United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7093
www.blm.gov/co

TAKE PRIDE IN AMERICA

In Reply Refer To:
7250 (CO-932)

DEC 1 1 2009

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

Dear Ms. Bassi:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its recommendation for an instream flow water right on Willow Creek, located in Water Division 4.

Location and Land Status: Willow Creek is a tributary to the Gunnison River at Blue Mesa Reservoir, approximately eight miles southwest of Gunnison. State Highway 149 crosses the location where the creek enters Blue Mesa Reservoir, approximately one mile south of where the highway bridge crosses Blue Mesa Reservoir. The creek is located within the upper Gunnison River watershed. This recommendation covers a reach beginning at the confluence of Sugar Creek and extending downstream to the confluence with Blue Mesa Reservoir.

Approximately 3.5 miles of the 4.0-mile reach are located on federally managed lands, and approximately 0.5 miles of the reach are located on private lands. All of the federal lands are managed by the BLM, with the exception of 0.25 miles that are managed by the National Park Service as part of Curecanti National Recreation Area.

Biological Summary: This segment of Willow Creek is a moderate gradient stream, with moderate to large substrate size, punctuated by large boulders. The proposed reach is confined by a canyon, and some portions of the creek are further confined by the construction and maintenance of a county road. The riparian community is in good condition and composed of willow, alders, and cottonwood. The creek supports a good diversity and biomass of aquatic macroinvertebrates, including mayfly, caddisfly, and stonefly. The creek provides a good mix of pools, riffles, and runs for fish habitat, and some of the deeper pools are critical for year-round survival of the fish population. The fish population appears to change in response to hydrologic conditions. Historical surveys have documented speckled dace in the creek system. Recent surveys have documented white suckers. It is likely that the creek is repopulated from stocks in Blue Mesa Reservoir after dry periods.

There are also numerous wildlife species that depend on the creek. There have been numerous sightings of chorus frog and salamanders. In addition, bird inventories have documented

Audubon's warbler, yellow warbler, Wilson's warbler, green towhee, warbling vireo, broad-tailed hummingbird, red-tailed hawk, common nighthawk, and brown-head cowbird. Finally, the riparian habitat along the creek is considered critical brood-rearing habitat for the Gunnison sage grouse, because the stream is close to leks (display areas) and nesting areas in adjacent uplands.

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

Party	Date	Discharge	250%-40%	Summer (3/3)	Winter (2/3)
BLM	06/04/2007	0.49	0.2-1.2	Out of range	0.74
BLM	06/04/2007	0.26	0.1-0.7	Out of range	0.47
BLM	06/04/2007	0.38	0.2-0.9	Out of range	0.33
BLM	06/04/2008	5.09	2.0-12.7	2.34	Out of range

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

> 2.3 cubic feet per second is recommended during the snowmelt runoff period from April 1 through June 30. This recommendation is driven by the average depth criteria. Since this stream experiences flows that wet a high percentage of the stream channel for only for a short period each year, it is critical to provide as much physical habitat as possible for the fish population so they can successfully complete life cycles. It is also critical to recharge the alluvial aquifer during this period, so that the riparian community has groundwater available during high temperature and low flow periods later in the summer.
>
> 0.5 cubic feet per second is recommended from July 1 through March 30. This recommendation is driven by the wetted perimeter criteria. This creek experiences low flows from late summer through winter, so it is important to protect any water that is available to support the highly diverse wildlife community. Flows during this period are critical for maintaining pool habitats that serve as refugia for the fish population.

Water Availability: Stream flows in Willow Creek vary significantly from year to year, and are highly dependent upon lower elevation snowpack each year within the Gunnison Basin. In very dry years during late summer and fall, flow is provided by channel-bottom springs. The BLM is concerned that any additional diversions during the low flow season could result in a stream environment that is no longer suitable for fish.

For water availability analysis, the BLM recommends a comparative basin analysis on the United States Geological Survey (USGS) Gage on Curecanti Creek near Sapinero, which is another tributary to the Gunnison River. This gage is located only eight miles from Willow Creek and likely reflects a similar precipitation pattern to Willow Creek.

The BLM is aware of only one water right in the recommended reach, which is the Arta Smith

ditch. The ditch historically irrigated lands that are adjacent to the creek. Diversion records for this structure are spotty.

Relationship to Management Plans: Under the current resource management plan, Willow Creek is managed to maintain and improve riparian habitat conditions. Changes in grazing management, along with beaver activity, have significantly improved riparian and aquatic conditions. In addition, the BLM is implementing a basin-wide plan to protect and improve habitat for Gunnison sage grouse, and this creek is considered a critical sage grouse habitat area. The BLM management plan specifically calls for instream flow recommendations on creeks within this management unit that support fisheries.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2009. We thank both the Division of Wildlife and the Water Conservation Board for their cooperation in this effort.

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

Sincerely,

Linda Anañia

Linda Anañia
Deputy State Director, Natural Resources and Fire

cc: Andrew Breibart, Gunnison Field Office
Brian St. George, Gunnison Field Office

DRAFT INSTREAM FLOW RECOMMENDATION

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

Dear Ms. Bassi:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its recommendation for an instream flow water right on South Willow Creek, located in Water Division 4.

Location and Land Status. South Willow Creek is tributary to the Gunnison River at Blue Mesa Reservoir, approximately eight miles southwest of Gunnison. State Highway 149 crosses the location where the creek enters Blue Mesa Reservoir, approximately one mile south of where the highway bridge crosses Blue Mesa Reservoir. The creek is located within the upper Gunnison River watershed. This recommendation covers a reach beginning at the confluence of Sugar Creek and extending downstream to the confluence with Blue Mesa Reservoir.

Approximately 3.5 miles of the 4.0-mile reach are located on federally managed lands, and approximately 0.5 miles of the reach are located on private lands. All of the federal lands are managed by BLM, with the exception of 0.25 miles that are managed by the National Park Service as part of Curecanti National Recreation Area.

Biological Summary. This segment of South Willow Creek is a moderate gradient stream, with moderate to large substrate size, punctuated by large boulders. The proposed reach is confined by a canyon, and some portions of the creek are further confined by the construction and maintenance of a county road. The riparian community is in good condition and composed of willow, alders, and cottonwood. The creek supports a good diversity and biomass of aquatic macroinvertebrates, including mayfly, caddisfly, and stonefly. The creek provides a good mix of pools, riffles, and runs for fish habitat, and some of the deeper pools are critical for year-round survival of the fish population. The fish population appears to change in response to hydrologic conditions. Historical surveys have documented speckled dace in the creek system. Recent surveys have documented white suckers. It is likely that the creek is repopulated from stocks in Blue Mesa Reservoir after dry periods.

There are also numerous wildlife species that depend on the creek. There have been numerous sightings of chorus frog and salamanders. In addition, bird inventories have documented Audubon's warbler, yellow warbler, Wilson's warbler, green towhee, warbling vireo, broad-tailed hummingbird, red-tailed hawk, common nighthawk, and brown-head cowbird. Finally, the riparian habitat along the creek is considered critical brood-rearing habitat for the Gunnison sage grouse, because the stream is close to leks (display areas) and nesting areas in adjacent uplands.

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

Party	Date	Discharge	250%-40%	Summer (3/3)	Winter (2/3)
BLM	06/04/2007	0.49	0.2-1.2	Out of range	0.74
BLM	06/04/2007	0.26	0.1-0.7	Out of range	0.47
BLM	06/04/2007	0.38	0.2-0.9	Out of range	0.33
BLM	06/04/2008	5.09	2.0-12.7	2.34	Out of range

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

> 2.3 cubic feet per second is recommended during the snowmelt runoff period from April 1 through June 30. This recommendation is driven by the average depth criteria. Since this stream experiences flows that wet a high percentage of the stream channel for only for a short period each year, it is critical to provide as much physical habitat as possible for the fish population so they can successfully complete life cycles. It is also critical to recharge the alluvial aquifer during this period, so that the riparian community has groundwater available during high temperature and low flow periods later in the summer.
>
> 0.5 cubic feet per second is recommended from July 1 through March 30. This recommendation is driven by the wetted perimeter criteria. This creek experiences very low flows from late summer through winter, so it is important to protect any water that is available to support the highly diverse wildlife community. Flows during this period are critical for maintaining pool habitats that serve as refugia for the fish population.

Water Availability. Stream flows in South Willow Creek vary significantly from year to year, and are highly dependent upon lower elevation snowpack each year within the Gunnison Basin. In some years, the entire reach flows year-round. In dry years during late summer and fall, flow can be observed in only some portions of the creek that are fed by channel-bottom springs. BLM does not recommend using the standard water availability criteria of requiring appropriated flows to be available at least 50% of the time. BLM believes that appropriating water whenever it is available, even if those flows occur far less than 50% of the time, is critical for the environment in this creek. BLM is concerned that any additional diversions during the low flow season could result in a stream environment that is no longer suitable for fish.

BLM is aware of only one water right in the recommended reach, which is the Arta Smith ditch. The ditch historically irrigated lands that are adjacent to the creek. Diversion records for this structure are spotty.

For water availability analysis, BLM recommends developing a synthetic hydrograph using the equations provided in *Estimation of Natural Streamflow Characteristics in Western Colorado, USGS Water Resources Investigation Report 85-4086, 1985.* This method incorporates data about basin size and elevation. This data can then be compared to periodic discharge measurements that have been taken from the creek.

