data collection efforts. The modeling results from this survey effort were valid to quantify the amount of water necessary to preserve the natural environment to a reasonable degree.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence with Bull Fork East Willow Creek	Confluence with West Willow Creek	2.69	18%	82%

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 "East Willow Creek is small, high gradient stream with small to medium sized substrate and a stable canal. Cover, aquatic insect population, water qualities, and flows are adequate for salmonids. Fishery surveys indicate a self-sustaining population of rainbow trout. Protection of flows is important because of the limited amount of physical habitats and pools in the stream".

Field Survey Data & Biological Flow Quantification

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.

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, three 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.

Table 1: East Willow Creek R2Cross Summary

			Confidence Intervals	**Recommended Flows (cfs)**	
Party	**Date**	**Q (cfs)**	**250%-40%**	**Summer (3/3)**	**Winter (2/3)**
BLM	10/25/1994	1.38	3.44 – 0.55	0.92	(1)
BLM	09/09/1997	1.82	4.5 – 0.7	1.15	0.74
BLM	09/08/2004	0.7	1.7 – 0.3	0.76	0.58

BLM = Bureau of Land Management
(1) Predicted flow outside of the accuracy range of Manning's Equation.

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 0.8 cfs. The winter flow recommendation, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model is 0.6 cfs. These recommendations were

derived by averaging the results of the data sets. It is our belief 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.

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 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 **East Willow Creek** no such gage is available at the LT. In fact, there is no gage on East Willow Creek. It is thus necessary to describe the normal flow regime at the East Willow Creek LT through a "representative" gage station. The gage station selected for this was BLACK SULPHUR CREEK NEAR RIO BLANCO, CO (USGS 09306175); it has an available 9 year period of record (POR) collected between 1974 and 1983. The gage is at an approximate elevation of 6,130 ft above mean sea level (amsl) and has a drainage area of 103 mi^2. The hydrograph (plot of discharge over time) produced by this gage includes the consumptive uses of several upstream diversions. To make the measured data transferable to East Willow Creek the consumptive portions of these upstream diversions were added back to the measured hydrograph. The resulting adjusted hydrograph was then used on East Willow Creek by multiplying the adjusted Black Sulphur Creek near Rio Blanco discharge values (hydrograph) by the ratio of East Willow Creek basin area (14.83 mi^2 above the LT) to Black Sulphur Creek near Rio Blanco basin

area (103 mi^2). The resulting proportioned hydrograph was then adjusted (decreased) to reflect the existing depletions in East Willow Creek due to upstream consumptive irrigation use. The final hydrograph thus represents a distribution of flow over time that has been reduced to reflect existing human uses.

The following hydrograph depicts the mean monthly discharge of East Willow Creek (proportioned on Black Sulphur Cr near Rio Blanco). Included in the hydrograph are the recommended ISF values. The data used in the creation of this hydrograph are displayed in Table #2.

Figure 1 - East Willow Cr Mean Q (Proportioned fr Black Sulphur Cr) Adjusted for Irr (Subtracted) & ISFs

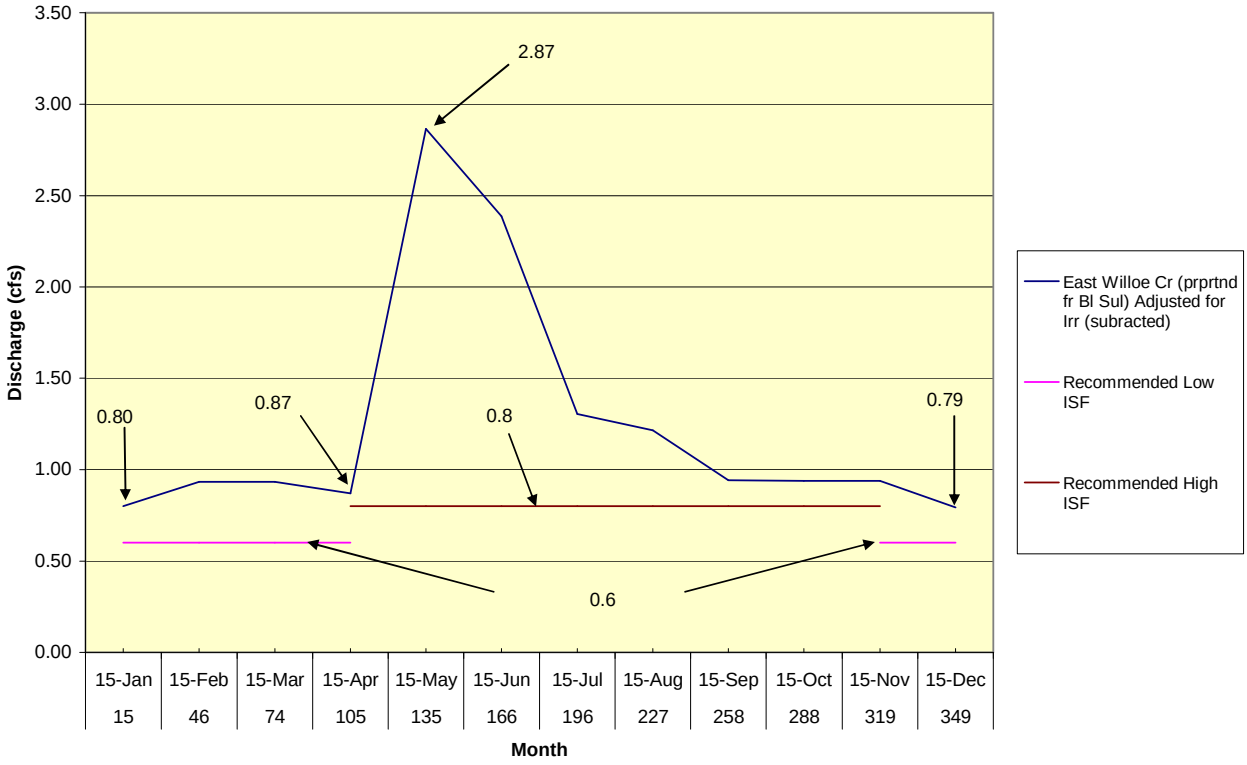


Table 2 – Mean Monthly Discharge and Recommended Instream Flows – East Willow Creek

	Julian Day	E. Willow Cr (cfs)	Recommended ISFs (cfs)
15-Jan	15	0.80	0.6
15-Feb	46	0.93	0.6
15-Mar	74	0.94	0.6
15-Apr	105	0.87	0.6
30-Apr	120	0.87	0.6
1-May	121	2.87	0.8
15-May	135	2.87	0.8
15-Jun	166	2.39	0.8
15-Jul	196	1.31	0.8
15-Aug	227	1.22	0.8
15-Sep	258	0.94	0.8
15-Oct	288	0.94	0.8
31-Oct	304	0.94	0.8
1-Nov	305	0.94	0.6
15-Nov	319	0.94	0.6
15-Dec	349	0.79	0.6

Existing Water Right Information

Staff has analyzed the water rights tabulation to identify any potential water availability problems. According to records, there are two known decreed surface diversions within the reach, Willow Creek Ditch No. 2 & 3. The water rights were included in the hydrological analysis; however, Exxon Mobil acquired these rights and the consumptive use portion was further analyzed. There are also numerous small reservoirs, spring developments and wells located in the watershed that feed East Willow Creek. Based on this analysis staff has determined that water is available for appropriation on East Willow Creek, between the confluence with Bull Fork East Willow Creek and the confluence with West Willow 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:

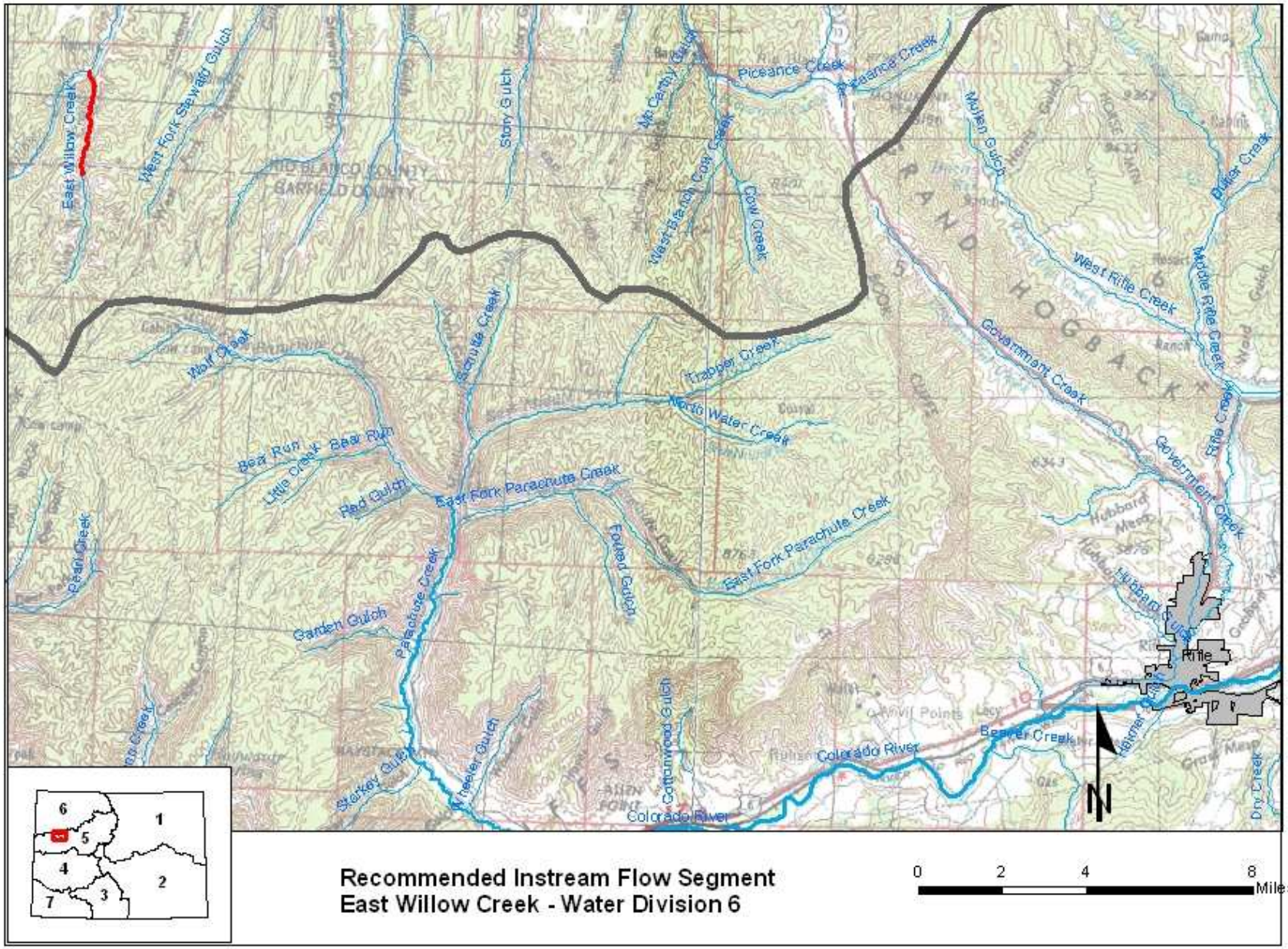
Segment: Confluence Bull Fork East Willow Creek to Confluence West Willow Creek

Upper Terminus: CONFLUENCE WITH BULL FORK EAST WILLOW CREEK AT
(Latitude 39° 41' 32.68"N) (Longitude 108° 16' 58.85"W)
UTM = 4398772.9 N UTM = 218480.8 E
NW NE S21 T4S R97W 6PM
2500' West of East Section Line; 675'South of the North Section Line

Lower Terminus: CONFLUENCE WITH WEST WILLOW CREEK AT
(Latitude 39° 43' 42.08"N) (Longitude 108° 16' 55.27"W)
UTM = 4402760.4 N UTM = 218712.5 E
NW SE S4 T4S R97W 6PM
2000' West of the East Section Line; 1650' North of South Section Line

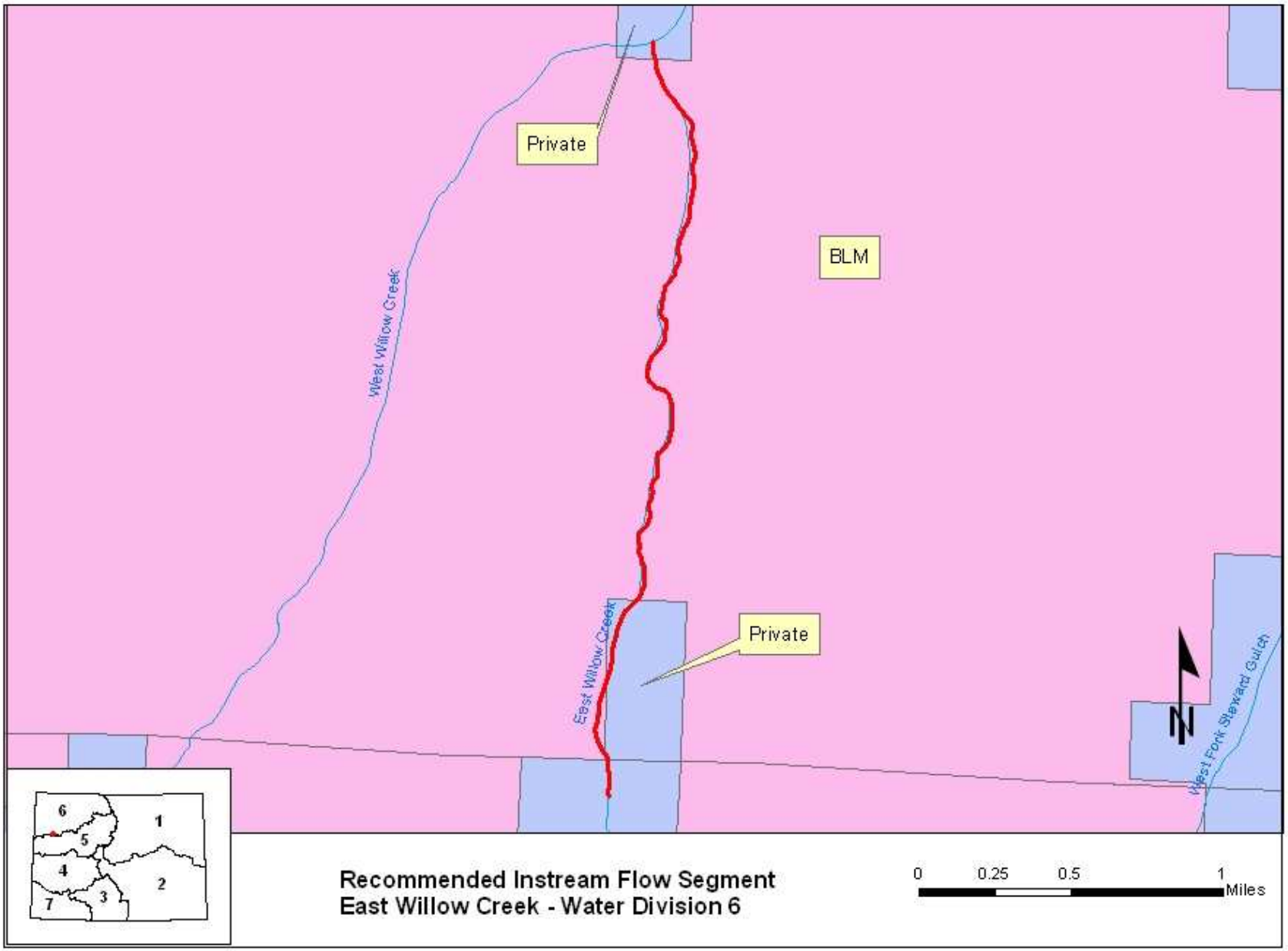
Watershed: Piceance-Yellow (HUC#: 14050006)
Counties: Garfield, Rio Blanco
Length: 2.69 miles
USGS Quad(s): Bull Fork
Flow Recommendation: 0.8 cfs (May 1 - October 31)
0.6 cfs (November 1 - April 30)