Relationship to Management Plans. Under the current resource management plan, Cochetopa Creek is managed to maintain and improve riparian habitat conditions. Changes in grazing management, along with beaver activity, have significantly improved riparian and aquatic conditions. In addition, BLM is implementing basin-wide plan to protect and improve habitat for Gunnison sage grouse, and this creek is considered a critical sage grouse habitat area. The BLM management plan specifically calls for instream flow recommendations on creeks within this management unit that support fisheries.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2009. We thank both the Division of Wildlife and the Water Conservation Board for their cooperation in this effort.

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

Sincerely,

Linda Anania
Deputy State Director
Resources and Fire

cc: Art Hayes, Gunnison Field Office
Field Office Manager, Gunnison Field Office

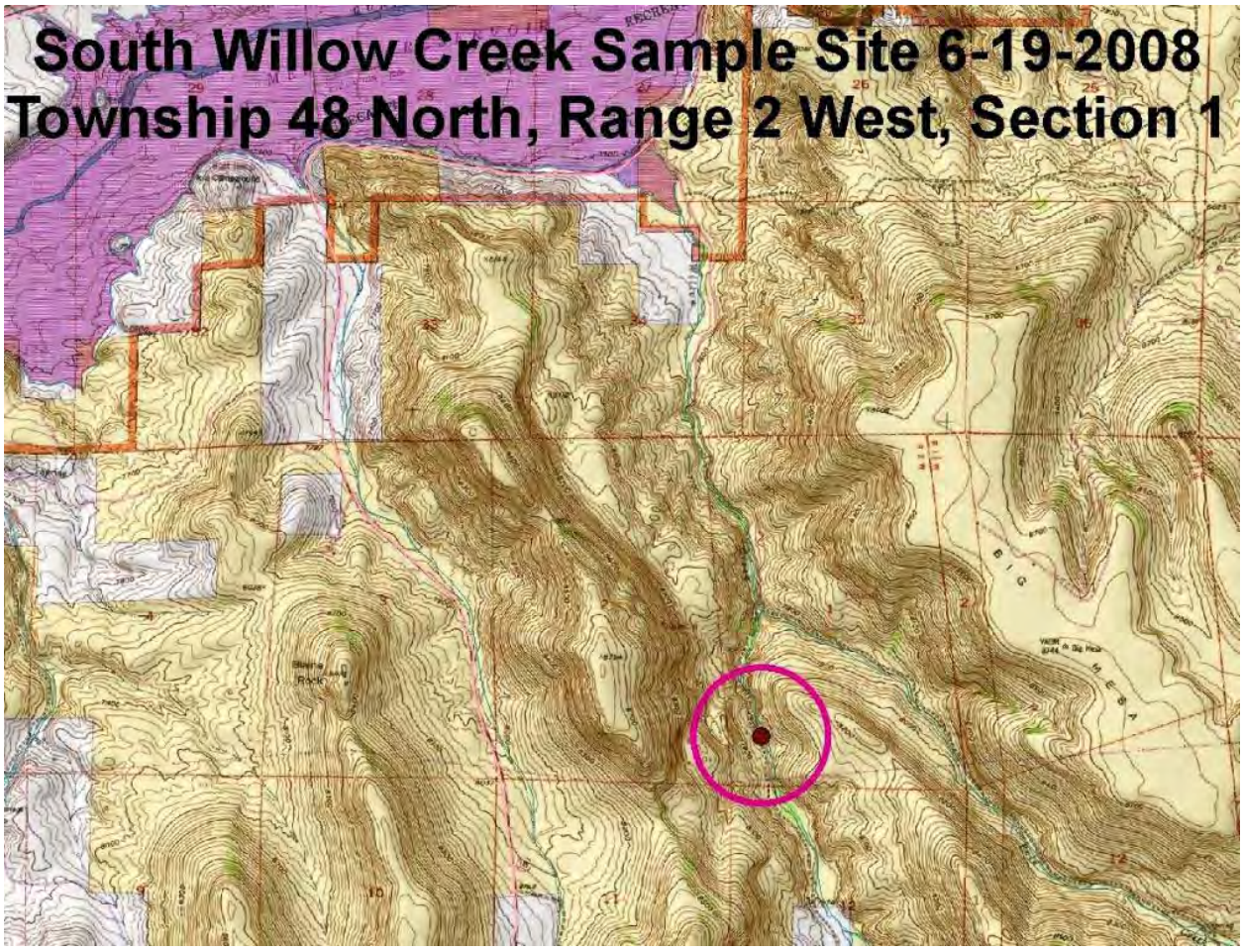
Gunnison Field Office Stream Surveys

June 2008

South Willow Creek - Water Code #44040

South Willow Creek, located west of Gunnison, CO on BLM lands managed by the Gunnison Field Office, was sampled on June 19, 2008. South Willow Creek is tributary to Blue Mesa Reservoir (Gunnison River). Presence/absence sampling was done in support of the Colorado BLM in-stream flow program. Sampling was conducted via backpack electro-shocker and approximately 500 feet of stream was sampled. Personnel present were Tom Fresques, Gregor Dekleva, and Art Hayes, BLM.

A total of 33 fish were collected – all white suckers. See data sheet below.



Map

White Suckers

White Suckers

FISH SAMPLING FORM

WATER S. Willow Creek CODE_44040___ DATE 06/19/2008

GEAR_Backpack Electroshocker EFFORT ~500 ft. STATION #_____ PASS #_1__

CREW Dekleva, Fresques, Hayes

species	length	weight	mark		species	length	weight	mark
WHS	175				WHS	106		
WHS	163				WHS	108		
WHS	161				WHS	102		
WHS	213				WHS	66		
WHS	157				WHS	98		
WHS	159				WHS	113		
WHS	148				WHS	90		
WHS	160				WHS	89		
WHS	156				WHS	105		
WHS	136				WHS	62		
WHS	145				WHS	88		
WHS	133				WHS	67		
WHS	128							
WHS	114							
WHS	135							
WHS	55							
WHS	112							
WHS	119							
WHS	94							

GPS Location:

Notes (water temp, etc.):

Discussion:

Stream habitat looked good with good pools and good riparian vegetation. However, fish were only collected in one location in the upper portion of the stream. Seasonal low flows are a likely limiting factor. The severe drought of 2002 may also have been a factor in the lack of fish distributed within the stream. All fish captured looked healthy. Aquatic insects noted included caddis, stone, and mayflies.

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: South Willow Cr. Below the coke-n #1 | CROSS-SECTION NO.: 3

CROSS-SECTION LOCATION: NAD 83 320082 4258635

DATE: 6/4/07 | OBSERVERS: D. MURPHY, A. HAYES

LEGAL DESCRIPTION: ¼ SECTION: SE | SECTION: 31 | TOWNSHIP: 49 (N)S | RANGE: 2 E(W) | PM: N.M.

COUNTY: GUNNISON | WATERSHED: GUNNISON | WATER DIVISION: 4 | DOW WATER CODE: 1040

MAP(S): USGS: Big Mesa 7.5' | USFS:

SUPPLEMENTAL DATA

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

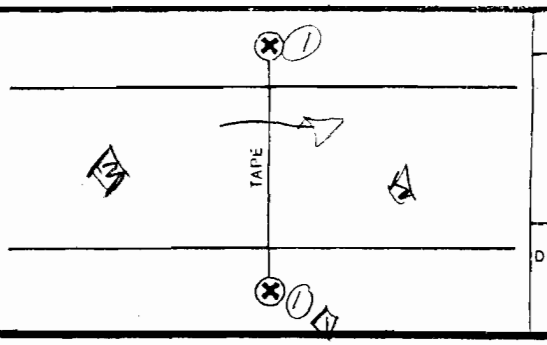
METER NUMBER: | DATE RATED: | CALIB/SPIN: _____ sec | TAPE WEIGHT: _____ lbs/foot | TAPE TENSION: _____ lbs

CHANNEL BED MATERIAL SIZE RANGE: 2-6" 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	
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0 6.90 12.90	6.91 / 6.91
② WS Upstream	5.0	6.87
③ WS Downstream	6.6	6.92
SLOPE	0.0113	

SKETCH



LEGEND: Stake ⊗ | Station ① | Photo ◇1 | Direction of Flow

AQUATIC SAMPLING SUMMARY

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

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

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

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME: Ephemeroptera, Tricoptera, Diptera

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Swallow Below Pole #1 | CROSS-SECTION NO: 3 | DATE: | SHEET __ OF __

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: ____ ft | TIME: 10:20 Am

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)
S	1.0		5.10								
	2.91		5.76								
G	4.00		5.97								
W	6.90		6.91								
	7.20		[illegible]	0.10					0.00		
	7.40		[illegible]	0.10					0.00		
	7.60		[illegible]	0.20					[illegible]		
	7.80		[illegible]	0.15					0.07		
	8.00		7.04	0.15					0.24		
	8.20		7.05	0.15					0.29		
	8.40		7.06	0.15					0.57		
	8.60		7.13	0.25					0.84		
	8.80		[illegible]	0.20					0.91		
	9.00		[illegible]	0.30					0.61		
	9.20		[illegible]	0.40					0.66		
	9.40		7.30	0.40					0.70		
	9.60		7.33	0.45					0.44		
	9.80		7.26	0.35					0.43		
	10.00		[illegible]	0.35					0.33		
	10.20		[illegible]	0.35					0.22		
	10.40		[illegible]	0.35					0.08		
	10.60		[illegible]	0.30					0.06		
	10.80		[illegible]	0.30					0.02		
	11.00		[illegible]	0.30					0.01		
	11.20		[illegible]	0.25					0.00		
	11.60		[illegible]	0.10					0.00		
	12.00		[illegible]	0.10					0.00		
	12.40		[illegible]	0.10					0.00		
	12.80		7.01	0.10					0.00		
W	12.90		6.90								
G.	14.2		5.98								
	15.0		4.48								
S	16.5		4.02								
TOTALS:											