Vicinity Map

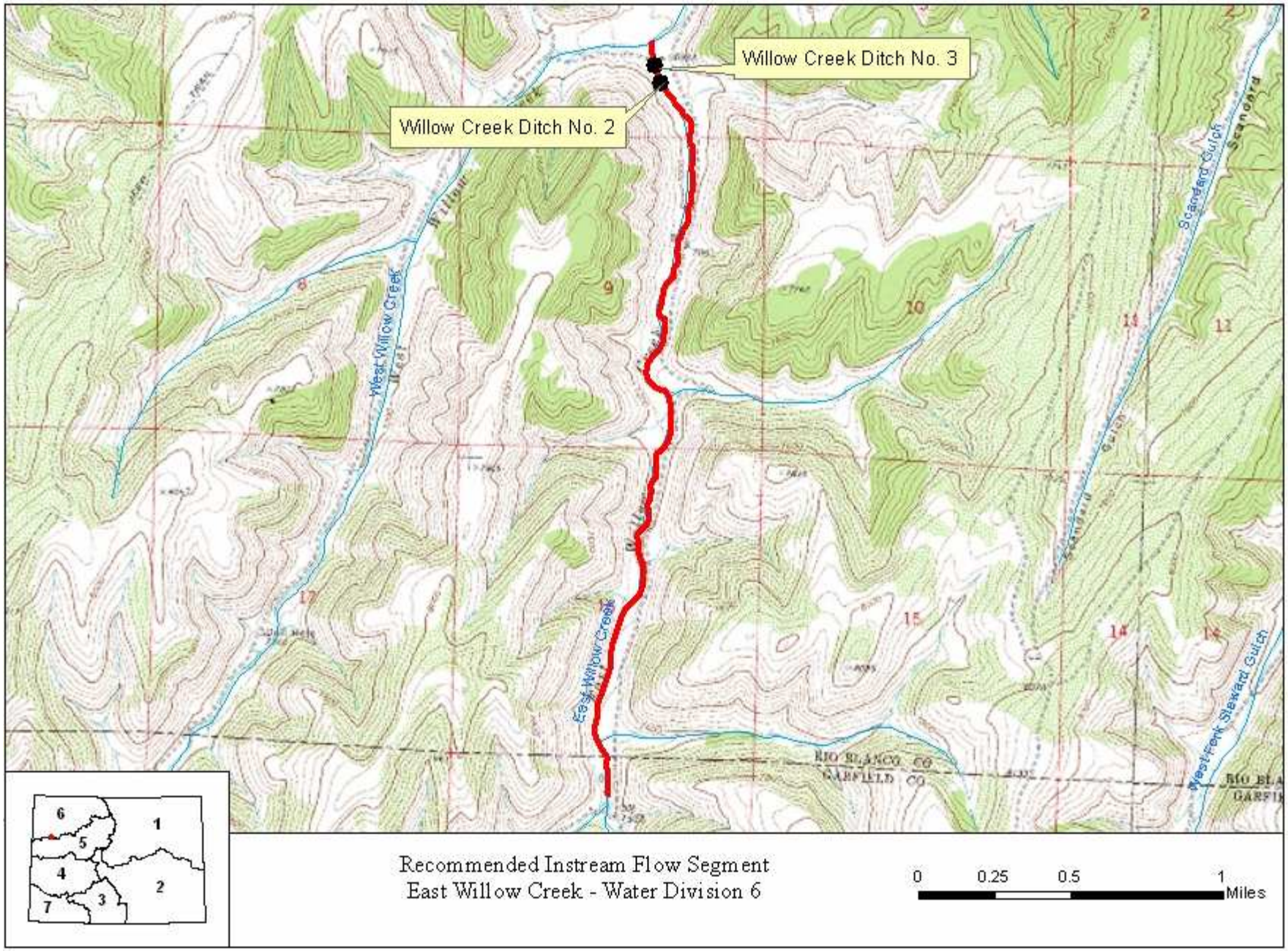


Recommended Instream Flow Segment
East Willow Creek - Water Division 6

Land Use Map


Private
BLM
Private
West Willow Creek
East Willow Creek
West Fork Steward Gulch
N
6
1
5
4
2
7
3
Recommended Instream Flow Segment
East Willow Creek - Water Division 6
0
0.25
0.5
1
Miles

Topographic & Water Rights Map



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE
2850 YOUNGFIELD STREET
LAKEWOOD, COLORADO 80215-7093

In Reply Refer To:
7250 (CO-932)

DEC 2 6 2007

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 instream flow recommendation for East Willow Creek, located in Water Division 6.

Location and Land Status. East Willow Creek is tributary to Willow Creek approximately 20 miles southwest of Meeker. This recommendation covers the stream reach beginning at the confluence with the Bull Fork and extends downstream to the confluence with West Willow Creek. Approximately 81% of the 2.69-mile reach is federally owned, while the remaining 19% is privately owned.

Biological Summary. East Willow Creek is small, high gradient stream with small to medium sized substrate and a stable channel. Cover, aquatic insect population, water qualities, and flows are adequate for salmonids. Fishery surveys indicate a self-sustaining population of rainbow trout. Protection of flows is important because of the limited amount of physical habitat and pools in this small stream.

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:

- 0.8 cubic feet per second is recommended for the high temperature period from May 1 to October 31. This recommendation is driven by the average depth criteria. Many portions of this reach have high width-to-depth ratio, so it is important to maintain sufficient depth for fish passage and fish spawning. Protecting flows during this time period is also important for recharging the alluvial aquifer, which discharges water to the stream and maintains flow levels during later summer.

- 0.6 cubic feet per second is recommended from November 1 through April 30. This recommendation is driven by the average velocity criteria. This flow rate will maintain

suitable salmonid temperatures during late summer and fall, when naturally low flows and high temperatures push stream temperatures higher.

Water Availability. BLM is not aware of any decreed surface diversions within this reach. However, there are numerous small reservoirs, spring developments, and wells located in the watersheds that feed East Willow Creek. In addition, there is one decreed ditch located upstream; Willow Creek Ditch #3. BLM recommends using U.S. Geological Survey (USGS) gage 09306175 (Black Sulphur Creek near Rio Blanco, Colorado) as an indicator of water availability. This gage is located at the confluence of Black Sulphur Creek and Piceance Creek, a nearby watershed watershed with similar elevation, slope, and aspect. A basin comparison can be performed to determine water availability for this reach, which is located high within the Willow Creek watershed. An additional indicator of water availability would be diversion records for ditches located downstream on the mainstem of Willow Creek.

Relationship to Management Plans. The White River Resource Management Plan identifies management of streams supporting coldwater fisheries as a priority for BLM. The plan specifies that BLM will work to improve riparian and aquatic conditions in these streams, and will also work to prevent surface disturbances close to them. In addition, the plan specifies that BLM will work with the Colorado Water Conservation Board to appropriate instream flow water rights to protect these fisheries. This fishery has been maintained because of the remote location of the creek and very low fishing pressure. Under current management plans, this management scenario is likely to continue.

The BLM requests that the Board recognize that this recommendation is based only upon the minimum flows necessary to support cold-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 were included with BLM's draft recommendation in February 2007.

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, Water Rights Specialist, at 303-239-3940.

Sincerely,

Dennis D. Zachman (ACTING)

for Linda M. Anañia
Deputy State Director
Resources and Fire

cc: Tom Johnson, White River Field Office
Bob Lange, White River Field Office
Kent Walter, White River Field Office
Ed Hollowed, White River Field Office

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: East Willow Creek | CROSS-SECTION NO.:

CROSS-SECTION LOCATION: 2.4 miles downstream of confluence w/ Bull Fork (Bull Fork is intermittent)

DATE: 10-25-94 | OBSERVERS: R. Smith, C. Hollowed

LEGAL DESCRIPTION | ¼ SECTION: NE | SECTION: 9 | TOWNSHIP: 4 N(S) | RANGE: 97 E(W) | PM: 6th

COUNTY: Rio Blanco | WATERSHED: Piceance | WATER DIVISION: 5 | DOW WATER CODE:

MAP(S) | USGS: Bull Fork 7.5' | USFS:

SUPPLEMENTAL DATA

TAG TAPE SECTION SAME AS DISCHARGE SECTION (YES/NO) | METER TYPE: Pygmy

METER NUMBER: | DATE RATED: Jan 1980 | CALIB/SPIN ____ sec | TAPE WEIGHT ____ lbs/foot | TAPE TENSION: 15 lbs

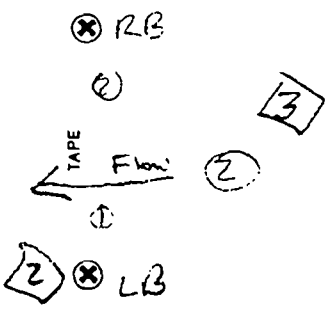
CHANNEL BED MATERIAL SIZE RANGE: .5 to 5" cobbles over sand/gravel | PHOTOGRAPHS TAKEN (YES/NO) | NUMBER OF PHOTOGRAPHS: 3

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	1.71
⊗ Tape @ Stake RB	0.0	1.71
① WS @ Tape LB/RB	0.0	4.95
② WS Upstream	60'	4.82
③ WS Downstream	3.5'	5.10

SLOPE | 0.28'/9.5' = 0.0294 = 2.94%

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 Comments																	

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

COMMENTS

No precip for at least one week.
DOW has surveyed this stream.

PROOF SHEET

LOCATION INFORMATION

STREAM NAME: EAST WILLOW CREEK
XS LOCATION: 2.4 MI D/S OF BULL FORK
XS NUMBER: 1

DATE: 10/25/94
OBSERVERS: SMITH HOLLOWED

1/4 SEC: NE
SECTION: 9
TWP: 4S
RANGE: 97W
PM: 6TH

COUNTY: RIO BLANCO
WATERSHED: PICEANCE
DIVISION: 5
DOW CODE:

USGS MAP: BULL FORK
USFS MAP:

SUPPLEMENTAL DATA

TAPE WT: 0.0001
TENSION: 15

CHANNEL PROFILE DATA

SLOPE: 0.0294

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

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

INPUT DATA # DATA POINTS= 46

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	TAPE TO Q	TAPE TO WATER
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.00	0.20	0.00	0.00	0.00	0.00	0.00
	1.50	0.40	0.00	0.00	0.00	0.00	0.00
	2.00	0.40	0.00	0.00	0.00	0.00	0.00
	2.50	0.80	0.00	0.00	0.00	0.00	0.00
	3.00	0.80	0.00	0.00	0.00	0.00	0.00
	3.50	1.40	0.00	0.00	0.00	0.00	0.00
	4.00	1.60	0.00	0.00	0.00	0.00	0.00
	4.50	1.80	0.00	0.00	0.00	0.00	0.00
	5.00	1.90	0.00	0.00	0.00	0.00	0.00
	5.50	2.10	0.00	0.00	0.00	0.00	0.00
	6.00	2.50	0.00	0.00	0.00	0.00	0.00
	6.50	2.80	0.00	0.00	0.00	0.00	0.00
	7.00	3.00	0.00	0.00	0.00	0.00	0.00
1 GL WL	7.30	3.30	0.00	0.00	0.00	0.00	0.00
	7.50	3.40	0.20	0.00	0.05	0.00	3.20
	7.80	3.40	0.20	0.26	0.06	0.02	3.20
	8.10	3.50	0.30	1.49	0.09	0.13	3.20
	8.40	3.50	0.30	2.15	0.09	0.19	3.20
	8.70	3.50	0.30	2.25	0.09	0.20	3.20
	9.00	3.50	0.30	0.90	0.09	0.08	3.20
	9.30	3.50	0.30	2.06	0.09	0.19	3.20
	9.60	3.50	0.30	1.98	0.09	0.18	3.20
	9.90	3.50	0.30	2.11	0.09	0.19	3.20
	10.20	3.50	0.30	1.46	0.09	0.13	3.20
	10.50	3.40	0.20	1.11	0.06	0.07	3.20
1 GL WL	10.80	3.30	0.00	0.00	0.00	0.00	0.00
	11.00	3.00	0.00	0.00	0.00	0.00	0.00
	11.50	3.00	0.00	0.00	0.00	0.00	0.00
	12.00	2.90	0.00	0.00	0.00	0.00	0.00
	12.50	2.70	0.00	0.00	0.00	0.00	0.00
	13.00	2.70	0.00	0.00	0.00	0.00	0.00
	13.50	2.60	0.00	0.00	0.00	0.00	0.00
	14.00	2.60	0.00	0.00	0.00	0.00	0.00
	14.50	2.50	0.00	0.00	0.00	0.00	0.00
	15.00	2.40	0.00	0.00	0.00	0.00	0.00
	15.50	2.30	0.00	0.00	0.00	0.00	0.00
	16.00	2.00	0.00	0.00	0.00	0.00	0.00
	16.50	1.80	0.00	0.00	0.00	0.00	0.00
	17.00	1.40	0.00	0.00	0.00	0.00	0.00
	17.50	1.20	0.00	0.00	0.00	0.00	0.00
	18.00	1.10	0.00	0.00	0.00	0.00	0.00
	18.50	0.80	0.00	0.00	0.00	0.00	0.00
	19.00	0.60	0.00	0.00	0.00	0.00	0.00
	19.50	0.40	0.00	0.00	0.00	0.00	0.00
S	19.80	0.40	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TOTALS	0.89	1.38

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

LOCATION INFORMATION

STREAM NAME: EAST WILLOW CREEK
XS LOCATION: 2.4 MI D/S OF BULL FORK
XS NUMBER: 1

DATE: 10/25/94
OBSERVERS: SMITH HOLLOWED

1/4 SEC: NE
SECTION: 9
TWP: 4S
RANGE: 97W
PM: 6TH

COUNTY: RIO BLANCO
WATERSHED: PICEANCE
DIVISION: 5
DOW CODE:

USGS MAP: BULL FORK
USFS MAP:

SUPPLEMENTAL DATA *** NOTE ***
Leave TAPE WT and TENSION
at defaults for data collected
TAPE WT: 0.0001 with a survey level and rod
TENSION: 15

CHANNEL PROFILE DATA

SLOPE: 0.0294

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

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

STREAM NAME: EAST WILLOW CREEK
XS LOCATION: 2.4 MI D/S OF BULL FORK
XS NUMBER: 1

INPUT DATA # DATA POINT 46 VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	1.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	1.50	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	2.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	2.50	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	3.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	3.50	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	4.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	4.50	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	5.00	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	5.50	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	6.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	6.50	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	7.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
1 GL WL	7.30	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	7.50	3.40	0.20	0.00	0.22	0.20	0.05	0.00	0.0%
	7.80	3.40	0.20	0.26	0.30	0.20	0.06	0.02	1.1%
	8.10	3.50	0.30	1.49	0.32	0.30	0.09	0.13	9.7%
	8.40	3.50	0.30	2.15	0.30	0.30	0.09	0.19	14.0%
	8.70	3.50	0.30	2.25	0.30	0.30	0.09	0.20	14.7%
	9.00	3.50	0.30	0.90	0.30	0.30	0.09	0.08	5.9%
	9.30	3.50	0.30	2.06	0.30	0.30	0.09	0.19	13.5%
	9.60	3.50	0.30	1.98	0.30	0.30	0.09	0.18	12.9%
	9.90	3.50	0.30	2.11	0.30	0.30	0.09	0.19	13.8%
	10.20	3.50	0.30	1.46	0.30	0.30	0.09	0.13	9.5%
	10.50	3.40	0.20	1.11	0.32	0.20	0.06	0.07	4.8%
1 GL WL	10.80	3.30	0.00	0.00	0.32	0.00	0.00	0.00	0.0%
	11.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	11.50	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	12.00	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	12.50	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	13.00	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	13.50	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	14.00	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	14.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	15.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	15.50	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	16.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	16.50	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	17.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	17.50	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	18.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	18.50	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	19.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	19.50	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
S	19.80	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0%

TOTALS —	3.57	0.3 (Max.)	0.89	1.38	100.0%

Manning's 'n' = [illegible]

STREAM NAME: EAST WILLOW
XS LOCATION: 2.4 MI D/S OF
XS NUMBER: 1

WATER LINE COMPARISON TAB

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
3.05	0.89	1.49	67.7%
3.07	0.89	1.41	58.9%
3.09	0.89	1.34	50.2%
3.11	0.89	1.26	41.6%
3.13	0.89	1.18	33.0%
3.15	0.89	1.11	24.6%
3.17	0.89	1.03	16.2%
3.19	0.89	0.96	7.9%
3.21	0.89	0.89	-0.4%
3.23	0.89	0.81	-8.5%
3.25	0.89	0.74	-16.8%
3.26	0.89	0.71	-20.6%
3.27	0.89	0.67	-24.6%
3.28	0.89	0.64	-28.6%
3.29	0.89	0.60	-32.6%
3.30	0.89	0.57	-36.5%
3.31	0.89	0.53	-40.4%
3.32	0.89	0.50	-44.3%
3.33	0.89	0.46	-48.1%
3.34	0.89	0.43	-51.8%
3.35	0.89	0.40	-55.5%
3.37	0.89	0.33	-62.7%
3.39	0.89	0.27	-69.6%
3.41	0.89	0.21	-76.0%
3.43	0.89	0.16	-81.8%
3.45	0.89	0.11	-87.4%
3.47	0.89	0.07	-92.6%
3.49	0.89	0.02	-97.6%
3.51	0.89	0.00	-100.0%
3.53	0.89	0.00	-100.0%
3.55	0.89	0.00	-100.0%

WATERLINE AT MINIM
AREA ERROR = 3.21

STREAM NAME: EAST WILLOW CREEK
XS LOCATION: 2.4 MI D/S OF BULL FORK
XS NUMBER: 1

STAGING TABLE

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

	DIST T WATE (FT)	TOP WIDT (FT)	AVG DEPT (FT)	MAX. DEPT (FT)	AREA (SQ FT	WETT PERIM (FT)	PERCE WET P (%)	HYDR RADIU (FT)	FLOW (CFS	AVG. VELOCITY (FT/SEC)
*GL	3.30	3.50	0.16	0.20	0.56	3.57	100.0%	0.16	0.65	1.14
*WL	3.21	3.65	0.24	0.29	0.89	3.81	106.6%	0.23	1.31	1.48
	3.26	3.57	0.20	0.24	0.71	3.68	102.9%	0.19	0.92	1.30
	3.31	3.45	0.15	0.19	0.53	3.52	98.5%	0.15	0.59	1.11
	3.36	3.20	0.11	0.14	0.36	3.25	90.9%	0.11	0.33	0.91
	3.41	2.64	0.08	0.09	0.21	2.67	74.7%	0.08	0.15	0.73
	3.46	2.34	0.04	0.04	0.09	2.35	65.9%	0.04	0.04	0.44

1.00 cfs summer
.5 cfs winter

0.92 cfs summer
0.45 cfs winter

STREAM NAME: EAST WILLOW CREEK
IS LOCATION: 2.4 MI D/S OF BULL FORK
IS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.38 cfs
CALCULATED FLOW (Qc)=	1.31 cfs
(Qm-Qc)/Qm * 100 =	4.7 %
MEASURED AREA (Am)=	0.89 sq ft
CALCULATED AREA (Ac)=	0.89 sq ft
(Am-Ac)/Am * 100 =	0.4 %
MAX MEASURED DEPTH (Dm)=	0.30 ft
MAX CALCULATED DEPTH (Dc)	0.29 ft
(Dm-Dc)/Dm * 100	3.3 %
MEAN VELOCITY=	1.48 ft/sec
MANNING'S N=	0.065
SLOPE=	0.0294 ft/ft
.4 * Qm =	0.55 cfs
2.5 * Qm=	3.44 cfs

RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD

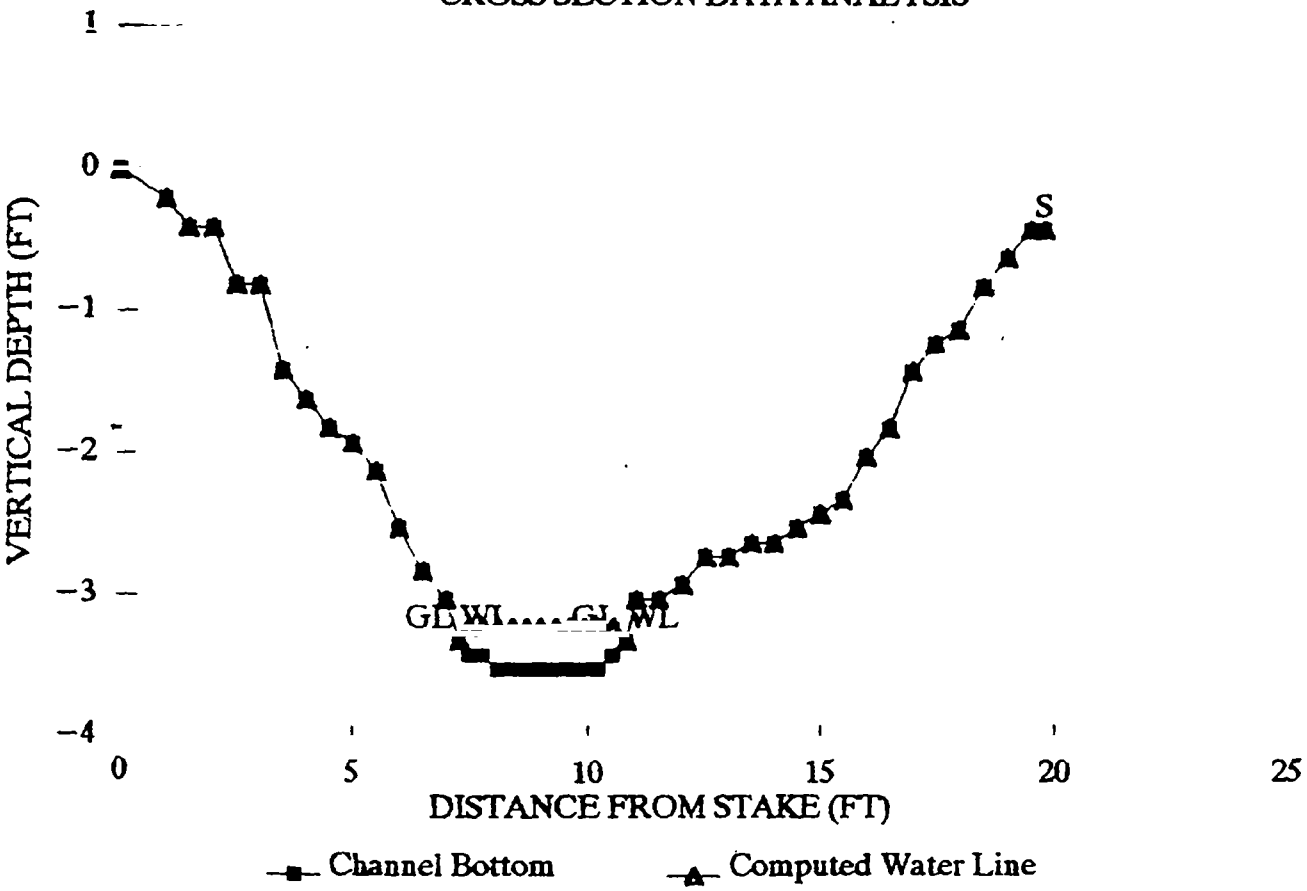
RATIONALE FOR RECOMMENDATION:

DOW RECOMMENDATION BY: ..... DATE.....

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

EAST WILLOW CREEK

CROSS SECTION DATA ANALYSIS



FISHERY SURVEY - EAST WILLOW CREEK, WHITE RIVER RESOURCE AREA

Date sampled: 22 & 23 July 1996
Location sampled: T4S R97W section 16 SWNE
Length of stream sampled: approx. 0.25 mile
Fish observed and captured: (shocking not employed due to vulnerable fish population and limited suitable habitat)

22 July

2 6-7" rainbow trout (by outward appearance) observed
2 8-9" rainbow trout (by outward appearance) observed
2 10-12" rainbow trout (by outward appearance) observed

23 July

1-10" rainbow (by outward appearance) caught and photographed

Photographs: enclosed

Comments - Habitat condition and suitability:

- Channel segments accessible to livestock from east (45% of BLM)

  - PL Ranch, June through July use period (tentative). Scattered cows possible throughout growing season.

  - Bank shearing, channel trailing prevalent. Little opportunity for development of floodplain or bank overhang components. Excessive W:D ratio.

- Channel segments accessible to livestock from west (50% of BLM).

  - Pat Johnson, use period 3-4 weeks in September.

  - Improved W:D ratio, effective floodplains developing with limited trampling damage of anchoring vegetation (sedge primarily)--current incidence may be attributable to fence maintenance problems and PL cows. Woody expression limited to scattered stands of (primarily) coyote willow and skunkbush sumac confined to an historic floodplain elevation about 3.5' above current active channel.

- Channel segment enclosed into upstream private (approx 3%) at extreme upper end of BLM ownership.

  - Pat Johnson (appears to receive very little to no use in channel).

  - W:D ratio at potential, marked woody proliferation (primarily "yellow" form of willow, chokecherry, skunkbush sumac) providing numerous bed controls and pools (root wads) and an estimated 70-80% stream overhang/shading effect.

  - Dense herbaceous development on banks and floodplains.

- All segments:

  - Sediment input from several points of adjacent road probably inescapable, but at this time not of overriding concern.

  - Limited ongoing and imminent expansion of natural gas development in East Willow valley and upstream tributaries (e.g. Bull Fork). Chevron and Texakoma are current lease holders.

- Noxious weed situation needs attention. Musk thistle appears confined to upper half of BLM (2nd year plants (reproductive phase) removed from channel and adjacent terraces 23 July). Control is also apparently being applied to upstream private. Bull thistle prevalent, but with improving channel conditions, not of particular concern. Canada thistle established at several points (primarily associated with terrace burn) and spreading--needs chemical treatment.

General Observations:

- System rigidly confined by historic incise (up to 15+') and exacerbated by stream gradient.

- Little opportunity for lateral valley development due to extreme slope of incise. However, based on enclosed segment, abundant opportunity to improve woody expression, pool depth and abundance, and undercut banks. Need to decrease W:D ratio and water temperature -- this can occur over time without the aid of beaver, which may be undesirable due to proximity of irrigated haylands downstream

- BLM segments suffer primarily from lack of woody development. Upper half has remnant coyote willow/skunkbush source, not to mention abundant upstream sources. Apparently bank instability/absence or limited availability of floodplains (livestock induced) and perhaps persistent browsing of young leaders suppresses establishment or proliferation. Consequently, limited number and size of pools, warmer water temperatures.

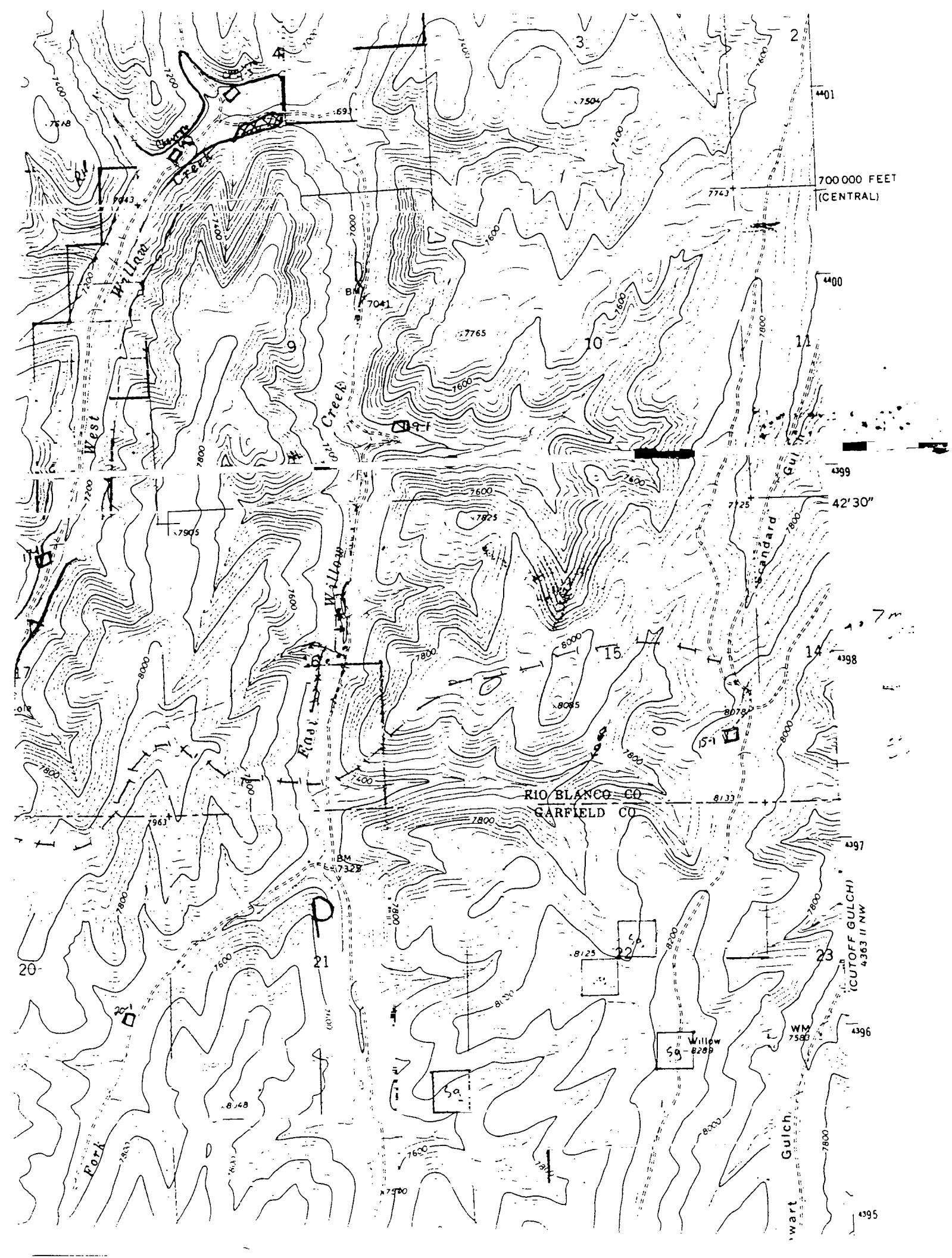
- Enclosed segment offers excellent comparison area for stream potential. Apparent that stream relies on woody plants for gradient control, pool development (root wads), shading (70-80% at noon), and invertebrate substrate. Perhaps all but lower 1500' of BLM capable of attaining conditions exhibited in this enclosure.

- Deeply incised in upper 80% of BLM, situation offering abundant opportunity to emplace physical deterrents to livestock trailing in channel bed without the use of fencing. Appears that livestock trailing damage to rudimentary floodplains (consequently bank building/undercut banks and woody growth substrate) is the most pressing and correctable management issue at this time.

- Although BLM reach suffers from varying degrees of incompatible livestock use, fence maintenance between the 2 adjacent allotments has markedly improved channel conditions on that 50% of channel accessible from west (see above) over last 3 years. Limited livestock trailing in these sections has initiated floodplain development and provided clean gravel substrate in riffles and runs suitable for spawning and macro production. Progress in these areas demonstrates that the system is sensitive to even limited livestock use, but essential elements are intact and remain resilient.