End of Measurement: Time 1045 | Gage Reading: ____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: South Willow Cr. below Pole #2 | CROSS-SECTION NO.: 2

CROSS-SECTION LOCATION: NAD 83 320082 4258604

DATE: 6/4/07 | OBSERVERS: D. Murphy, A. Hayes

LEGAL DESCRIPTION: ¼ SECTION: SE | SECTION: 31 | TOWNSHIP: 49 (N/S) | RANGE: 2 (E/W) | PM:

COUNTY: Gunnison | WATERSHED: Gunnison | WATER DIVISION: 4 | DOW WATER CODE:

MAP(S): USGS: Big Mesa 7.5' | USFS:

SUPPLEMENTAL DATA

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

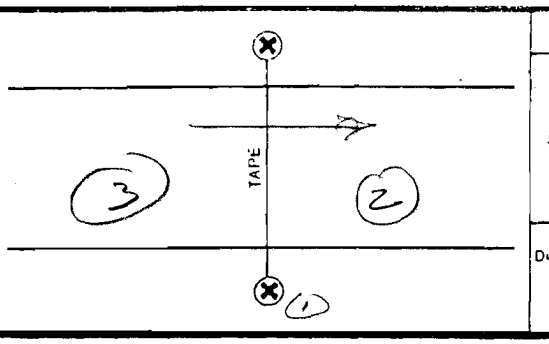
METER NUMBER: | DATE RATED: | CALIB/SPIN: ____ sec | TAPE WEIGHT: ____ lbs/foot | TAPE TENSION: ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: 2-6 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	
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0 6.4 12.3	6.89 / 6.91
② WS Upstream	8.5	6.76
③ WS Downstream	9.0	7.01
SLOPE	[illegible] / 17.5	[illegible]

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: Ephemeroptera, tricoptera, Diptera

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: S Wilson Helen Ck #2 | CROSS-SECTION NO: 2 | DATE: 6/11/97 | SHEET 1 OF 1

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: ____ ft | TIME: 11:00

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)
S	0.7		5.25								
G	3.0		5.71								
	3.1		6.11								
W	6.4		6.89								
	6.6		6.94	0.05					[illegible]		
	6.8		6.98	0.10					0.00		
	7.0		[illegible]	0.05					0.00		
	7.2		[illegible]	0.10					0.00		
	7.4		[illegible]	0.10					0.23		
	7.6		[illegible]	0.15					0.65		
	7.8		[illegible]	0.20					0.27		
	8.0		[illegible]	0.10					0.49		
	8.2		[illegible]	0.10					0.47		
	8.4		[illegible]	0.10					0.34		
	8.6		[illegible]	0.05					0.07		
	8.8		[illegible]	0.05					0.00		
	9.0		[illegible]	0.20					0.13		
	9.2		[illegible]	0.10					0.09		
	9.4		[illegible]	0.10					0.03		
	9.6		[illegible]	0.10					0.00		
	9.8		[illegible]	0.20					0.05		
	10.0		[illegible]	0.25					0.01		
	10.2		[illegible]	0.25					0.01		
	10.40		[illegible]	0.20					0.20		
	10.60		7.21	0.30					1.08		
	10.80		7.22	0.30					0.81		
	11.00		[illegible]	0.20					0.00		
	11.20		[illegible]	0.20					0.00		
	11.40		[illegible]	0.20					0.02		
	11.60		7.12	0.20					0.00		
	11.80		[illegible]	0.20					0.00		
	12.00		[illegible]	0.15					0.53		
	12.20		[illegible]	0.15					0.77		
	12.40		[illegible]	0.15					1.39		
W	12.5		6.91								
G	15.9		5.75								
S	20.0		3.86								
TOTALS											

End of Measurement | Time: 11:20 | Gage Reading: ____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: South Willow Creek Abv. Pole Creek | CROSS-SECTION NO: 1

CROSS-SECTION LOCATION: NAD 83 320486 4257220

DATE: 6/4/07 | OBSERVERS: T. Murphy A. Hawes

LEGAL DESCRIPTION | ¼ SECTION: NW | SECTION: 1 | TOWNSHIP: 48 (N) S | RANGE: 2 E (W) | PM: NM

COUNTY: Gunnison | WATERSHED: | WATER DIVISION: 4 | DOW WATER CODE:

MAP(S): USGS: Italy Mesa 7.5' | USFS:

SUPPLEMENTAL DATA

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

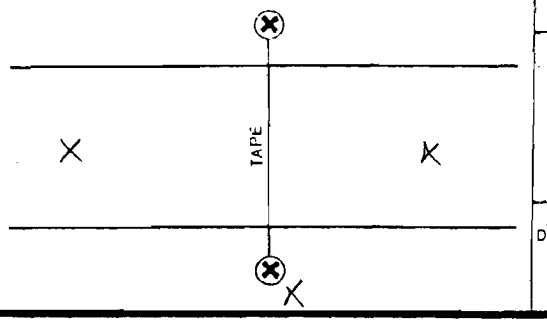
METER NUMBER: | DATE RATED: | CALIB/SPIN: ____ sec | TAPE WEIGHT: ____ lbs/foot | TAPE TENSION: ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: 2-6 cobble | PHOTOGRAPHS TAKEN: (YES) NO | NUMBER OF PHOTOGRAPHS: 5

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	5.28 / 5.27
② WS Upstream	7.0	5.22
③ WS Downstream	7.0	5.34
SLOPE	.12 / 14.0 = .0086	

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: Diptera

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Willow Above Bible Creek | CROSS-SECTION NO: 1 | DATE: 6/4/07 | SHEET 1 OF 1

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: LEFT / RIGHT (0.0 AT STAKE) | Gage Reading: _____ ft | TIME: 9:40 AM

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)
S	1.0		4.36								
G	2.8		4.66								
W	6.0		5.28								
	6.2		5.53	0.25					0.0		
	6.4		5.5[illegible]	0.30					0.13		
	6.6		5.4[illegible]	0.20					0.74		
	6.8		5.4[illegible]	0.20					0.46		
	7.0		[illegible]	0.20					0.67		
	7.2		5.45	0.20					0.59		
	7.4		5.4[illegible]	0.20					0.49		
	7.6		5.4[illegible]	0.20					0.47		
	7.8		5.46	0.20					0.51		
	8.0		5.48	0.20					0.41		
	8.2		[illegible]	0.25					1.05		
	8.4		5.54	0.25					1.21		
	8.6		5.54	0.25					1.16		
	8.8		5.54	0.25					0.74		
	9.0		2.[illegible]	0.25					1.05		
	9.2		5.[illegible]	0.25					1.05		
	9.40		5.27								
	13.0		5.12								
G	14.9		4.67								
S	15.6		4.22								
TOTALS											

End of Measurement: Time 9:55 | Gage Reading: _____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO WATER CONSERVATION BOARD

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Willow Creek					CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: 0.8 mile upstream from [illegible]					
DATE: [illegible]	OBSERVERS: [illegible]				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM: N.M.
COUNTY: [illegible]	WATERSHED: [illegible]	WATER DIVISION:	DOW WATER CODE:		
MAP(S):	USGS: 0320064				
	USFS: 4258179				

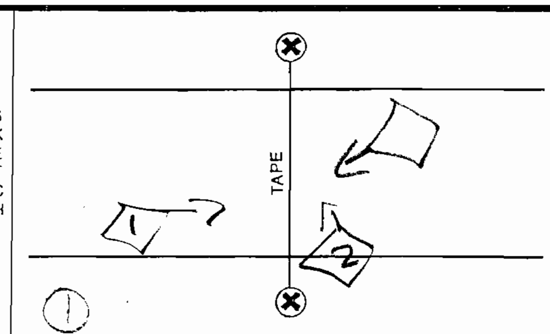
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO	METER TYPE: M - M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ______ sec	TAPE WEIGHT: surveyed ______ lbs/foot	TAPE TENSION: surveyed ______ lbs
CHANNEL BED MATERIAL SIZE RANGE: 2" cobbles [illegible] boulders		PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: [illegible]	

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	6.64 6.65
② WS Upstream	7.5'	6.46
③ WS Downstream	20.0	[illegible] 40
SLOPE	[illegible] =	

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:

COMMENTS

ph = 7.5 TDS: 390 Temp = [illegible] °F

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Willow Creek	CROSS-SECTION NO.:	DATE: [illegible] 93	SHEET ___ OF ___

BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME: 8:45 am

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Obser-vation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
RS	0.0		5.90								
G	2.0		6.14								
	[illegible]		[illegible]								
	6.0		6.90	0.20				0.60			
	7.0		6.75	0.10				1.30			
	8.0		7.05	0.30				1.07			
	9.0		7.05	0.30				0.99			
	10.0		7.15	0.40				1.73			
	10.5		7.05	0.30				0.76			
	11.0		7.05	0.30				1.76			
	11.5		7.25	0.60				2.61			
	12.0		7.05	0.30				2.12			
	12.5		7.05	0.30				[illegible]			
	13.0		7.05	0.30				[illegible]			
	13.5		6.85	0.20				1.38			
	14.0		7.05	0.30				[illegible]			
	[illegible]		7.15	0.40				2.26			
	15.0		7.15	0.40				1.86			
	15.5		7.00	0.25				1.19			
	16.0		7.05	0.30				2.24			
	16.5		6.75	0.10				0.28			
W	17.0		[illegible]								
G	18.0		[illegible]								
W	17.4		5.52								
TOTALS:											