- Although spring runoff flows and summer/fall storm events would continue to provide flow and sediment necessary for channel evolution amenable to fishery restoration, very limited base flows will continue to constrain fishery potential. Protection of instream flows is necessary to allow fish populations to realize full potential use on 1.5 miles of upper East Willow's limited habitat base. Instream flow protection would also provide seasonal continuity with larger, inherently more productive downstream segments. Instream flow protection would also provide the flows and stream power capable of producing bank undercuts and scour pools, which is key to holding increased numbers and size of fish during critical base flow periods.

- Intend on macro sampling later this year. Gravelly substrate in upper quarter mile well populated with caddisfly. Substrate believed to become more embedded downstream.


700 000 FEET
(CENTRAL)
42'30"
RIO BLANCO CO
GARFIELD CO
West Willow Creek
East Willow Creek
Willow Creek
Standard Gulch
(CUTOFF GULCH)
4363 II NW
Willow Sp - 8289
BM 7328
WM 7580
4401
4400
4399
4398
4397
4396
4395

CDOW STREAM SURVEY (1991 REVISION)

LEVEL 2: FIELD SURVEY SUMMARY

STREAM: Willow Cr. East SEG#: — WATER CODE: [redacted] FLOW RECORD: [redacted]

SURVEYORS: E C [illegible] DATE OF SURVEY: [redacted]

SURVEY LOCATION: T 45 R [redacted] S 16 ELEVATION: [redacted]

UTM ZONE: [redacted] UTM X: 733[illegible] UTM Y: [redacted]

LOCATION DESCRIPTION: From [illegible] of the allot. fence [redacted] unnamed trib. on the E. side of cr. downstream of the [redacted]

STREAM FLOW PROFILE (Y or N): Y IF YES-DATE AND TYPE: [redacted]

HABITAT EVALUATION (Y or N): N IF YES-DATE AND TYPE: —

WATER CHEMISTRY ANALYSIS (Y or N): N IF YES-ATTACH SEPARATE ANALYSIS SHEET

FISH PRESENT (Y or N): Y POP. EST. METHOD: — STATION LENGTH: 280 (FEET)

AVG. WIDTH: 2 (FEET) TOTAL STATION AREA: .013 (ACRES)

FLOW (CFS) AT TIME OF SURVEY: 1.82 METHOD: .6 USGS

LIMITING FACTORS TO FISHERY: A10, A12, A16

COMMENTS:

LENGTH FREQUENCY RECORD (CM)

SPECIES	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	38-40	40-42	42-44	44-46	46-48	48-50
RBT												•	•	•											

SUMMARY INFORMATION

SPECIES	NO. FISH CAUGHT	AVG. LENGTH (CM)	LENGTH RANGE (CM)	AVG. WEIGHT (Grams)	WEIGHT RANGE (Grams)	% TOTAL CATCH	BIOMASS lb/Acre	DENSITY No./Acre	DENSITY Conf. Int.
RBT	3	24.5	222-267	202	178-246	100	103	231	

COLORADO DIVISION OF WILDLIFE

Length-Weight Data File

Stream Name Willow Cr. East

CDOW Water Code 93961 Date 9 Sep 97

Gear Coffelt Electroshocker

Effort 5.3 min.

Station No. 1

Species Code	Total Length	Weight	Species Code	Total Length	Weight	Species Code	Total Length	Weight
RBT	22.2	178						
"	24.7	122						
"	26.7	246						

Comments:

EUILOWCK.WK1
WJLOWCK.RFC

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: East Willow Creek | CROSS-SECTION NO.: 1

CROSS-SECTION LOCATION: 2.4 miles downstream from confluence w/ Bull Fork

DATE: 9-9-97 | OBSERVERS: C. Hollowed, R. Smith

LEGAL DESCRIPTION: ¼ SECTION: NE | SECTION: 9 | TOWNSHIP: 4 N(S) | RANGE: 97 E(W) | PM: 6th

COUNTY: Rio Blanco | WATERSHED: White River | WATER DIVISION: 5 | DOW WATER CODE: 23961

MAP(S): USGS: Bull Fork 7.5' | USFS:

SUPPLEMENTAL DATA

TAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO | METER TYPE: Ryan V

METER NUMBER: | DATE RATED: | CALIB/SPIN: ____ sec | TAPE WEIGHT: ____ lbs/foot | TAPE TENSION: 18 lbs

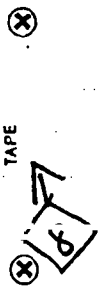
CHANNEL BED MATERIAL SIZE RANGE: gravel to 8" cobbles | PHOTOGRAPHS TAKEN: (YES) NO | NUMBER OF PHOTOGRAPHS: 3

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape & Stake LB	0.0	4.84
⊗ Tape & Stake RB	0.0	4.84
① WS & Tape LB/RB	0.0	6.95 / 6.95
② WS Upstream	10.0	6.42
③ WS Downstream	10.0	7.13

SLOPE: 0.71'/20.0' = 0.0355

SKETCH



LEGEND

Stake ⊗
Station ①
Photo ①
Direction of Flow ①

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

Caddisfly, Mayfly (abundant); snails

COMMENTS

Ph = 8.6 Conductivity = 850 Stream Temp = 14° C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: East Willow | CROSS-SECTION NO.: 1 | DATE: 9-9-97 | SHEET 1 OF 1

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) | LEFT / RIGHT | Gage Reading: 0.4 ft | TIME: 1:00 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)
①	S	0.0		0.8								
	G	0.7		1.3								
		1.6		1.70								
		2.2	0.40	2.20	0.2	0.6	Ø	Ø		0	0.080	0
		2.7	0.40	2.40	0.4		20	40		0.512	0.160	0.082
		3.0	0.30	2.50	0.45		40	46		0.865	0.135	0.117
		3.3	0.30	2.40	0.40		40	43		0.924	0.120	0.111
		3.6	0.30	2.40	0.40		50	45		1.10	0.120	0.132
		3.9	0.30	2.35	0.35		30	42		0.717	0.105	0.075
⑩		4.2	0.30	2.40	0.40		50	42		1.17	0.120	0.140
		4.5	0.30	2.40	0.40		80	45		1.73	0.120	0.208
		4.8	0.30	2.40	0.40		100	41		2.37	0.120	0.284
		5.1	0.30	2.40	0.40		150	51		2.85	0.120	0.342
		5.4	0.30	2.40	0.40		100	45		2.16	0.120	0.259
		5.7	0.30	2.30	0.30		25	44		0.577	0.090	0.052
		6.0	0.30	2.20	0.20		7	54		0.157	0.060	0.009
		6.3	0.30	2.20	0.20		3	41		0.103	0.060	0.006
		6.6	0.20	2.10	0.10		Ø	Ø		0	0.020	0
		7.0		1.60								
⑳	G	7.3		1.30								
		8.0		1.10								
	S	10.0		0.6								
	W	1.9	0.15	2.0	0						0	0
	W	6.7	0.05	2.0	0						0	0

TOTALS: 1.55 1.817

End of Measurement | Time: 1:35 | Gage Reading: 0.4 ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

PROOF SHEET

LOCATION INFORMATION

STREAM NAME:	East Willow Creek
XS LOCATION:	2.4 mi. downstream from Bull Fork
XS NUMBER:	1
DATE:	09/09/97
OBSERVERS:	C. Hollowed, R. Smith
1/4 SEC:	NE
SECTION:	9
TWP:	4 S
RANGE:	97 W
PM:	6th
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	5
DOW CODE:	23961
USGS MAP:	Bull Fork
USFS MAP:	

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	18

CHANNEL PROFILE DATA

SLOPE: 0.0355

INPUT DATA # DATA POINTS= 24

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	TAPE TO WATER
S	0.00	0.80	0.00	0.00	0.00	0.00	0.00
1 G	0.70	1.30	0.00	0.00	0.00	0.00	0.00
	1.60	1.70	0.00	0.00	0.00	0.00	0.00
W	1.90	2.00	0.00	0.00	0.00	0.00	0.00
	2.20	2.20	0.20	0.00	0.08	0.00	2.01
	2.70	2.40	0.40	0.51	0.16	0.08	2.01
	3.00	2.50	0.45	0.87	0.13	0.12	2.06
	3.30	2.40	0.40	0.92	0.12	0.11	2.01
	3.60	2.40	0.40	1.10	0.12	0.13	2.01
	3.90	2.35	0.35	0.72	0.11	0.08	2.01
	4.20	2.40	0.40	1.17	0.12	0.14	2.01
	4.50	2.40	0.40	1.73	0.12	0.21	2.01
	4.80	2.40	0.40	2.37	0.12	0.28	2.01
	5.10	2.40	0.40	2.85	0.12	0.34	2.01
	5.40	2.40	0.40	2.16	0.12	0.26	2.01
	5.70	2.30	0.30	0.58	0.09	0.05	2.01
	6.00	2.20	0.20	0.16	0.06	0.01	2.01
	6.30	2.20	0.20	0.10	0.06	0.01	2.01
	6.60	2.10	0.10	0.00	0.02	0.00	2.01
W	6.70	2.00	0.00	0.00	0.00	0.00	0.00
	7.00	1.60	0.00	0.00	0.00	0.00	0.00
1 G	7.30	1.30	0.00	0.00	0.00	0.00	0.00
	8.00	1.10	0.00	0.00	0.00	0.00	0.00
S	10.00	0.60	0.00	0.00	0.00	0.00	0.00
TOTALS					1.55 ✓	1.82 ✓	

CHECKED BY: Bill Carey DATE 2/2/98

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

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

LOCATION INFORMATION
==========

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

DATE: 09/09/97
OBSERVERS: C. Hollowed, R. Smith

1/4 SEC: NE
SECTION: 9
TWP: 4 S
RANGE: 97 W
PM: 6th

COUNTY: Rio Blanco
WATERSHED: White River
DIVISION: 5
DOW CODE: 23961

USGS MAP: Bull Fork
USFS MAP:

SUPPLEMENTAL DATA
==========

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

TAPE WT: 0.0106
TENSION: 18

CHANNEL PROFILE DATA
==========
SLOPE: 0.0355

INPUT DATA CHECKED BY: Bill Conoy .....DATE 2/2/98.....

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

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

INPUT DATA	# DATA POINTS= 24				VALUES COMPUTED FROM RAW FIELD DATA				
FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
S	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
1 G	0.70	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	1.60	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
W	1.90	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	2.20	2.20	0.20	0.00	0.36	0.20	0.08	0.00	0.0%
	2.70	2.40	0.40	0.51	0.54	0.40	0.16	0.08	4.5%
	3.00	2.50	0.45	0.87	0.32	0.45	0.13	0.12	6.4%
	3.30	2.40	0.40	0.92	0.32	0.40	0.12	0.11	6.1%
	3.60	2.40	0.40	1.10	0.30	0.40	0.12	0.13	7.3%
	3.90	2.35	0.35	0.72	0.30	0.35	0.11	0.08	4.1%
	4.20	2.40	0.40	1.17	0.30	0.40	0.12	0.14	7.7%
	4.50	2.40	0.40	1.73	0.30	0.40	0.12	0.21	11.4%
	4.80	2.40	0.40	2.37	0.30	0.40	0.12	0.28	15.6%
	5.10	2.40	0.40	2.85	0.30	0.40	0.12	0.34	18.8%
	5.40	2.40	0.40	2.16	0.30	0.40	0.12	0.26	14.3%
	5.70	2.30	0.30	0.58	0.32	0.30	0.09	0.05	2.9%
	6.00	2.20	0.20	0.16	0.32	0.20	0.06	0.01	0.5%
	6.30	2.20	0.20	0.10	0.30	0.20	0.06	0.01	0.3%
	6.60	2.10	0.10	0.00	0.32	0.10	0.02	0.00	0.0%
W	6.70	2.00	0.00	0.00	0.14	0.00	0.00	0.00	0.0%
	7.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
1 G	7.30	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	8.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
S	10.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
TOTALS					5.03	0.45 (Max.)	1.55	1.82	100.0%

Manning's n = 0.1089

STREAM NAME: East Willow Cr
XS LOCATION: 2.4 mi. downns
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
1.76	1.55	2.82	82.3%
1.78	1.55	2.72	75.5%
1.80	1.55	2.62	68.8%
1.82	1.55	2.51	62.2%
1.84	1.55	2.41	55.6%
1.86	1.55	2.31	49.0%
1.88	1.55	2.21	42.5%
1.90	1.55	2.11	36.1%
1.92	1.55	2.01	29.6%
1.94	1.55	1.91	23.3%
1.96	1.55	1.81	16.9%
1.97	1.55	1.76	13.8%
1.98	1.55	1.72	10.7%
1.99	1.55	1.67	7.5%
2.00	1.55	1.62	4.4%
2.01	1.55	1.57	1.3%
2.02	1.55	1.52	-1.8%
2.03	1.55	1.47	-4.8%
2.04	1.55	1.43	-7.9%
2.05	1.55	1.38	-10.9%
2.06	1.55	1.33	-14.0%
2.08	1.55	1.24	-20.0%
2.10	1.55	1.15	-25.9%
2.12	1.55	1.06	-31.8%
2.14	1.55	0.97	-37.5%
2.16	1.55	0.88	-43.2%
2.18	1.55	0.80	-48.7%
2.20	1.55	0.71	-54.1%
2.22	1.55	0.63	-59.2%
2.24	1.55	0.56	-64.0%
2.26	1.55	0.49	-68.6%

WATERLINE AT ZERO
AREA ERROR = 2.010

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

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 PER (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	1.31	6.59	0.83	1.20	5.47	7.36	100.0%	0.74	11.53	2.11
	1.31	6.58	0.83	1.20	5.44	7.34	99.8%	0.74	11.45	2.11
	1.36	6.42	0.80	1.15	5.12	7.15	97.2%	0.72	10.52	2.06
	1.41	6.25	0.77	1.10	4.80	6.95	94.5%	0.69	9.63	2.01
	1.46	6.09	0.74	1.05	4.49	6.76	91.9%	0.66	8.79	1.96
	1.51	5.93	0.71	1.00	4.19	6.57	89.3%	0.64	7.98	1.90
	1.56	5.77	0.68	0.95	3.90	6.37	86.7%	0.61	7.22	1.85
	1.61	5.61	0.64	0.90	3.61	6.18	84.0%	0.58	6.49	1.80
	1.66	5.46	0.61	0.85	3.34	6.00	81.5%	0.56	5.80	1.74
	1.71	5.32	0.58	0.80	3.07	5.82	79.1%	0.53	5.14	1.68
	1.76	5.23	0.54	0.75	2.80	5.68	77.3%	0.49	4.50	1.60
	1.81	5.14	0.49	0.70	2.54	5.55	75.5%	0.46	3.89	1.53
	1.86	5.05	0.45	0.65	2.29	5.42	73.7%	0.42	3.31	1.45
	1.91	4.97	0.41	0.60	2.04	5.29	71.8%	0.39	2.78	1.36
	1.96	4.88	0.37	0.55	1.79	5.15	70.0%	0.35	2.28	1.27
WL	2.01	4.79	0.32	0.50	1.55	5.02	68.2%	0.31	1.82	1.17
	2.06	4.66	0.28	0.45	1.31	4.86	66.0%	0.27	1.41	1.08
	2.11	4.53	0.24	0.40	1.08	4.69	63.8%	0.23	1.05	0.97
	2.16	4.31	0.20	0.35	0.86	4.44	60.4%	0.19	0.74	0.86
	2.21	3.78	0.17	0.30	0.65	3.89	52.9%	0.17	0.51	0.78
	2.26	3.51	0.13	0.25	0.47	3.60	48.9%	0.13	0.31	0.66
	2.31	3.23	0.09	0.20	0.30	3.31	44.9%	0.09	0.16	0.52
	2.36	2.92	0.05	0.15	0.15	2.98	40.5%	0.05	0.05	0.35
	2.41	0.58	0.05	0.10	0.03	0.61	8.3%	0.05	0.01	0.33
	2.46	0.28	0.02	0.05	0.01	0.29	4.0%	0.02	0.00	0.20

$\frac{Q - 1.05}{1.41 - 1.05} = \frac{1 - 0.97}{1.08 - 0.97}$ $Q = 1.15$

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.82 cfs
CALCULATED FLOW (Qc)=	1.82 cfs
(Qm-Qc)/Qm * 100 =	-0.2 %
MEASURED WATERLINE (WLm)=	2.01 ft
CALCULATED WATERLINE (WLc)=	2.01 ft
(WLm-WLc)/WLm * 100 =	-0.2 %
MAX MEASURED DEPTH (Dm)=	0.45 ft
MAX CALCULATED DEPTH (Dc)=	0.50 ft
(Dm-Dc)/Dm * 100	-10.3 %
MEAN VELOCITY=	1.17 ft/sec
MANNING'S N=	0.109
SLOPE=	0.0355 ft/ft
.4 * Qm =	0.7 cfs
2.5 * Qm=	4.5 cfs

RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD
0.74	Winter
1.15	Summer

RATIONALE FOR RECOMMENDATION:

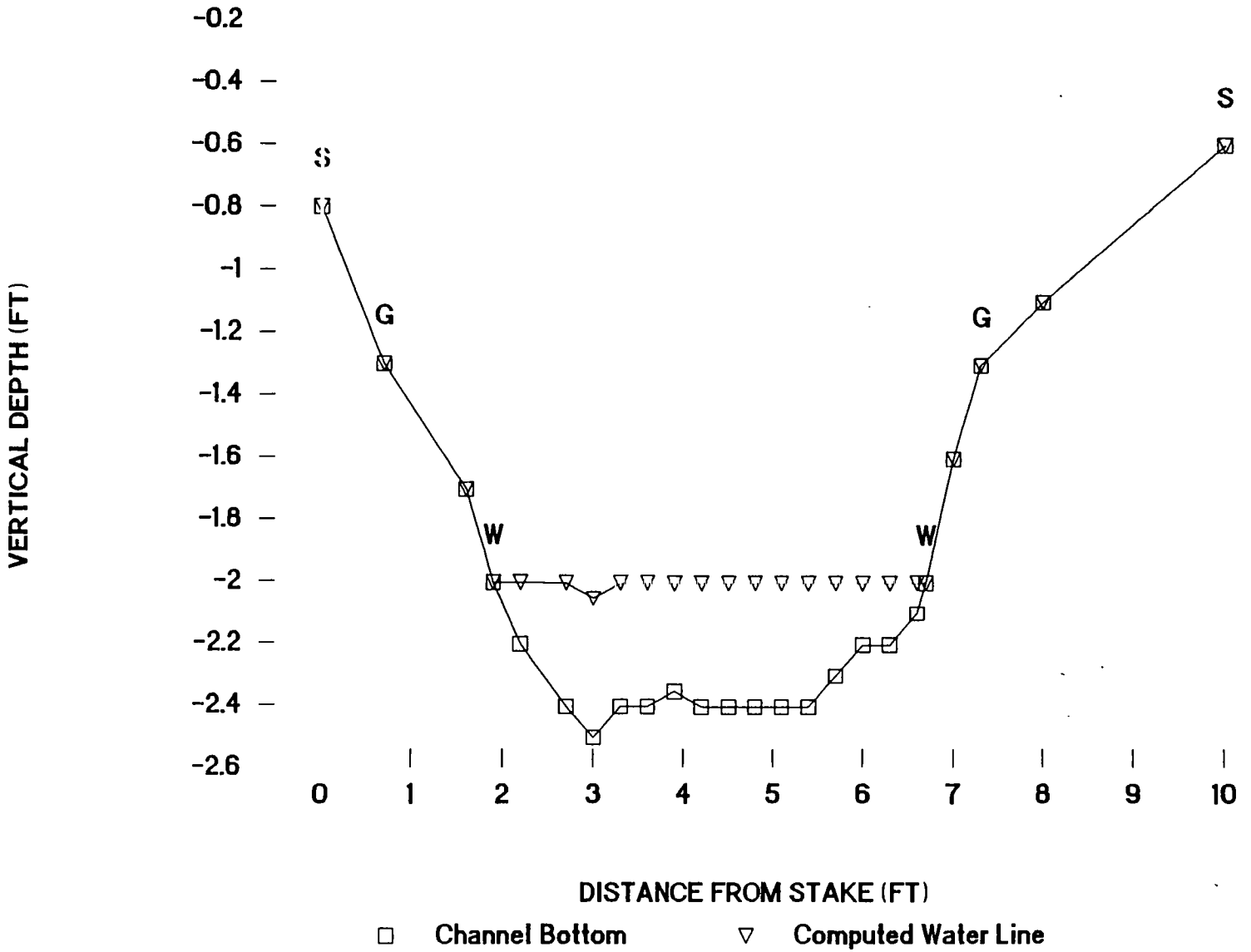
Winter Flow at 0.74 cfs satisfies $\bar{V}$ and %D WP
Summer flow at 1.15 cfs satisfies all 3 criteria

RECOMMENDATION BY: Bill Carey AGENCY: BLM DATE: 2/2/98

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

East Willow Creek

CROSS SECTION DATA ANALYSIS



COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: East Willow Creek | CROSS-SECTION NO: 1

CROSS SECTION LOCATION: between confluence w/ Bull Fork + West Willow

DATE: 9-8-04 | OBSERVERS: K. Smith, P. Daggett

LEGAL DESCRIPTION: ¼ SECTION: SE | SECTION: 9 | TOWNSHIP: 4N N/S | RANGE: 97 E/W | PM: 6th

COUNTY: Rio Blanco | WATERSHED: White River | WATER DIVISION: 6 | DOW WATER CODE: 23961

MAP(S): USGS: Bull Fork 7.5' 125 0733155 4399573 | USFS:

SUPPLEMENTAL DATA

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

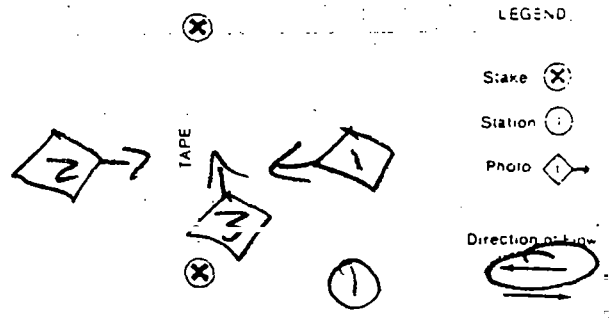
METER NUMBER: | DATE RATED: | CALIB/SPIN ____ sec | TAPE WEIGHT surveyed ____ lbs/foot | TAPE TENSION surveyed ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: silt to 3" 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	6.89 / 6.92
② WS Upstream	15.0	6.41
③ WS Downstream	15.0	7.28

SLOPE: 0.87 / 30.0 = 0.03



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 previous survey																	

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME

caddisfly, snail, annelids, mayfly

COMMENTS

Temp = 18°C TDS = 1,030 Ph = 8.5

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: EAST WILLOW CREEK | CROSS-SECTION NO: 1 | DATE: 9-8-04 | SHEET __ OF __

BEGINNING OF MEASUREMENT: EDGE OF WATER LOOKING DOWNSTREAM (0.0 AT STAKE) | LEFT / RIGHT | Gage Reading: ____ ft | TIME: 1:00

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		5.76								
G	3.0		6.54								
W	4.2		6.89	0	ø						
	5.1		7.07	0.2				0.13			
	5.4		7.17	0.3				1.96			
	5.7		7.18	0.3				1.78			
	6.0		7.15	0.25				1.13			
	6.3		7.14	0.25				1.48			
	6.6		7.17	0.30				1.39			
	6.9		7.07	0.20				0.41			
W	7.2		6.92	0	ø						
	8.3		6.66								
G	9.4		6.48								
RS	12.8		5.96								
TOTALS:											

End of Measurement | Time: 1:20 | Gage Reading: ____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

Data Input & Proofing

STREAM NAME:	East Willow Creek
XS LOCATION:	between confluence w/ Bull Fork & West Willow
XS NUMBER:	1
DATE:	9/8/04
OBSERVERS:	R. Smith, P. Daggett
1/4 SEC:	SE
SECTION:	9
TWP:	4 S
RANGE:	97 W
PM:	6th PM
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	23961
USGS MAP:	Bull Fork
USFS MAP:	
TAPE WT:	0.0106 Level and Rod Survey lbs / ft
TENSION:	99999 lbs
SLOPE:	0.03 ft / ft

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

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

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
			Total Data Points = 14					
	LS	0.00	5.76			0.00	0.00	0.00
1	G	3.00	6.54			0.00	0.00	0.00
	W	4.20	6.89	0.00	0.00	0.00	0.00	0.00
		5.10	7.07	0.20	0.13	0.12	0.02	6.87
		5.40	7.17	0.30	1.96	0.09	0.18	6.87
		5.70	7.18	0.30	1.78	0.09	0.16	6.88
		6.00	7.15	0.25	1.13	0.08	0.08	6.90
		6.30	7.14	0.25	1.48	0.08	0.11	6.89
		6.60	7.17	0.30	1.39	0.09	0.13	6.87
		6.90	7.07	0.20	0.41	0.06	0.02	6.87
	W	7.20	6.92	0.00	0.00	0.00	0.00	0.00
		8.30	6.66			0.00	0.00	0.00
1	G	9.40	6.48			0.00	0.00	0.00
	RS	12.80	5.96			0.00	0.00	0.00
					Totals	0.60	0.70	

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

LOCATION INFORMATION

STREAM NAME:	East Willow Creek
XS LOCATION:	between confluence w/ Bull Fork & West Willow
XS NUMBER:	1
DATE:	8-Sep-04
OBSERVERS:	R. Smith, P. Daggett
1/4 SEC:	SE
SECTION:	9
TWP:	4 S
RANGE:	97 W
PM:	6th PM
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	23961
USGS MAP:	Bull Fork
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

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

CHANNEL PROFILE DATA

SLOPE:	0.03

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

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

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
XS NUMBER: 1

DATA POINTS= 14 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	5.76			0.00		0.00	0.00	0.0%
1	G	3.00	6.54			0.00		0.00	0.00	0.0%
	W	4.20	6.89	0.00	0.00	0.00		0.00	0.00	0.0%
		5.10	7.07	0.20	0.13	0.92	0.20	0.12	0.02	2.2%
		5.40	7.17	0.30	1.96	0.32	0.30	0.09	0.18	25.3%
		5.70	7.18	0.30	1.78	0.30	0.30	0.09	0.16	23.0%
		6.00	7.15	0.25	1.13	0.30	0.25	0.08	0.08	12.1%
		6.30	7.14	0.25	1.48	0.30	0.25	0.08	0.11	15.9%
		6.60	7.17	0.30	1.39	0.30	0.30	0.09	0.13	17.9%
		6.90	7.07	0.20	0.41	0.32	0.20	0.06	0.02	3.5%
	W	7.20	6.92	0.00	0.00	0.34		0.00	0.00	0.0%
		8.30	6.66			0.00		0.00	0.00	0.0%
1	G	9.40	6.48			0.00		0.00	0.00	0.0%
	RS	12.80	5.96			0.00		0.00	0.00	0.0%
	TOTALS ----------					3.09	0.3 (Max.)	0.60	0.70	100.0%

Manning's n = 0.0742
Hydraulic Radius= 0.194236673

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.60	0.53	-11.6%
6.66	0.60	1.52	153.8%
6.68	0.60	1.43	137.6%
6.70	0.60	1.33	122.0%
6.72	0.60	1.24	106.8%
6.74	0.60	1.15	92.2%
6.76	0.60	1.07	78.1%
6.78	0.60	0.99	64.4%
6.80	0.60	0.91	51.3%
6.82	0.60	0.83	38.7%
6.84	0.60	0.76	26.7%
6.86	0.60	0.69	15.1%
6.87	0.60	0.66	9.5%
6.88	0.60	0.62	4.0%
6.89	0.60	0.59	-1.3%
6.90	0.60	0.56	-6.5%
6.91	0.60	0.53	-11.6%
6.92	0.60	0.50	-16.5%
6.93	0.60	0.47	-21.2%
6.94	0.60	0.44	-25.9%
6.95	0.60	0.42	-30.4%
6.96	0.60	0.39	-34.8%
6.98	0.60	0.34	-43.2%
7.00	0.60	0.29	-51.2%
7.02	0.60	0.25	-58.7%
7.04	0.60	0.21	-65.8%
7.06	0.60	0.17	-72.4%
7.08	0.60	0.13	-78.5%
7.10	0.60	0.09	-84.2%
7.12	0.60	0.06	-89.5%
7.14	0.60	0.03	-94.4%
7.16	0.60	0.01	-98.2%

WATERLINE AT ZERO
AREA ERROR = 6.883

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
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"	6.54	6.03	0.36	0.64	2.15	6.21	100.0%	0.35	3.68	1.71
	6.58	5.63	0.34	0.60	1.91	5.80	93.3%	0.33	3.15	1.65
	6.63	5.15	0.32	0.55	1.64	5.31	85.5%	0.31	2.59	1.58
	6.68	4.72	0.29	0.50	1.39	4.86	78.3%	0.29	2.09	1.50
	6.73	4.33	0.27	0.45	1.16	4.47	71.9%	0.26	1.65	1.41
	6.78	3.95	0.24	0.40	0.96	4.07	65.5%	0.24	1.26	1.32
	6.83	3.57	0.22	0.35	0.77	3.67	59.1%	0.21	0.94	1.22
"WL"	6.88	3.18	0.19	0.30	0.60	3.28	52.8%	0.18	0.67	1.12
	6.93	2.76	0.16	0.25	0.45	2.84	45.8%	0.16	0.46	1.02
	6.98	2.41	0.13	0.20	0.32	2.48	39.9%	0.13	0.29	0.89
	7.03	2.06	0.10	0.15	0.21	2.11	34.0%	0.10	0.16	0.75
	7.08	1.72	0.07	0.10	0.12	1.76	28.3%	0.07	0.07	0.57
	7.13	1.42	0.03	0.05	0.04	1.44	23.2%	0.03	0.01	0.30

1. 0.2 $\bar{d}$ 0.19 / 0.20 / 0.22 — 0.67 / X / 0.94 — $\frac{0.01}{0.03}$ $\frac{X}{0.27}$ = 0.09 + 0.67 = (0.76 cfs)

2. 50% wetted perimeter
0.46 / 0.50 / 0.53 — 0.46 / X / 0.67 — $\frac{0.04}{0.07}$ $\frac{X}{0.21}$ = 0.12 + 0.46 = (0.58 cfs)

3. 1 ft/sec $\bar{V}$ 0.89 / 1.00 / 1.02 — 0.29 / X / 0.46 — $\frac{0.11}{0.13}$ $\frac{X}{0.17}$ = 0.14 + 0.29 = (0.43 cfs)

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.70	cfs
CALCULATED FLOW (Qc)=	0.67	cfs
(Qm-Qc)/Qm * 100 =	3.9	%
MEASURED WATERLINE (WLm)=	6.91	ft
CALCULATED WATERLINE (WLc)=	6.88	ft
(WLm-WLc)/WLm * 100 =	0.3	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.30	ft
(Dm-Dc)/Dm * 100	0.8	%
MEAN VELOCITY=	1.12	ft/sec
MANNING'S N=	0.074	
SLOPE=	0.03	ft/ft
.4 * Qm =	0.3	cfs
2.5 * Qm=	1.7	cfs