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

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

LOCATION INFORMATION

STREAM NAME:	Willow Creek
XS LOCATION:	Below Pole Creek
XS NUMBER:	2
DATE:	4-Jun-07
OBSERVERS:	D. Murphy, A. Hayes
1/4 SEC:	SE
SECTION:	34
TWP:	49N
RANGE:	2W
PM:	NM
COUNTY:	Gunnison
WATERSHED:	Gunnison
DIVISION:	4
DOW CODE:	44040
USGS MAP:	Big Mesa 7.5'
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:	0.014

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

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

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Creek
XS NUMBER: 2

DATA POINTS= 37

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	0.70	5.25			0.00		0.00	0.00	0.0%
1	G	3.00	5.71			0.00		0.00	0.00	0.0%
		3.10	6.11			0.00		0.00	0.00	0.0%
	W	6.40	6.89			0.00		0.00	0.00	0.0%
		6.60	6.94	0.05	0.00	0.21	0.05	0.01	0.00	0.0%
		6.80	6.98	0.10	0.00	0.20	0.10	0.02	0.00	0.0%
		7.00	6.95	0.05	0.00	0.20	0.05	0.01	0.00	0.0%
		7.20	6.99	0.10	0.00	0.20	0.10	0.02	0.00	0.0%
		7.40	7.00	0.10	0.23	0.20	0.10	0.02	0.00	1.7%
		7.60	7.05	0.15	0.65	0.21	0.15	0.03	0.02	7.4%
		7.80	7.10	0.20	0.27	0.21	0.20	0.04	0.01	4.1%
		8.00	6.98	0.10	0.49	0.23	0.10	0.02	0.01	3.7%
		8.20	6.97	0.10	0.47	0.20	0.10	0.02	0.01	3.6%
		8.40	7.00	0.10	0.34	0.20	0.10	0.02	0.01	2.6%
		8.60	6.94	0.05	0.07	0.21	0.05	0.01	0.00	0.3%
		8.80	6.96	0.05	0.00	0.20	0.05	0.01	0.00	0.0%
		9.00	7.12	0.20	0.13	0.26	0.20	0.04	0.01	2.0%
		9.20	7.01	0.10	0.09	0.23	0.10	0.02	0.00	0.7%
		9.40	7.00	0.10	0.03	0.20	0.10	0.02	0.00	0.2%
		9.60	7.00	0.10	0.00	0.20	0.10	0.02	0.00	0.0%
		9.80	7.08	0.20	0.05	0.22	0.20	0.04	0.00	0.8%
		10.00	7.13	0.25	0.01	0.21	0.25	0.05	0.00	0.2%
		10.20	7.14	0.25	0.01	0.20	0.25	0.05	0.00	0.2%
		10.40	7.11	0.20	0.20	0.20	0.20	0.04	0.01	3.0%
		10.60	7.21	0.30	1.08	0.22	0.30	0.06	0.06	24.5%
		10.80	7.22	0.30	0.81	0.20	0.30	0.06	0.05	18.4%
		11.00	7.11	0.20	0.00	0.23	0.20	0.04	0.00	0.0%
		11.20	7.11	0.20	0.00	0.20	0.20	0.04	0.00	0.0%
		11.40	7.10	0.20	0.02	0.20	0.20	0.04	0.00	0.3%
		11.60	7.12	0.20	0.00	0.20	0.20	0.04	0.00	0.0%
		11.80	7.11	0.20	0.00	0.20	0.20	0.04	0.00	0.0%
		12.00	7.07	0.15	0.53	0.20	0.15	0.03	0.02	6.0%
		12.20	7.06	0.15	0.77	0.20	0.15	0.03	0.02	8.7%
		12.40	7.04	0.15	1.39	0.20	0.15	0.02	0.03	11.8%
	W	12.50	6.91			0.16		0.00	0.00	0.0%
1	G	15.90	5.75			0.00		0.00	0.00	0.0%
	RS	20.00	3.86			0.00		0.00	0.00	0.0%
	TOTALS ----------					6.41	0.3 (Max.)	0.91	0.26	100.0%

Manning's n = 0.1653
Hydraulic Radius= 0.14244657

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Creek
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.91	0.91	0.0%
6.65	0.91	2.66	191.3%
6.67	0.91	2.50	174.2%
6.69	0.91	2.35	157.4%
6.71	0.91	2.20	140.9%
6.73	0.91	2.05	124.8%
6.75	0.91	1.91	108.9%
6.77	0.91	1.76	93.4%
6.79	0.91	1.63	78.2%
6.81	0.91	1.49	63.3%
6.83	0.91	1.36	48.7%
6.85	0.91	1.23	34.4%
6.86	0.91	1.16	27.4%
6.87	0.91	1.10	20.4%
6.88	0.91	1.04	13.5%
6.89	0.91	0.97	6.7%
6.90	0.91	0.91	0.0%
6.91	0.91	0.85	-6.6%
6.92	0.91	0.79	-13.2%
6.93	0.91	0.73	-19.7%
6.94	0.91	0.67	-26.2%
6.95	0.91	0.62	-32.5%
6.97	0.91	0.51	-44.3%
6.99	0.91	0.41	-54.7%
7.01	0.91	0.33	-63.6%
7.03	0.91	0.26	-71.3%
7.05	0.91	0.20	-78.5%
7.07	0.91	0.14	-84.7%
7.09	0.91	0.09	-89.9%
7.11	0.91	0.05	-94.3%
7.13	0.91	0.03	-96.5%
7.15	0.91	0.02	-97.7%

WATERLINE AT ZERO
AREA ERROR = 6.900

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Creek
XS NUMBER: 2

Constant Manning's n

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

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.75	12.89	0.96	1.47	12.39	13.76	100.0%	0.90	12.29	0.99
	5.90	12.41	0.85	1.32	10.49	13.14	95.5%	0.80	9.60	0.92
	5.95	12.25	0.81	1.27	9.88	12.93	94.0%	0.76	8.77	0.89
	6.00	12.09	0.77	1.22	9.27	12.73	92.5%	0.73	7.98	0.86
	6.05	11.94	0.73	1.17	8.67	12.52	91.0%	0.69	7.21	0.83
	6.10	11.78	0.69	1.12	8.07	12.32	89.5%	0.66	6.48	0.80
	6.15	11.46	0.65	1.07	7.49	11.98	87.0%	0.63	5.83	0.78
	6.20	11.10	0.62	1.02	6.93	11.60	84.3%	0.60	5.22	0.75
	6.25	10.74	0.59	0.97	6.38	11.23	81.6%	0.57	4.66	0.73
	6.30	10.38	0.56	0.92	5.85	10.86	78.9%	0.54	4.12	0.70
	6.35	10.03	0.53	0.87	5.34	10.49	76.2%	0.51	3.63	0.68
	6.40	9.67	0.50	0.82	4.85	10.12	73.5%	0.48	3.16	0.65
	6.45	9.31	0.47	0.77	4.38	9.74	70.8%	0.45	2.73	0.62
	6.50	8.95	0.44	0.72	3.92	9.37	68.1%	0.42	2.33	0.59
	6.55	8.59	0.41	0.67	3.48	9.00	65.4%	0.39	1.97	0.56
	6.60	8.24	0.37	0.62	3.06	8.63	62.7%	0.35	1.63	0.53
	6.65	7.88	0.34	0.57	2.66	8.25	60.0%	0.32	1.33	0.50
	6.70	7.52	0.30	0.52	2.27	7.88	57.3%	0.29	1.06	0.46
	6.75	7.16	0.27	0.47	1.91	7.51	54.6%	0.25	0.81	0.43
	6.80	6.80	0.23	0.42	1.56	7.14	51.9%	0.22	0.60	0.39
	6.85	6.44	0.19	0.37	1.23	6.77	49.2%	0.18	0.42	0.34
WL	6.90	6.09	0.15	0.32	0.91	6.40	46.5%	0.14	0.26	0.29
	6.95	5.68	0.11	0.27	0.62	5.96	43.3%	0.10	0.14	0.23
	7.00	3.95	0.09	0.22	0.37	4.16	30.2%	0.09	0.08	0.21
	7.05	3.07	0.06	0.17	0.20	3.21	23.3%	0.06	0.03	0.17
	7.10	2.03	0.03	0.12	0.07	2.10	15.3%	0.03	0.01	0.11
	7.15	0.45	0.05	0.07	0.02	0.48	3.5%	0.04	0.00	0.13
	7.20	0.26	0.01	0.02	0.00	0.26	1.9%	0.01	0.00	0.06

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Creek
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.26	cfs
CALCULATED FLOW (Qc)=	0.26	cfs
(Qm-Qc)/Qm * 100 =	-0.1	%
MEASURED WATERLINE (WLm)=	6.90	ft
CALCULATED WATERLINE (WLc)=	6.90	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.32	ft
(Dm-Dc)/Dm * 100	-6.6	%
MEAN VELOCITY=	0.29	ft/sec
MANNING'S N=	0.165	
SLOPE=	0.014	ft/ft
.4 * Qm =	0.1	cfs
2.5 * Qm=	0.7	cfs

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

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

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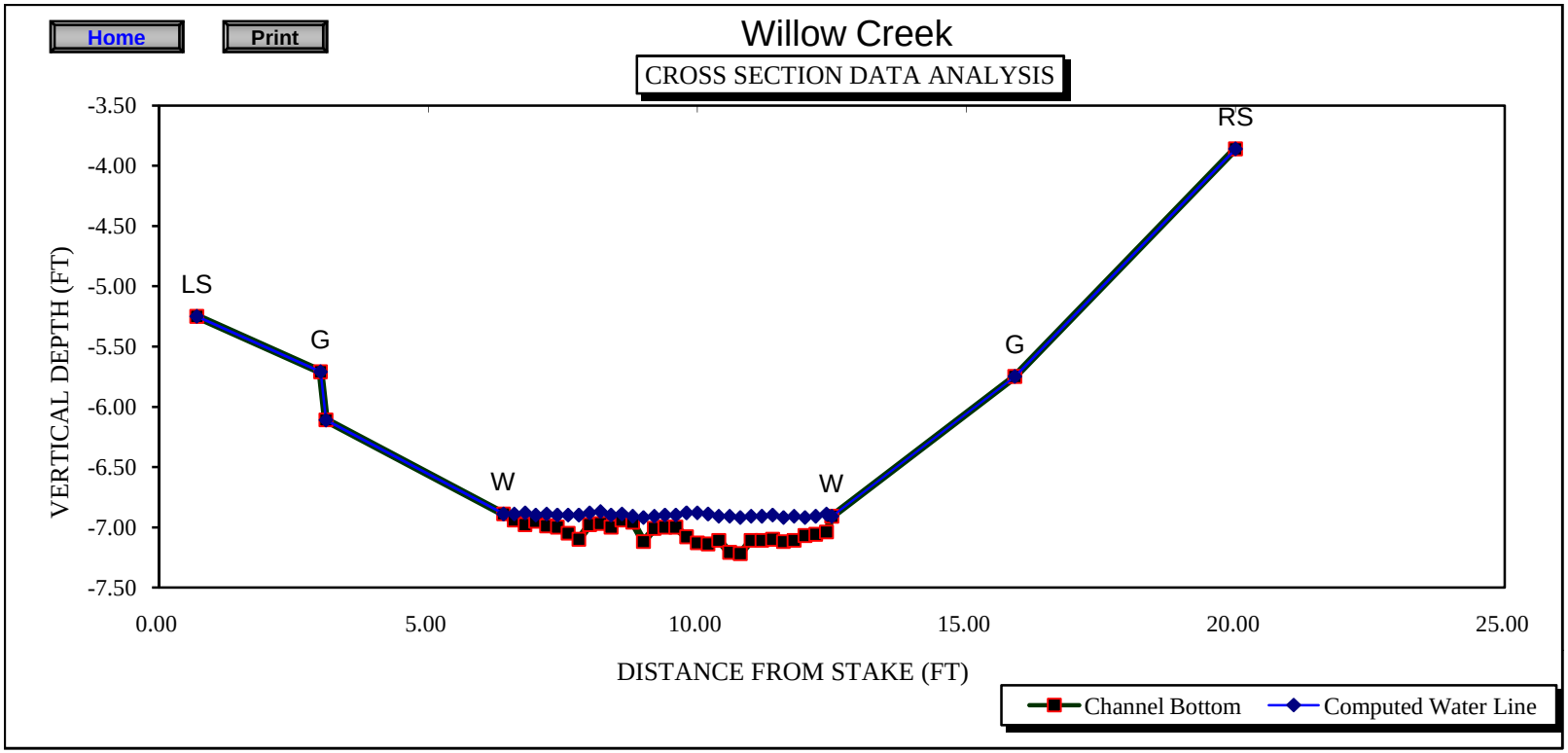
RECOMMENDATION BY: ……………………...………..……............................... AGENCY..………………………......……....…...……....... DATE:.......….…….......……………

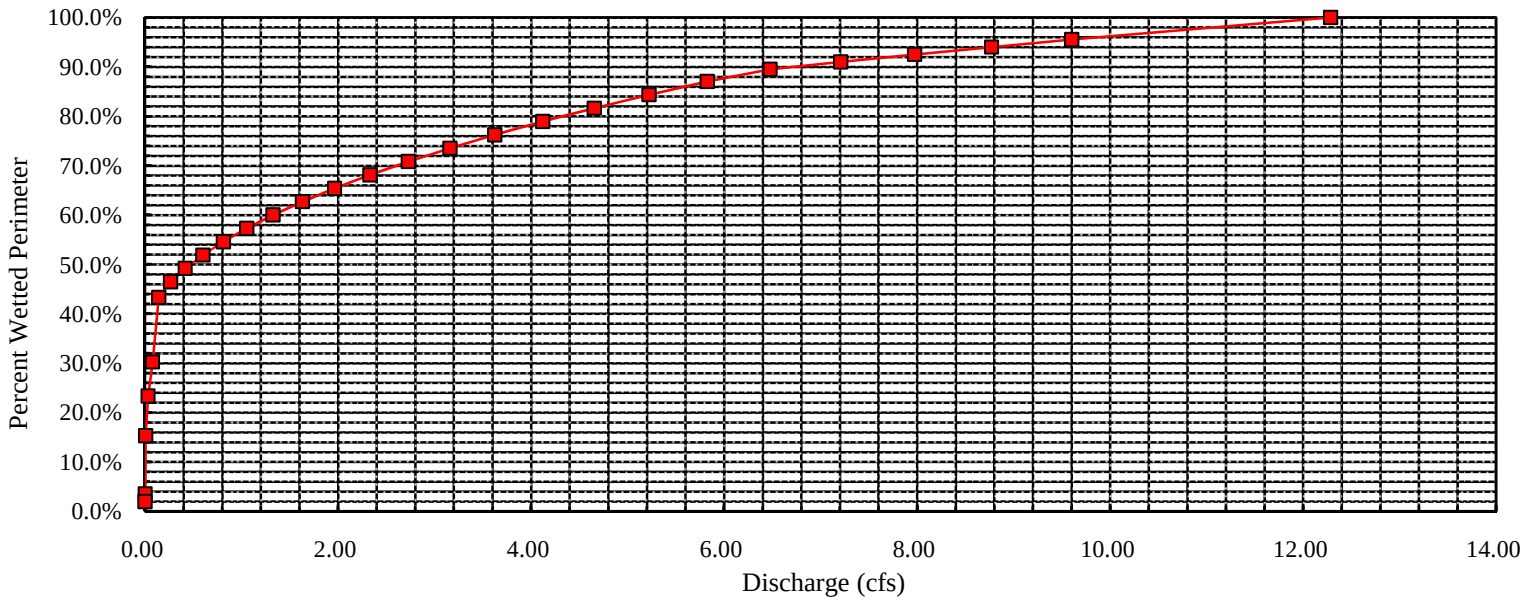
CWCB REVIEW BY: ..……………………………....……………………………………………………...…............. DATE:..................…………….....…



ChartMin	0	ChartMinY	-7.5
ChartMax	25	ChartMaxY	-3.5

Home Print

Percent Wetted Perimeter vs. Discharge



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

LOCATION INFORMATION

STREAM NAME:	Willow Creek
XS LOCATION:	Above Pole Gulch
XS NUMBER:	1
DATE:	4-Jun-07
OBSERVERS:	D. Murphy, A. Hayes
1/4 SEC:	SW
SECTION:	1
TWP:	48N
RANGE:	2W
PM:	NM
COUNTY:	Gunnison
WATERSHED:	Gunnison
DIVISION:	4
DOW CODE:	44040
USGS MAP:	Big Mesa 7.5
USFS MAP:	0

SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

SLOPE:	0.0086

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

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

STREAM NAME: Willow Creek
XS LOCATION: Above Pole Gulch
XS NUMBER: 1

DATA POINTS= 23

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	1.00	4.36			0.00		0.00	0.00	0.0%
1	G	2.80	4.66			0.00		0.00	0.00	0.0%
	W	6.00	5.28			0.00		0.00	0.00	0.0%
		6.20	5.53	0.25	0.00	0.32	0.25	0.05	0.00	0.0%
		6.40	5.57	0.30	0.13	0.20	0.30	0.06	0.01	1.6%
		6.60	5.46	0.20	0.74	0.23	0.20	0.04	0.03	6.0%
		6.80	5.46	0.20	0.46	0.20	0.20	0.04	0.02	3.7%
		7.00	5.47	0.20	0.67	0.20	0.20	0.04	0.03	5.4%
		7.20	5.45	0.20	0.59	0.20	0.20	0.04	0.02	4.8%
		7.40	5.47	0.20	0.49	0.20	0.20	0.04	0.02	4.0%
		7.60	5.46	0.20	0.47	0.20	0.20	0.04	0.02	3.8%
		7.80	5.46	0.20	0.51	0.20	0.20	0.04	0.02	4.1%
		8.00	5.48	0.20	0.41	0.20	0.20	0.04	0.02	3.3%
		8.20	5.53	0.25	1.05	0.21	0.25	0.05	0.05	10.6%
		8.40	5.54	0.25	1.21	0.20	0.25	0.05	0.06	12.2%
		8.60	5.54	0.25	1.16	0.20	0.25	0.05	0.06	11.7%
		8.80	5.54	0.25	0.74	0.20	0.25	0.05	0.04	7.5%
		9.00	5.56	0.25	1.05	0.20	0.25	0.05	0.05	10.6%
	W	9.20	5.53	0.25	1.05	0.20	0.25	0.05	0.05	10.6%
		9.40	5.27			0.33		0.00	0.00	0.0%
		13.00	5.12			0.00		0.00	0.00	0.0%
1	G	14.90	4.67			0.00		0.00	0.00	0.0%
	RS	15.60	4.22			0.00		0.00	0.00	0.0%
	TOTALS ----------					3.69	0.3 (Max.)	0.73	0.49	100.0%

Manning's n = 0.0690
Hydraulic Radius= 0.19764301

STREAM NAME: Willow Creek
XS LOCATION: Above Pole Gulch
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.73	0.73	0.0%
5.03	0.73	2.38	225.9%
5.05	0.73	2.21	202.2%
5.07	0.73	2.04	179.1%
5.09	0.73	1.87	156.5%
5.11	0.73	1.71	134.5%
5.13	0.73	1.55	112.9%
5.15	0.73	1.41	92.7%
5.17	0.73	1.27	74.0%
5.19	0.73	1.15	57.0%
5.21	0.73	1.03	41.5%
5.23	0.73	0.93	27.7%
5.24	0.73	0.89	21.4%
5.25	0.73	0.84	15.4%
5.26	0.73	0.80	9.9%
5.27	0.73	0.76	4.8%
5.28	0.73	0.73	0.0%
5.29	0.73	0.70	-4.6%
5.30	0.73	0.66	-9.3%
5.31	0.73	0.63	-13.9%
5.32	0.73	0.60	-18.5%
5.33	0.73	0.56	-23.0%
5.35	0.73	0.50	-32.1%
5.37	0.73	0.43	-41.0%
5.39	0.73	0.37	-49.9%
5.41	0.73	0.30	-58.7%
5.43	0.73	0.24	-67.4%
5.45	0.73	0.17	-76.1%
5.47	0.73	0.12	-83.9%
5.49	0.73	0.08	-88.7%
5.51	0.73	0.05	-92.9%
5.53	0.73	0.02	-96.7%

WATERLINE AT ZERO
AREA ERROR = 5.275

STREAM NAME: Willow Creek
XS LOCATION: Above Pole Gulch
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	4.67	12.05	0.50	0.90	6.06	12.46	100.0%	0.49	7.49	1.24
	4.68	12.00	0.50	0.89	6.00	12.41	99.6%	0.48	7.39	1.23
	4.73	11.53	0.47	0.84	5.42	11.93	95.8%	0.45	6.39	1.18
	4.78	11.06	0.44	0.79	4.85	11.45	91.9%	0.42	5.46	1.13
	4.83	10.59	0.41	0.74	4.31	10.97	88.1%	0.39	4.61	1.07
	4.88	10.12	0.37	0.69	3.79	10.49	84.2%	0.36	3.84	1.01
	4.93	9.66	0.34	0.64	3.30	10.01	80.4%	0.33	3.14	0.95
	4.98	9.19	0.31	0.59	2.83	9.53	76.5%	0.30	2.51	0.89
	5.03	8.72	0.27	0.54	2.38	9.05	72.6%	0.26	1.95	0.82
	5.08	8.25	0.24	0.49	1.95	8.57	68.8%	0.23	1.46	0.75
	5.13	7.68	0.20	0.44	1.55	7.99	64.2%	0.19	1.04	0.67
	5.18	6.22	0.19	0.39	1.21	6.53	52.4%	0.18	0.78	0.65
	5.23	4.76	0.20	0.34	0.93	5.06	40.6%	0.18	0.60	0.65
WL	5.28	3.42	0.21	0.29	0.73	3.71	29.8%	0.20	0.49	0.67
	5.33	3.32	0.17	0.24	0.56	3.57	28.6%	0.16	0.33	0.58
	5.38	3.24	0.12	0.19	0.40	3.44	27.6%	0.12	0.19	0.47
	5.43	3.16	0.08	0.14	0.24	3.31	26.6%	0.07	0.08	0.34
	5.48	1.71	0.06	0.09	0.10	1.80	14.5%	0.05	0.03	0.29
	5.53	1.31	0.02	0.04	0.02	1.33	10.7%	0.02	0.00	0.14

STREAM NAME: Willow Creek
XS LOCATION: Above Pole Gulch
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.49	cfs
CALCULATED FLOW (Qc)=	0.49	cfs
(Qm-Qc)/Qm * 100 =	0.4	%
MEASURED WATERLINE (WLm)=	5.28	ft
CALCULATED WATERLINE (WLc)=	5.28	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.29	ft
(Dm-Dc)/Dm * 100	1.7	%
MEAN VELOCITY=	0.67	ft/sec
MANNING'S N=	0.069	
SLOPE=	0.0086	ft/ft
.4 * Qm =	0.2	cfs
2.5 * Qm=	1.2	cfs

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

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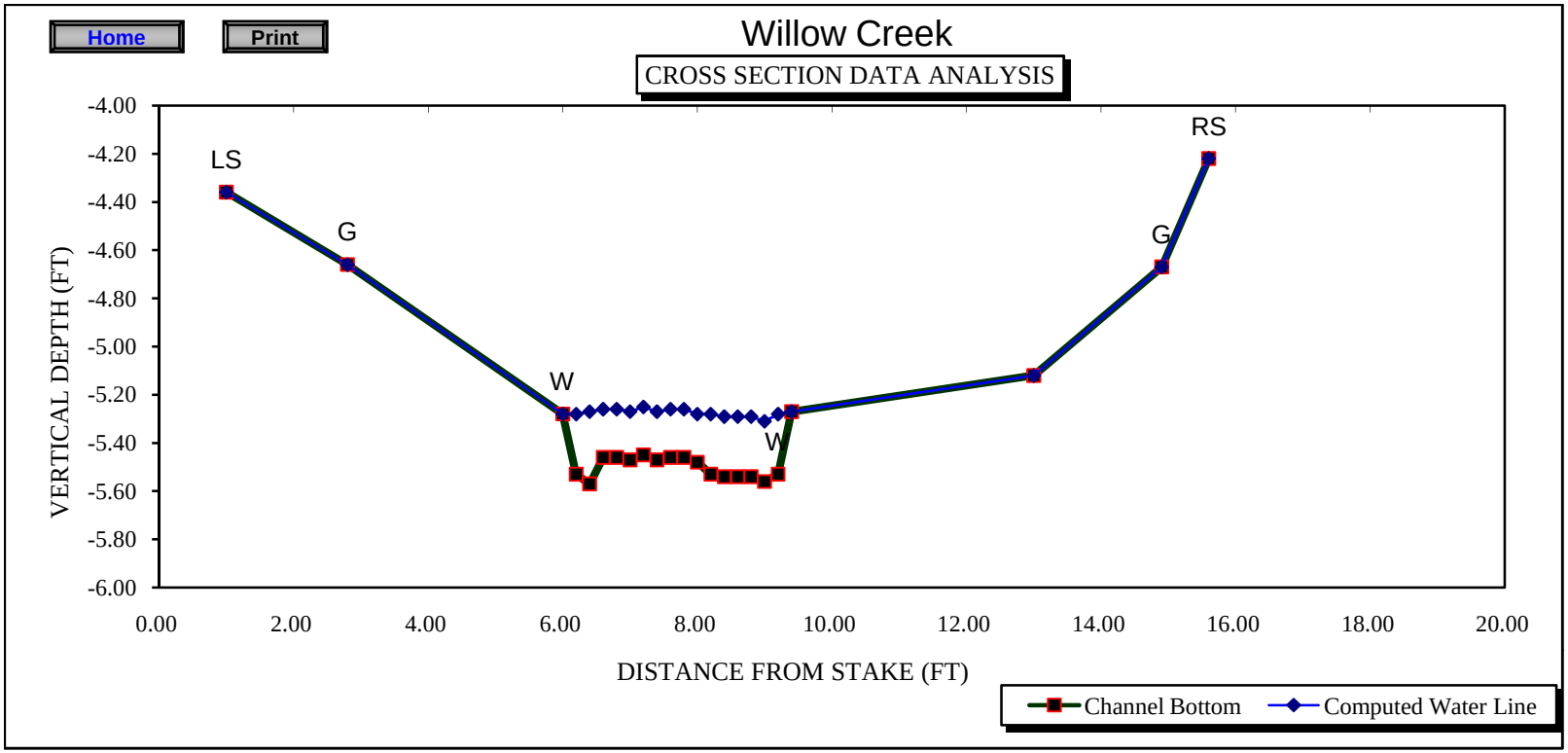
RECOMMENDATION BY: ……………………...……….……................................ AGENCY...………………………......……....…....……...... DATE:......…...…......……………

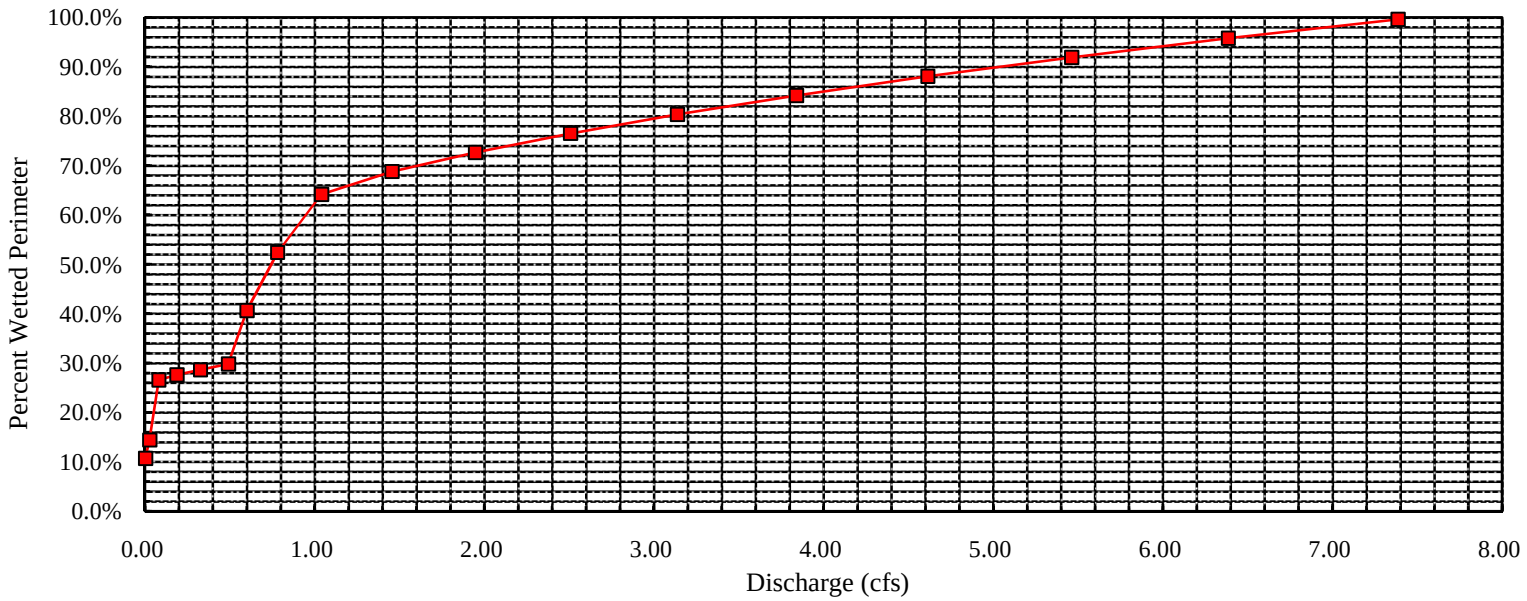
CWCB REVIEW BY: ...……………………………....……………………………………………………..…............... DATE:.................……………...…



ChartMin	0	ChartMinY	-6
ChartMax	20	ChartMaxY	-4

Home Print

Percent Wetted Perimeter vs. Discharge



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

LOCATION INFORMATION

STREAM NAME:	Willow Creek near Blue Mesa Res.
XS LOCATION:	0.8 mile upstream from Blue Mesa
XS NUMBER:	1
DATE:	4-Jun-08
OBSERVERS:	R. Smith, A. Hayes
1/4 SEC:	NW SE
SECTION:	34
TWP:	49N
RANGE:	2W
PM:	NM
COUNTY:	Gunnison
WATERSHED:	Gunnison
DIVISION:	4
DOW CODE:	44040
USGS MAP:	Big Mesa 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:	0.034

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

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

STREAM NAME: Willow Creek near Blue Mesa Res.
XS LOCATION: 0.8 mile upstream from Blue Mesa
XS NUMBER: 1

DATA POINTS= 24

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	0.00	5.90			0.00		0.00	0.00	0.0%
1	G	2.00	6.14			0.00		0.00	0.00	0.0%
	W	5.00	6.68			0.00		0.00	0.00	0.0%
		6.00	6.90	0.25	0.65	1.02	0.25	0.25	0.16	3.2%
		7.00	6.75	0.10	1.30	1.01	0.10	0.10	0.13	2.6%
		8.00	7.05	0.30	1.07	1.04	0.30	0.30	0.32	6.3%
		9.00	7.05	0.30	0.99	1.00	0.30	0.30	0.30	5.8%
		10.00	7.15	0.40	1.73	1.00	0.40	0.30	0.52	10.2%
		10.50	7.05	0.30	0.76	0.51	0.30	0.15	0.11	2.2%
		11.00	7.05	0.30	1.76	0.50	0.30	0.15	0.26	5.2%
		11.50	7.25	0.60	2.61	0.54	0.60	0.30	0.78	15.4%
		12.00	7.05	0.30	2.12	0.54	0.30	0.15	0.32	6.2%
		12.50	7.05	0.30	1.46	0.50	0.30	0.15	0.22	4.3%
		13.00	7.05	0.30	1.44	0.50	0.30	0.15	0.22	4.2%
		13.50	6.85	0.20	1.58	0.54	0.20	0.10	0.16	3.1%
		14.00	7.05	0.30	1.76	0.54	0.30	0.15	0.26	5.2%
		14.50	7.15	0.40	2.26	0.51	0.40	0.20	0.45	8.9%
		15.00	7.15	0.40	1.86	0.50	0.40	0.20	0.37	7.3%
		15.50	7.00	0.25	1.19	0.52	0.25	0.13	0.15	2.9%
		16.00	7.05	0.30	2.24	0.50	0.30	0.15	0.34	6.6%
		16.50	6.75	0.10	0.28	0.58	0.10	0.05	0.01	0.3%
	W	17.00	6.64			0.51		0.00	0.00	0.0%
1	G	18.00	6.12			0.00		0.00	0.00	0.0%
	LS	19.40	5.52			0.00		0.00	0.00	0.0%
	TOTALS ----------					12.38	0.6 (Max.)	3.28	5.09	100.0%

Manning's n = 0.0727
Hydraulic Radius= 0.26459192

STREAM NAME: Willow Creek near Blue Mesa Res.
XS LOCATION: 0.8 mile upstream from Blue Mesa
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	3.28	3.94	20.4%
6.41	3.28	7.20	119.7%
6.43	3.28	6.92	111.3%
6.45	3.28	6.64	102.9%
6.47	3.28	6.37	94.6%
6.49	3.28	6.10	86.4%
6.51	3.28	5.84	78.3%
6.53	3.28	5.58	70.3%
6.55	3.28	5.32	62.4%
6.57	3.28	5.06	54.5%
6.59	3.28	4.81	46.8%
6.61	3.28	4.56	39.1%
6.62	3.28	4.43	35.4%
6.63	3.28	4.31	31.6%
6.64	3.28	4.19	27.8%
6.65	3.28	4.07	24.1%
6.66	3.28	3.94	20.4%
6.67	3.28	3.82	16.8%
6.68	3.28	3.71	13.2%
6.69	3.28	3.59	9.6%
6.70	3.28	3.47	6.0%
6.71	3.28	3.36	2.5%
6.73	3.28	3.13	-4.5%
6.75	3.28	2.90	-11.4%
6.77	3.28	2.68	-18.1%
6.79	3.28	2.47	-24.7%
6.81	3.28	2.26	-31.0%
6.83	3.28	2.06	-37.1%
6.85	3.28	1.86	-43.1%
6.87	3.28	1.68	-48.8%
6.89	3.28	1.50	-54.2%
6.91	3.28	1.33	-59.5%

WATERLINE AT ZERO
AREA ERROR = 6.717

STREAM NAME: Willow Creek near Blue Mesa Res.
XS LOCATION: 0.8 mile upstream from Blue Mesa
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	6.14	15.96	0.70	1.11	11.23	16.51	100.0%	0.68	32.76	2.92
	6.17	15.76	0.69	1.08	10.80	16.30	98.7%	0.66	30.96	2.87
	6.22	15.39	0.65	1.03	10.03	15.91	96.4%	0.63	27.78	2.77
	6.27	15.01	0.62	0.98	9.27	15.52	94.0%	0.60	24.77	2.67
	6.32	14.64	0.58	0.93	8.52	15.13	91.6%	0.56	21.92	2.57
	6.37	14.26	0.55	0.88	7.80	14.74	89.3%	0.53	19.25	2.47
	6.42	13.89	0.51	0.83	7.10	14.35	86.9%	0.49	16.74	2.36
	6.47	13.52	0.47	0.78	6.41	13.95	84.5%	0.46	14.40	2.24
	6.52	13.14	0.44	0.73	5.75	13.56	82.2%	0.42	12.22	2.13
	6.57	12.77	0.40	0.68	5.10	13.17	79.8%	0.39	10.21	2.00
	6.62	12.39	0.36	0.63	4.47	12.78	77.4%	0.35	8.36	1.87
	6.67	11.95	0.32	0.58	3.86	12.32	74.7%	0.31	6.71	1.74
WL	6.72	11.48	0.29	0.53	3.27	11.85	71.8%	0.28	5.24	1.60
	6.77	10.91	0.25	0.48	2.71	11.25	68.2%	0.24	3.96	1.46
	6.82	10.09	0.22	0.43	2.19	10.41	63.1%	0.21	2.92	1.33
	6.87	9.20	0.19	0.38	1.70	9.48	57.4%	0.18	2.05	1.20
	6.92	8.33	0.15	0.33	1.27	8.56	51.9%	0.15	1.34	1.06
	6.97	7.83	0.11	0.28	0.87	8.02	48.6%	0.11	0.74	0.85
	7.02	7.10	0.07	0.23	0.49	7.25	43.9%	0.07	0.30	0.62
	7.07	3.35	0.06	0.18	0.21	3.45	20.9%	0.06	0.12	0.57
	7.12	1.93	0.04	0.13	0.07	2.00	12.1%	0.04	0.03	0.42
	7.17	0.41	0.04	0.08	0.02	0.45	2.7%	0.04	0.01	0.43
	7.22	0.16	0.02	0.03	0.00	0.18	1.1%	0.02	0.00	0.23

STREAM NAME: Willow Creek near Blue Mesa Res.
XS LOCATION: 0.8 mile upstream from Blue Mesa
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	5.09	cfs
CALCULATED FLOW (Qc)=	5.24	cfs
(Qm-Qc)/Qm * 100 =	-2.9	%
MEASURED WATERLINE (WLm)=	6.66	ft
CALCULATED WATERLINE (WLc)=	6.72	ft
(WLm-WLc)/WLm * 100 =	-0.9	%
MAX MEASURED DEPTH (Dm)=	0.60	ft
MAX CALCULATED DEPTH (Dc)=	0.53	ft
(Dm-Dc)/Dm * 100	11.2	%
MEAN VELOCITY=	1.60	ft/sec
MANNING'S N=	0.073	
SLOPE=	0.034	ft/ft
.4 * Qm =	2.0	cfs
2.5 * Qm=	12.7	cfs

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

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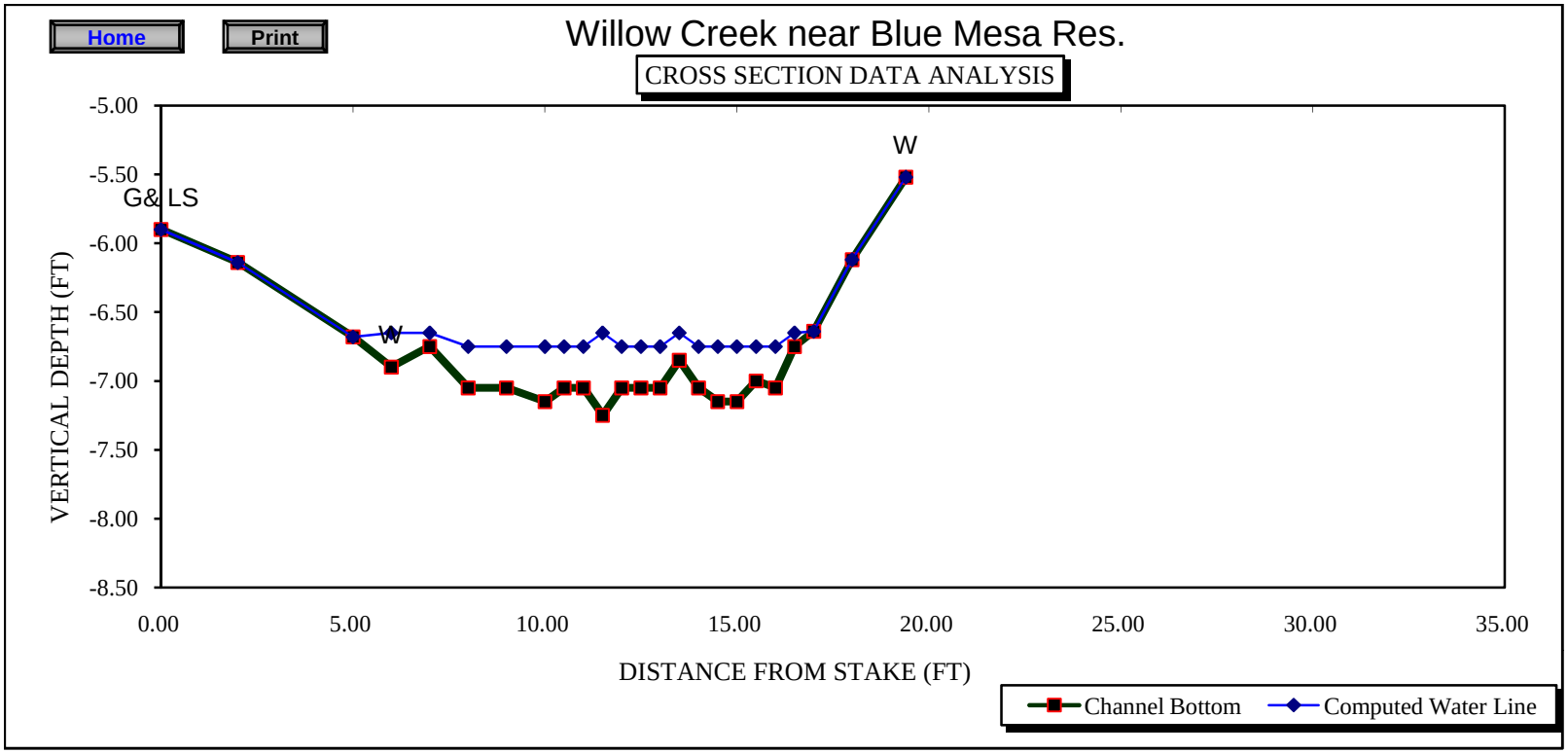
RECOMMENDATION BY: ……………………..………..……................................ AGENCY...…………………….......….......…...…....... DATE:.......…....….......……………

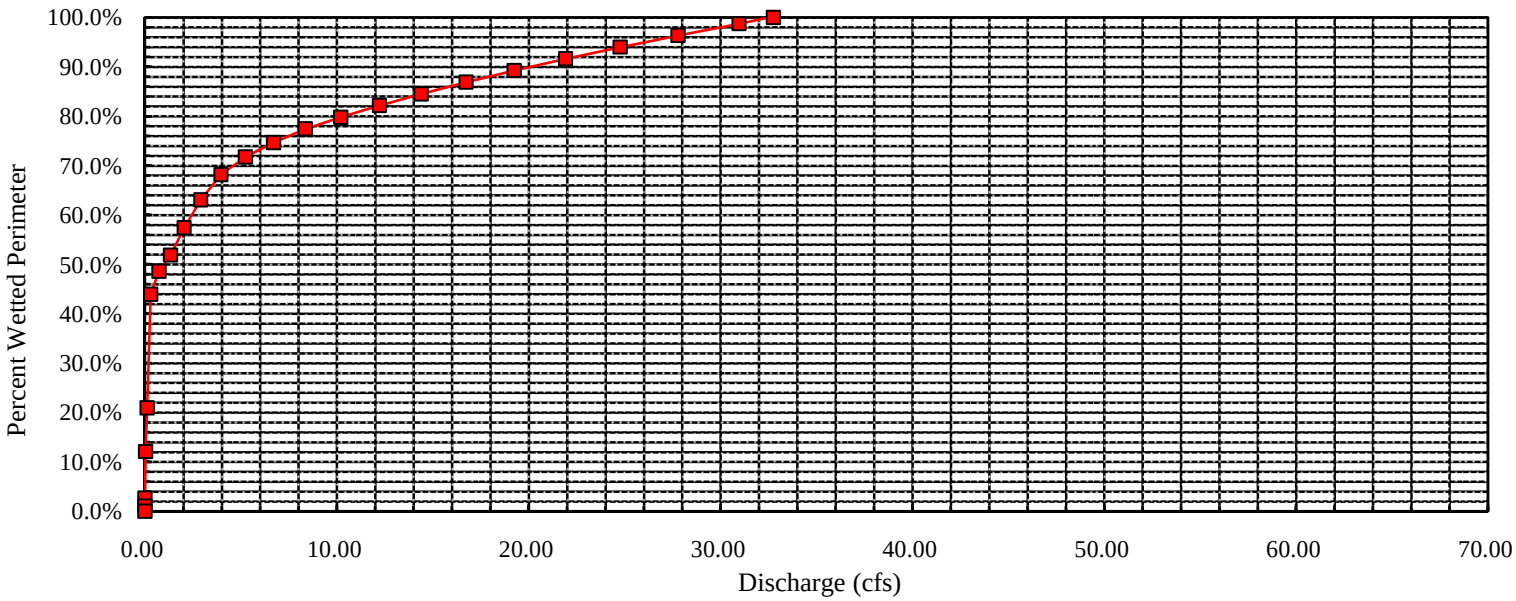
CWCB REVIEW BY: ..…………………………....……………………………………………………...…............. DATE:..................….………….....



ChartMin	0	ChartMinY	-7.5
ChartMax	20	ChartMaxY	-5.5

Home Print

Percent Wetted Perimeter vs. Discharge



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

LOCATION INFORMATION

STREAM NAME:	Willow Creek
XS LOCATION:	Below Pole Gulch
XS NUMBER:	3
DATE:	4-Jun-07
OBSERVERS:	D. Murphy, A. Hayes
1/4 SEC:	SE
SECTION:	34
TWP:	49N
RANGE:	2W
PM:	NM
COUNTY:	Gunnison
WATERSHED:	Gunnison
DIVISION:	4
DOW CODE:	44040
USGS MAP:	Big Mesa 7.5'
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:	0.0043

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

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

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Gulch
XS NUMBER: 3

DATA POINTS= 33

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
LS	1.00	5.10			0.00		0.00	0.00	0.0%
	2.90	5.76			0.00		0.00	0.00	0.0%
1 G	4.00	5.97			0.00		0.00	0.00	0.0%
W	6.90	6.91			0.00		0.00	0.00	0.0%
	7.20	7.00	0.10	0.00	0.31	0.10	0.03	0.00	0.0%
	7.40	7.00	0.10	0.00	0.20	0.10	0.02	0.00	0.0%
	7.60	7.08	0.20	0.00	0.22	0.20	0.04	0.00	0.0%
	7.80	7.04	