RECOMMENDED INSTREAM FLOW:

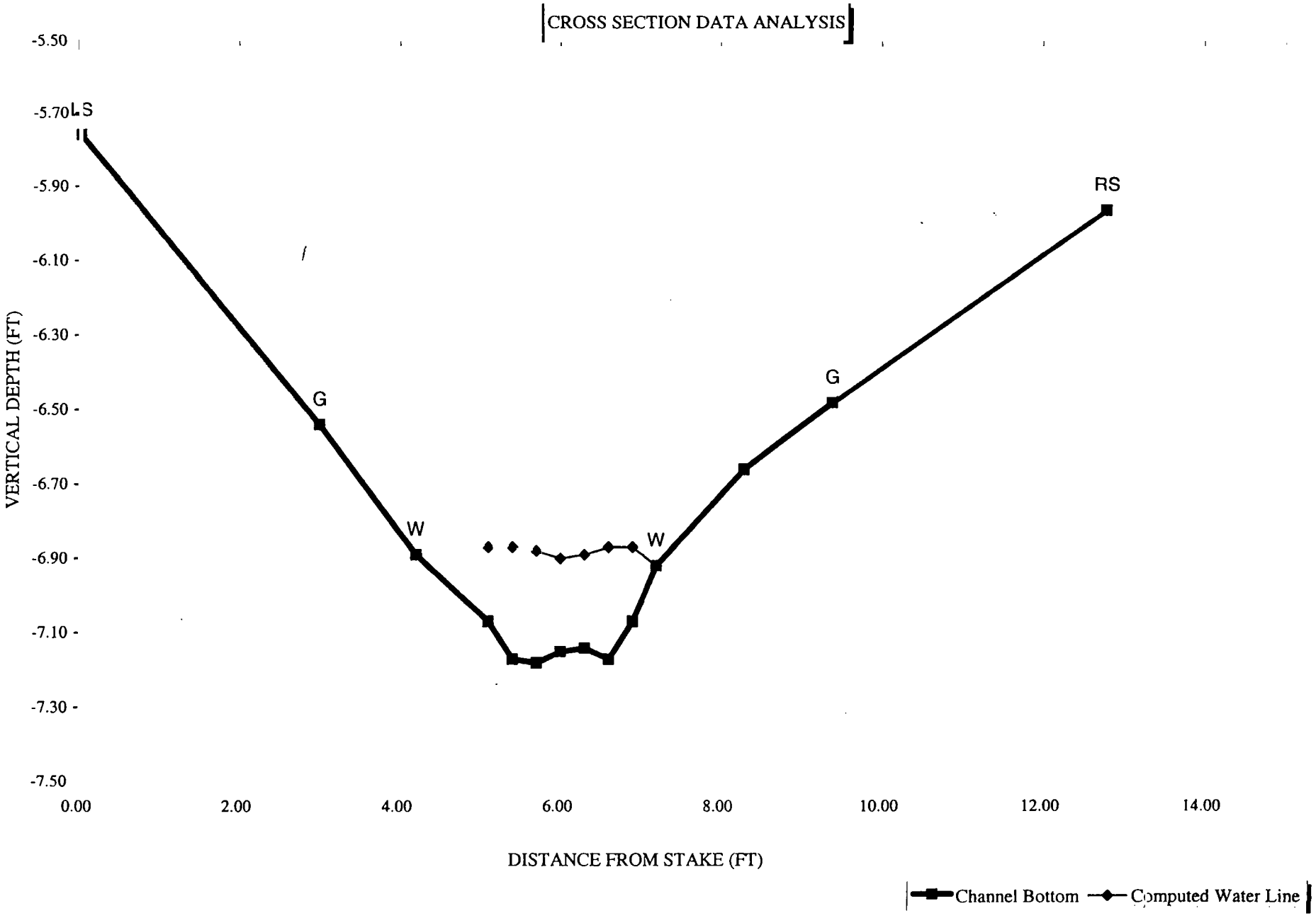
FLOW (CFS)	PERIOD

RATIONALE FOR RECOMMENDATION.

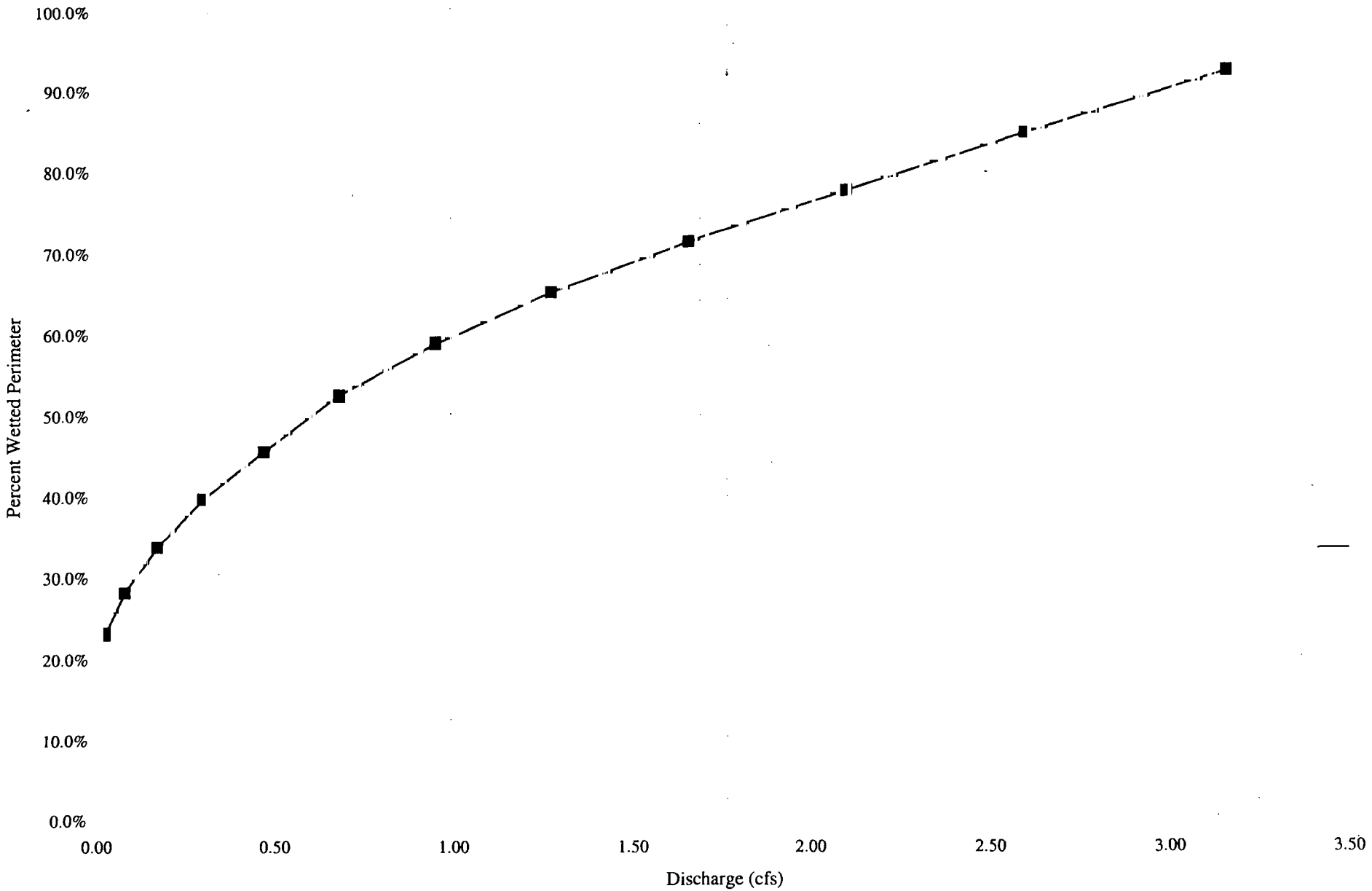
RECOMMENDATION BY: ..... AGENCY..... DATE:.....

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

East Willow Creek



Percent Wetted Perimeter vs. Discharge



EWILLOCK.WK1
WJ-WILLOCK.PRC

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: East Willow Creek | CROSS-SECTION NO.: 1

CROSS-SECTION LOCATION: 2.4 miles downstream from confluence w/ Bull Fork

DATE: 9-9-97 | OBSERVERS: C. Hollowed, R. Smith

LEGAL DESCRIPTION | ¼ SECTION: NE | SECTION: 9 | TOWNSHIP: 4 N(S) | RANGE: 97 E(W) | PM: 6th

COUNTY: Rio Blanco | WATERSHED: White River | WATER DIVISION: 5 | DOW WATER CODE: 23961

MAPIS | USGS: Bull Fork 7.5' | USFS:

SUPPLEMENTAL DATA

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

METER NUMBER: | DATE RATED: | CALIB/SPIN ____ sec | TAPE WEIGHT ____ lbs/foot | TAPE TENSION: 18 lbs

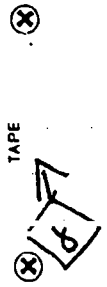
CHANNEL BED MATERIAL SIZE RANGE: gravel to 8" cobbles | PHOTOGRAPHS TAKEN: (YES)/NO | NUMBER OF PHOTOGRAPHS: 3

CHANNEL PROFILE DATA

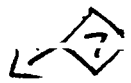
STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape & Stake LB	0.0	4.84
⊗ Tape & Stake RB	0.0	4.84
① WS & Tape LB/RB	0.0	6.95 / 6.95
② WS Upstream	10.0	6.42
③ WS Downstream	10.0	7.13

SLOPE | 0.71'/20.0' = 0.03550

SKETCH



LEGEND

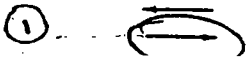


Stake ⊗

Station ①

Photo ◇→

Direction of Flow



AQUATIC SAMPLING SUMMARY

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

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

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

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

Caddisfly, Mayfly (abundant); snails

COMMENTS

Ph = 8.6 Conductivity = 850 Stream Temp = 14° C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: East Willow | CROSS-SECTION NO.: 1 | DATE: 9-9-97 | SHEET 1 OF 1

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) | LEFT / RIGHT | Gage Reading: 0.4 ft | TIME: 1:00 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)
①	S	0.0		0.8								
	G	0.7		1.3								
		1.6		1.70								
		2.2	0.40	2.80	0.2	0.6	Ø	Ø		0	0.080	0
		2.7	0.40	2.40	0.4		20	40		0.512	0.160	0.082
		3.0	0.30	2.50	0.45		40	46		0.865	0.135	0.117
		3.3	0.30	2.40	0.40		40	43		0.924	0.120	0.111
		3.6	0.30	2.40	0.40		50	45		1.10	0.120	0.132
		3.9	0.30	2.35	0.35		30	42		0.717	0.105	0.075
10		4.2	0.30	2.40	0.40		50	42		1.17	0.120	0.140
		4.5	0.30	2.40	0.40		80	45		1.73	0.120	0.208
		4.8	0.30	2.40	0.40		100	41		2.37	0.120	0.284
		5.1	0.30	2.40	0.40		150	51		2.85	0.120	0.342
		5.4	0.30	2.40	0.40		100	45		2.16	0.120	0.259
		5.7	0.30	2.30	0.30		25	44		0.577	0.090	0.052
		6.0	0.30	2.20	0.20		7	54		0.157	0.060	0.009
		6.3	0.30	2.20	0.20		3	41		0.103	0.060	0.006
		6.6	0.20	2.10	0.10		Ø	Ø		0	0.020	0
		7.0		1.60								
20	G	7.3		1.30								
		8.0		1.10								
24	S	10.0		0.6								
	W	1.9	0.15	2.0	0						0	0
	W	6.7	0.05	2.0	0						0	0

TOTALS: 1.55 1.817

End of Measurement | Time: 1:35 | Gage Reading: 0.4 ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

PROOF SHEET

LOCATION INFORMATION

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1
DATE: 09/09/97
OBSERVERS: C. Hollowed, R. Smith
1/4 SEC: NE
SECTION: 9
TWP: 4 S
RANGE: 97 W
PM: 6th
COUNTY: Rio Blanco
WATERSHED: White River
DIVISION: 5
DOW CODE: 23961
USGS MAP: Bull Fork
USFS MAP:

SUPPLEMENTAL DATA

TAPE WT: 0.0106
TENSION: 18

CHANNEL PROFILE DATA

SLOPE: 0.0355

CHECKED BY: Bill Long DATE 9/29/97

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

INPUT DATA

DATA POINTS= 24

FEATURE		DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	TAPE TO WATER
S		0.00	0.80	0.00	0.00	0.00	0.00	0.00
1 G		0.70	1.30	0.00	0.00	0.00	0.00	0.00
		1.60	1.70	0.00	0.00	0.00	0.00	0.00
W		1.90	2.00	0.00	0.00	0.00	0.00	0.00
		2.20	2.20	0.20	0.00	0.08	0.00	2.01
		2.70	2.40	0.40	0.51	0.16	0.08	2.01
		3.00	2.50	0.45	0.87	0.13	0.12	2.06
		3.30	2.40	0.40	0.92	0.12	0.11	2.01
		3.60	2.40	0.40	1.10	0.12	0.13	2.01
		3.90	2.35	0.35	0.72	0.11	0.08	2.01
		4.20	2.40	0.40	1.17	0.12	0.14	2.01
		4.50	2.40	0.40	1.73	0.12	0.21	2.01
		4.80	2.40	0.40	2.37	0.12	0.28	2.01
		5.10	2.40	0.40	2.85	0.12	0.34	2.01
		5.40	2.40	0.40	2.16	0.12	0.26	2.01
		5.70	2.30	0.30	0.58	0.09	0.05	2.01
		6.00	2.20	0.20	0.16	0.06	0.01	2.01
		6.30	2.20	0.20	0.10	0.06	0.01	2.01
		6.60	2.10	0.10	0.00	0.02	0.00	2.01
W		6.70	2.00	0.00	0.00	0.00	0.00	0.00
		7.00	1.60	0.00	0.00	0.00	0.00	0.00
1 G		7.30	1.30	0.00	0.00	0.00	0.00	0.00
		8.00	1.10	0.00	0.00	0.00	0.00	0.00
S		10.00	0.60	0.00	0.00	0.00	0.00	0.00
	TOTALS					1.55	1.82	

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

LOCATION INFORMATION
==========

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

DATE: 09/09/97
OBSERVERS: C. Hollowed, R. Smith

1/4 SEC: NE
SECTION: 9
TWP: 4 S
RANGE: 97 W
PM: 6th

COUNTY: Rio Blanco
WATERSHED: White River
DIVISION: 5
DOW CODE: 23961

USGS MAP: Bull Fork
USFS MAP:

SUPPLEMENTAL DATA
==========

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

TAPE WT: 0.0106
TENSION: 18

CHANNEL PROFILE DATA
==========
SLOPE: 0.0355

INPUT DATA CHECKED BY: B. A. ..... DATE 9/11/97

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

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

INPUT DATA	# DATA POINTS= 24				VALUES COMPUTED FROM RAW FIELD DATA				
FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
S	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
1 G	0.70	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	1.60	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
W	1.90	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	2.20	2.20	0.20	0.00	0.36	0.20	0.08	0.00	0.0%
	2.70	2.40	0.40	0.51	0.54	0.40	0.16	0.08	4.5%
	3.00	2.50	0.45	0.87	0.32	0.45	0.13	0.12	6.4%
	3.30	2.40	0.40	0.92	0.32	0.40	0.12	0.11	6.1%
	3.60	2.40	0.40	1.10	0.30	0.40	0.12	0.13	7.3%
	3.90	2.35	0.35	0.72	0.30	0.35	0.11	0.08	4.1%
	4.20	2.40	0.40	1.17	0.30	0.40	0.12	0.14	7.7%
	4.50	2.40	0.40	1.73	0.30	0.40	0.12	0.21	11.4%
	4.80	2.40	0.40	2.37	0.30	0.40	0.12	0.28	15.6%
	5.10	2.40	0.40	2.85	0.30	0.40	0.12	0.34	18.8%
	5.40	2.40	0.40	2.16	0.30	0.40	0.12	0.26	14.3%
	5.70	2.30	0.30	0.58	0.32	0.30	0.09	0.05	2.9%
	6.00	2.20	0.20	0.16	0.32	0.20	0.06	0.01	0.5%
	6.30	2.20	0.20	0.10	0.30	0.20	0.06	0.01	0.3%
	6.60	2.10	0.10	0.00	0.32	0.10	0.02	0.00	0.0%
W	6.70	2.00	0.00	0.00	0.14	0.00	0.00	0.00	0.0%
	7.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
1 G	7.30	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
	8.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
S	10.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
TOTALS					5.03	0.45 (Max.)	1.55	1.82	100.0%

Manning's n = 0.1089

STREAM NAME: East Willow Cr
XS LOCATION: 2.4 mi. dowwns
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
1.76	1.55	2.82	82.3%
1.78	1.55	2.72	75.5%
1.80	1.55	2.62	68.8%
1.82	1.55	2.51	62.2%
1.84	1.55	2.41	55.6%
1.86	1.55	2.31	49.0%
1.88	1.55	2.21	42.5%
1.90	1.55	2.11	36.1%
1.92	1.55	2.01	29.6%
1.94	1.55	1.91	23.3%
1.96	1.55	1.81	16.9%
1.97	1.55	1.76	13.8%
1.98	1.55	1.72	10.7%
1.99	1.55	1.67	7.5%
2.00	1.55	1.62	4.4%
2.01	1.55	1.57	1.3%
2.02	1.55	1.52	-1.8%
2.03	1.55	1.47	-4.8%
2.04	1.55	1.43	-7.9%
2.05	1.55	1.38	-10.9%
2.06	1.55	1.33	-14.0%
2.08	1.55	1.24	-20.0%
2.10	1.55	1.15	-25.9%
2.12	1.55	1.06	-31.8%
2.14	1.55	0.97	-37.5%
2.16	1.55	0.88	-43.2%
2.18	1.55	0.80	-48.7%
2.20	1.55	0.71	-54.1%
2.22	1.55	0.63	-59.2%
2.24	1.55	0.56	-64.0%
2.26	1.55	0.49	-68.6%

WATERLINE AT ZERO
AREA ERROR = 2.010

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. dowwnstream from Bull Fork
XS NUMBER: 1

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 PER (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	1.31	6.59	0.83	1.20	5.47	7.36	100.0%	0.74	11.53	2.11
	1.31	6.58	0.83	1.20	5.44	7.34	99.8%	0.74	11.45	2.11
	1.36	6.42	0.80	1.15	5.12	7.15	97.2%	0.72	10.52	2.06
	1.41	6.25	0.77	1.10	4.80	6.95	94.5%	0.69	9.63	2.01
	1.46	6.09	0.74	1.05	4.49	6.76	91.9%	0.66	8.79	1.96
	1.51	5.93	0.71	1.00	4.19	6.57	89.3%	0.64	7.98	1.90
	1.56	5.77	0.68	0.95	3.90	6.37	86.7%	0.61	7.22	1.85
	1.61	5.61	0.64	0.90	3.61	6.18	84.0%	0.58	6.49	1.80
	1.66	5.46	0.61	0.85	3.34	6.00	81.5%	0.56	5.80	1.74
	1.71	5.32	0.58	0.80	3.07	5.82	79.1%	0.53	5.14	1.68
	1.76	5.23	0.54	0.75	2.80	5.68	77.3%	0.49	4.50	1.60
	1.81	5.14	0.49	0.70	2.54	5.55	75.5%	0.46	3.89	1.53
	1.86	5.05	0.45	0.65	2.29	5.42	73.7%	0.42	3.31	1.45
	1.91	4.97	0.41	0.60	2.04	5.29	71.8%	0.39	2.78	1.36
	1.96	4.88	0.37	0.55	1.79	5.15	70.0%	0.35	2.28	1.27
WL	2.01	4.79	0.32	0.50	1.55	5.02	68.2%	0.31	1.82	1.17
	2.06	4.66	0.28	0.45	1.31	4.86	66.0%	0.27	1.41	1.08
	2.11	4.53	0.24	0.40	1.08	4.69	63.8%	0.23	1.05	0.97
	2.16	4.31	0.20	0.35	0.86	4.44	60.4%	0.19	0.74	0.86
	2.21	3.78	0.17	0.30	0.65	3.89	52.9%	0.17	0.51	0.78
	2.26	3.51	0.13	0.25	0.47	3.60	48.9%	0.13	0.31	0.66
	2.31	3.23	0.09	0.20	0.30	3.31	44.9%	0.09	0.16	0.52
	2.36	2.92	0.05	0.15	0.15	2.98	40.5%	0.05	0.05	0.35
	2.41	0.58	0.05	0.10	0.03	0.61	8.3%	0.05	0.01	0.33
	2.46	0.28	0.02	0.05	0.01	0.29	4.0%	0.02	0.00	0.20

$\frac{Q - 1.0?}{1.41 - 1.0?} = \frac{1 - ?.??}{1.08 - ?.??}$ $Q = 1.15$

STREAM NAME: East Willow Creek
XS LOCATION: 2.4 mi. downstream from Bull Fork
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.82 cfs
CALCULATED FLOW (Qc)=	1.82 cfs
(Qm-Qc)/Qm * 100 =	-0.2 %
MEASURED WATERLINE (WLm)=	2.01 ft
CALCULATED WATERLINE (WLc)=	2.01 ft
(WLm-WLc)/WLm * 100 =	-0.2 %
MAX MEASURED DEPTH (Dm)=	0.45 ft
MAX CALCULATED DEPTH (Dc)=	0.50 ft
(Dm-Dc)/Dm * 100	-10.3 %
MEAN VELOCITY=	1.17 ft/sec
MANNING'S N=	0.109
SLOPE=	0.0355 ft/ft
.4 * Qm =	0.7 cfs
2.5 * Qm=	4.5 cfs

RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD
0.94	Wint.
1.15	Sum.

RATIONALE FOR RECOMMENDATION:

Winter flow = 0.94 cfs. Natural flow at Bull Fork

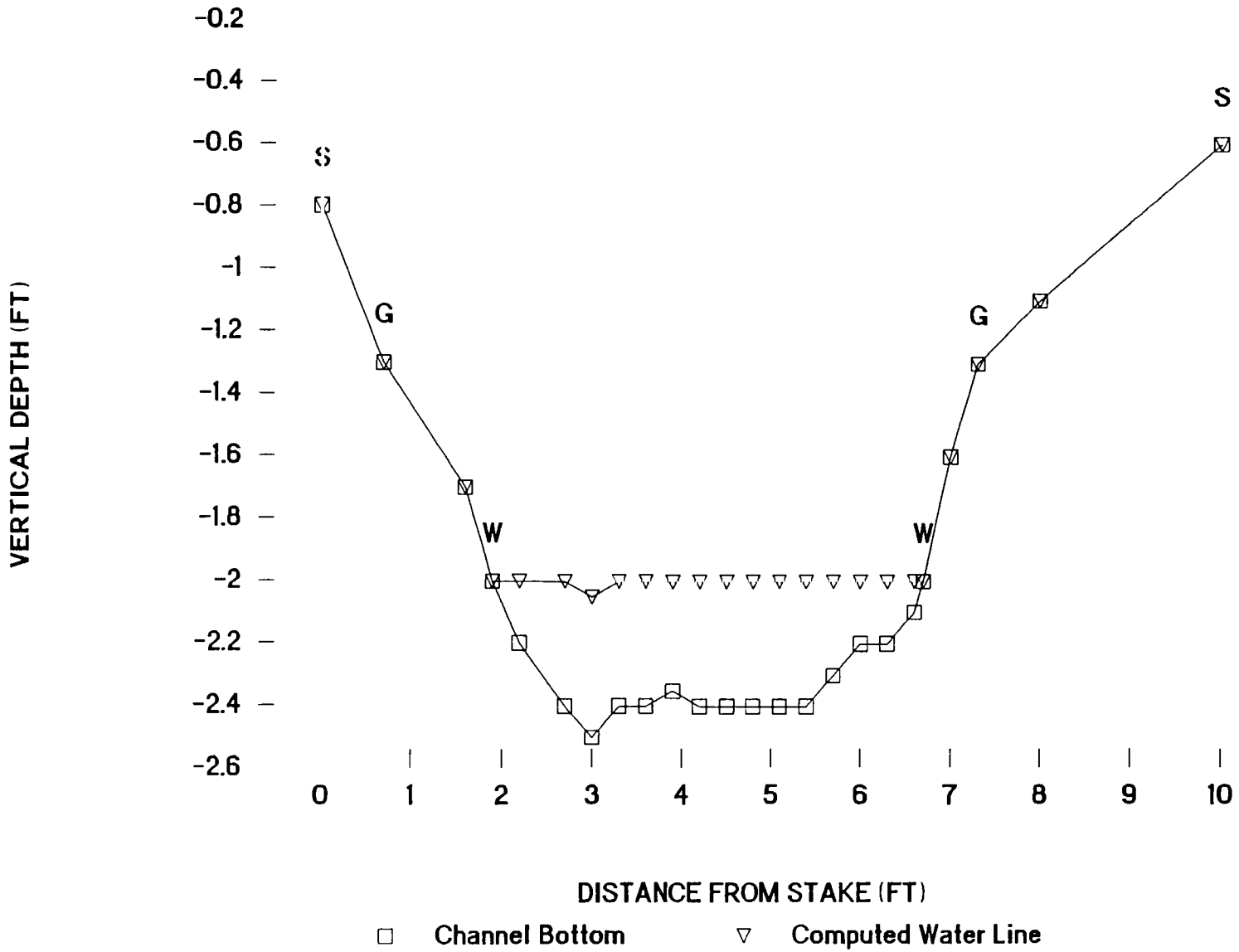
Summer flow = 1.15 cfs. [illegible]

RECOMMENDATION BY: [illegible] AGENCY: [illegible] DATE: [illegible]

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

East Willow Creek

CROSS SECTION DATA ANALYSIS



COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: East Willow Creek | CROSS-SECTION NO: 2

CROSS-SECTION LOCATION: between confluence w/ Bull Fork & West Willow

DATE: 9-8-04 | OBSERVERS: R. Smith, P. Daggett

LEGAL DESCRIPTION: ¼ SECTION: NE | SECTION: 9 | TOWNSHIP: 4 N/S | RANGE: 97 E/W | PM: 6th

COUNTY: Rio Blanco | WATERSHED: White River | WATER DIVISION: 6 | DOW WATER CODE: 73961

MAP(S): USGS: Bull Fork 7.5' | USFS:

IZS 0733170
4399627

SUPPLEMENTAL DATA

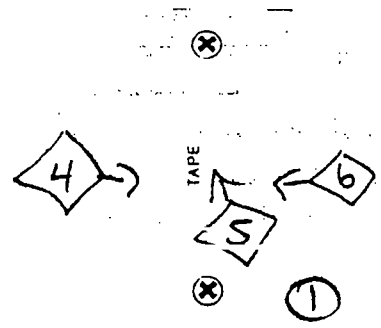
SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO | METER TYPE: Marsh-McBirney

METER NUMBER: | DATE RATED: | CALIB/SPIN ____ sec | TAPE WEIGHT: surveyed ___ lbs/100' | TAPE TENSION: surveyed ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: silt to 3" 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	6.39 / 6.42
② WS Upstream	15.0'	6.21
③ WS Downstream	15.0'	7.00'
SLOPE	0.79 / 30.0 = 0.03	



LEGEND: Stake ⊗ | Station ○ | Photo ◇ | Direction of flow →

AQUATIC SAMPLING SUMMARY

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

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

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

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME

caddisfly, mayfly

COMMENTS

Temp: 18°C TDS: 1,030 Ph: 8.5

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: EAST WILLOW CREEK | CROSS SECTION NO: 2 | DATE: 9-08-04 | SHEET __ OF __

BEGINNING OF MEASUREMENT: EDGE OF WATER LOOKING DOWNSTREAM (0.0 AT STAKE) | LEFT / RIGHT | Gage Reading: 0.35 ft | TIME: 1:50

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		5.78								
G	0.7		6.10								
W	1.0		6.39	Ø				Ø			
	1.3		6.72	0.3				0.05			
	1.6		6.77	0.35				1.51			
	1.9		6.72	0.3				1.76			
	2.2		6.75	0.35				1.70			
	2.5		6.75	0.35				1.67			
	2.8		6.68	0.25				1.43			
	3.1		6.55	0.15				-0.03			
W	3.4		6.42	Ø				Ø			
G	3.9		6.16								
	5.5		6.14								
RS	9.0		5.80								
TOTALS											

End of Measurement | Time: 2:15 | Gage Reading: 0.35 ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

Data Input & Proofing

STREAM NAME: |East Willow Creek
XS LOCATION: |between confluence w/ Bull Fork & West Willow
XS NUMBER: |2
DATE: |9/8/04
OBSERVERS: |R. Smith, P. Daggett

1/4 SEC: |NE
SECTION: |9
TWP: |4 S
RANGE: |97 W
PM: |6th PM

COUNTY: |Rio Blanco
WATERSHED: |White River
DIVISION: |6
DOW CODE: |23961
USGS MAP: |Bull Fork 7.5
USFS MAP: |

TAPE WT: |0.0106 lbs / ft
TENSION: |99999 lbs

SLOPE: | 0.03|ft / ft

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

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

Level and Rod Survey

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
			Total Data Points = 14					
	LS	0.00	5.78			0.00	0.00	0.00
1	G	0.70	6.10			0.00	0.00	0.00
	W	1.00	6.39	0.00	0.00	0.00	0.00	0.00
		1.30	6.72	0.30	0.05	0.09	0.00	6.42
		1.60	6.77	0.35	1.51	0.11	0.16	6.42
		1.90	6.72	0.30	1.76	0.09	0.16	6.42
		2.20	6.75	0.35	1.70	0.11	0.18	6.40
		2.50	6.75	0.35	1.67	0.11	0.18	6.40
		2.80	6.68	0.25	1.43	0.08	0.11	6.43
		3.10	6.55	0.15	0.03	0.05	0.00	6.40
	W	3.40	6.42	0.00	0.00	0.00	0.00	0.00
1	G	3.90	6.16			0.00	0.00	0.00
		5.50	6.14			0.00	0.00	0.00
	RS	9.10	5.80			0.00	0.00	0.00

	Totals	0.62	0.78

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

LOCATION INFORMATION

STREAM NAME:	East Willow Creek
XS LOCATION:	between confluence w/ Bull Fork & West Willow
XS NUMBER:	2
DATE:	8-Sep-04
OBSERVERS:	R. Smith, P. Daggett
1/4 SEC:	NE
SECTION:	9
TWP:	4 S
RANGE:	97 W
PM:	6th PM
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	23961
USGS MAP:	Bull Fork 7.5
USFS MAP:	0

SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

SLOPE:	0.03

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

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

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
XS NUMBER: 2

DATA POINTS= 14

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	5.78			0.00		0.00	0.00	0.0%
1 G	0.70	6.10			0.00		0.00	0.00	0.0%
W	1.00	6.39	0.00	0.00	0.00		0.00	0.00	0.0%
	1.30	6.72	0.30	0.05	0.45	0.30	0.09	0.00	0.6%
	1.60	6.77	0.35	1.51	0.30	0.35	0.11	0.16	20.2%
	1.90	6.72	0.30	1.76	0.30	0.30	0.09	0.16	20.2%
	2.20	6.75	0.35	1.70	0.30	0.35	0.11	0.18	22.8%
	2.50	6.75	0.35	1.67	0.30	0.35	0.11	0.18	22.4%
	2.80	6.68	0.25	1.43	0.31	0.25	0.08	0.11	13.7%
	3.10	6.55	0.15	0.03	0.33	0.15	0.05	0.00	0.2%
W	3.40	6.42	0.00	0.00	0.33		0.00	0.00	0.0%
1 G	3.90	6.16			0.00		0.00	0.00	0.0%
	5.50	6.14			0.00		0.00	0.00	0.0%
RS	9.10	5.80			0.00		0.00	0.00	0.0%
TOTALS ----------					2.62	0.35 (Max.)	0.62	0.78	100.0%

Manning's n = 0.0769
Hydraulic Radius= 0.234936885

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.62	0.63	2.7%
6.16	0.62	1.33	116.0%
6.18	0.62	1.27	105.7%
6.20	0.62	1.20	95.7%
6.22	0.62	1.14	86.0%
6.24	0.62	1.08	76.4%
6.26	0.62	1.03	67.0%
6.28	0.62	0.97	57.8%
6.30	0.62	0.92	48.8%
6.32	0.62	0.86	40.0%
6.34	0.62	0.81	31.4%
6.36	0.62	0.76	23.0%
6.37	0.62	0.73	18.8%
6.38	0.62	0.71	14.7%
6.39	0.62	0.68	10.7%
6.40	0.62	0.66	6.7%
6.41	0.62	0.63	2.7%
6.42	0.62	0.61	-1.2%
6.43	0.62	0.58	-5.0%
6.44	0.62	0.56	-8.8%
6.45	0.62	0.54	-12.6%
6.46	0.62	0.51	-16.3%
6.48	0.62	0.47	-23.5%
6.50	0.62	0.43	-30.6%
6.52	0.62	0.39	-37.4%
6.54	0.62	0.34	-44.0%
6.56	0.62	0.30	-50.4%
6.58	0.62	0.27	-56.6%
6.60	0.62	0.23	-62.6%
6.62	0.62	0.19	-68.4%
6.64	0.62	0.16	-74.0%
6.66	0.62	0.13	-79.3%

WATERLINE AT ZERO
AREA ERROR = 6.412

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
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"	6.16	3.14	0.42	0.61	1.31	3.51	100.0%	0.37	2.28	1.74
	6.16	3.13	0.42	0.61	1.31	3.50	99.8%	0.37	2.26	1.73
	6.21	2.98	0.39	0.56	1.15	3.32	94.7%	0.35	1.90	1.65
	6.26	2.84	0.36	0.51	1.01	3.14	89.5%	0.32	1.58	1.57
	6.31	2.69	0.32	0.46	0.87	2.96	84.4%	0.29	1.28	1.48
	6.36	2.54	0.29	0.41	0.74	2.78	79.3%	0.27	1.02	1.38
"WL"	6.41	2.40	0.26	0.36	0.61	2.61	74.2%	0.24	0.79	1.28
	6.46	2.24	0.22	0.31	0.50	2.41	68.8%	0.21	0.58	1.17
	6.51	2.08	0.19	0.26	0.39	2.22	63.2%	0.18	0.41	1.05
	6.56	1.92	0.15	0.21	0.29	2.03	57.7%	0.14	0.27	0.92
	6.61	1.76	0.11	0.16	0.20	1.83	52.2%	0.11	0.15	0.76
	6.66	1.59	0.07	0.11	0.12	1.64	46.7%	0.07	0.07	0.57
	6.71	1.37	0.03	0.06	0.04	1.39	39.5%	0.03	0.01	0.32
	6.76	0.10	0.00	0.01	0.00	0.10	2.8%	0.00	0.00	0.08

1. 0.2 $\bar{d}$

0.19 0.41
0.20 X
0.22 0.58

$\frac{0.01}{0.03} \quad \frac{X}{0.17}$ = 0.06 + 0.41 = (0.47 cfs)

2. 50% wetted perimeter

0.47 0.07
0.50 X
0.52 0.15

$\frac{0.03}{0.05} \quad \frac{X}{0.08}$ = 0.05 + 0.07 = (0.12 cfs)

3. 1 ft/sec $\bar{v}$

0.92 0.27
1.00 X
1.05 0.41

$\frac{0.08}{0.13} \quad \frac{X}{0.14}$ = 0.09 + 0.27 = (0.36 cfs)

STREAM NAME: East Willow Creek
XS LOCATION: between confluence w/ Bull Fork & West Willow
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.78	cfs
CALCULATED FLOW (Qc)=	0.79	cfs
(Qm-Qc)/Qm * 100 =	-0.3	%
MEASURED WATERLINE (WLm)=	6.41	ft
CALCULATED WATERLINE (WLc)=	6.41	ft
(WLm-WLc)/WLm * 100 =	-0.1	%
MAX MEASURED DEPTH (Dm)=	0.35	ft
MAX CALCULATED DEPTH (Dc)=	0.36	ft
(Dm-Dc)/Dm * 100	-2.3	%
MEAN VELOCITY=	1.28	ft/sec
MANNING'S N=	0.077	
SLOPE=	0.03	ft/ft
.4 * Qm =	0.3	cfs
2.5 * Qm=	2.0	cfs

RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD

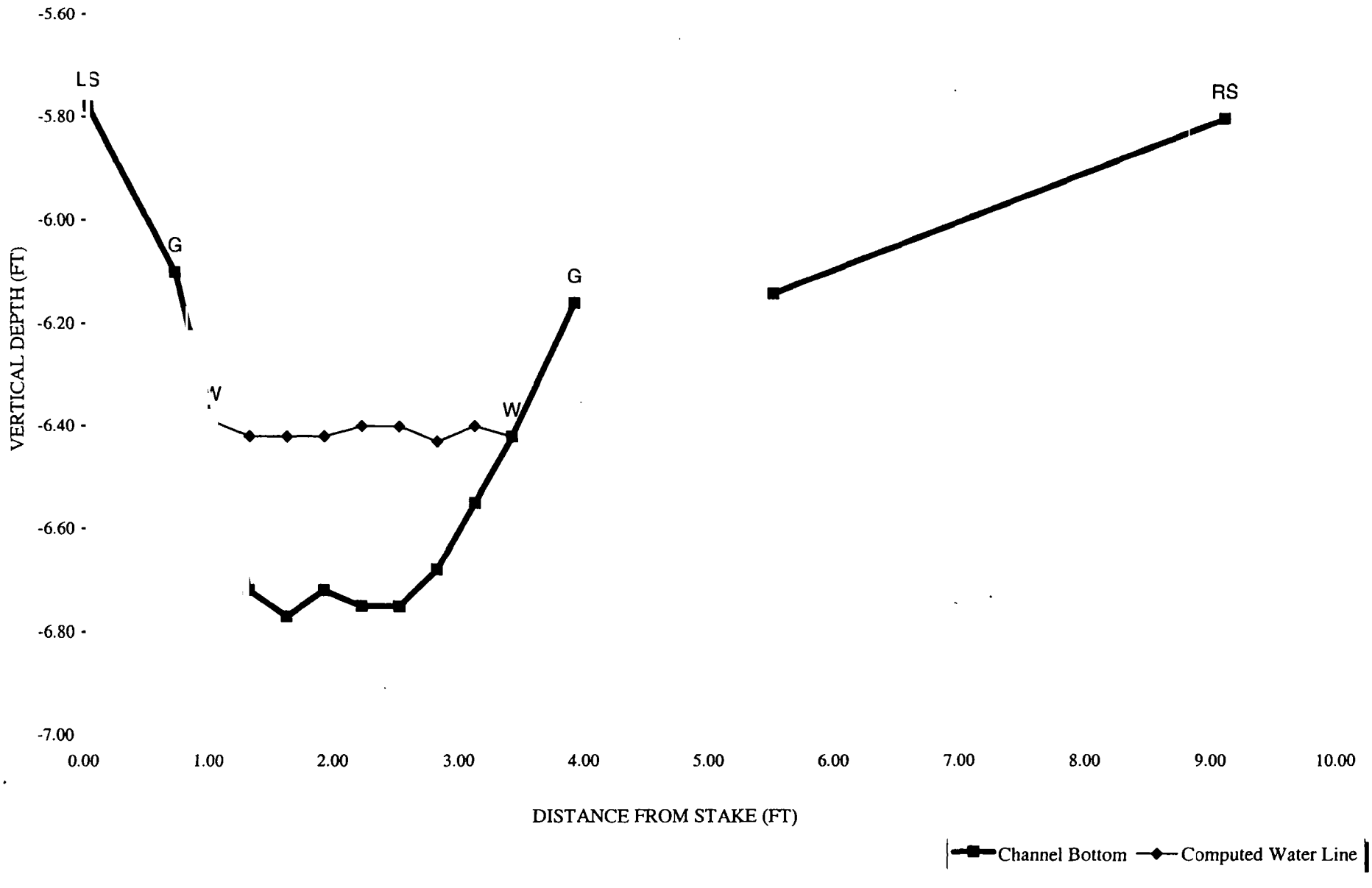
RATIONALE FOR RECOMMENDATION:

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

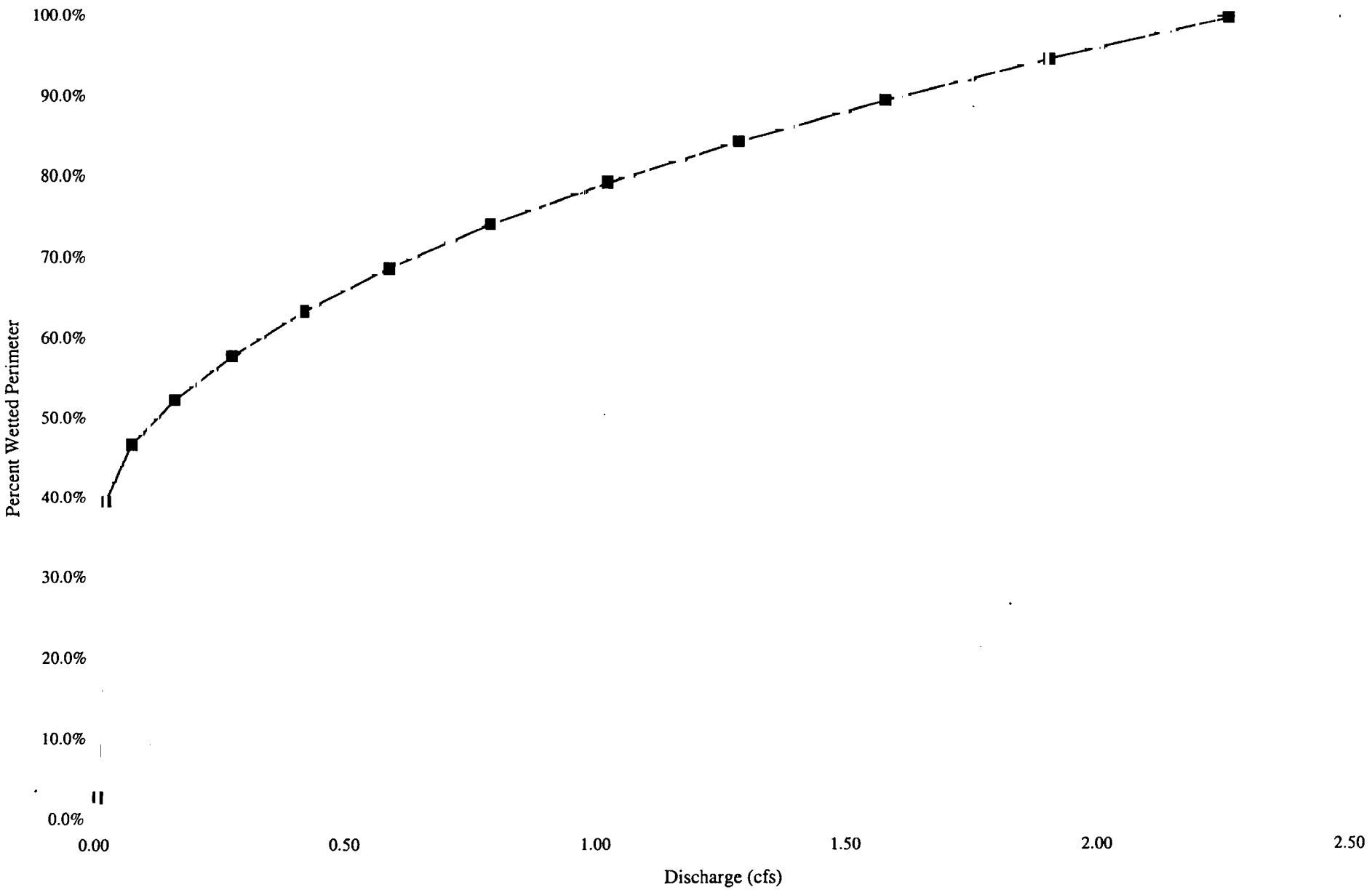
CWCB REVIEW BY: ..... DATE:.....

East Willow Creek

CROSS SECTION DATA ANALYSIS



Percent Wetted Perimeter vs. Discharge



CDOW STREAM SURVEY (1991 REVISION)

LEVEL 2: FIELD SURVEY SUMMARY — Bull Fork Quad

STREAM: Willow Cr. East SEC#: — WATER CODE: 23961 CDOW REGION: W

SURVEYORS: E & C Hallowed, R Smith, D Smith DATE OF SURVEY: 9 Sept 97

SURVEY LOCATION: T 45 R 97W S 16 ELEVATION: 7,180 STATION #: 1

UTM ZONE: 12 UTM X: 733110 m UTM Y: 4398340 m

LOCATION DESCRIPTION: From 350' downstream of the dist. fence Xing Co. at mouth of the first unnamed trib. on the E. side of cr. downstream of the Dept/BLM boundary.

STREAM FLOW PROFILE (Y or N): Y IF YES-DATE AND TYPE 9 Sept. 97, Rod & Level

HABITAT EVALUATION (Y or N): N IF YES-DATE AND TYPE —

WATER CHEMISTRY ANALYSIS (Y or N): N IF YES-ATTACH SEPARATE ANALYSIS SHEET

FISH PRESENT (Y or N): Y POP. EST. METHOD: — STATION LENGTH: 280 (FEET)

AVG. WIDTH: 2 (FEET) TOTAL STATION AREA: .013 (ACRES)

FLOW (CFS) AT TIME OF SURVEY: 1.82 METHOD: .6 USGS

LIMITING FACTORS TO FISHERY: A10, A12, A16

COMMENTS:

LENGTH FREQUENCY RECORD (CM)

SPECIES	0↓2	2↓4	4↓6	6↓8	8↓10	10↓12	12↓14	14↓16	16↓18	18↓20	20↓22	22↓24	24↓26	26↓28	28↓30	30↓32	32↓34	34↓36	36↓38	38↓40	40↓42	42↓44	44↓46	46↓48	48↓50
RBT												•	•	•				•							

SUMMARY INFORMATION

SPECIES	NO. FISH CAUGHT	AVG. LENGTH (CM)	LENGTH RANGE (CM)	AVG. WEIGHT (Grams)	WEIGHT RANGE (Grams)	% TOTAL CATCH	BIOMASS lb/Acre	DENSITY No./Acre	DENSITY Conf. Int.
RBT	3	24.5	22.2-26.7	202	178-246	100	103	231	

COLORADO DIVISION OF WILDLIFE

Length-Weight Data File

Stream Name Willow Cr. East CDOW Water Code 93961 Date 9 Sept 97

Gear Coffelt Electroshocker Effort 5.3 min. Station No. 1

Species Code	Total Length	Weight	Species Code	Total Length	Weight	Species Code	Total Length	Weight
RBT	22.2	178						
"	24.7	182						
"	26.7	246						

Comments: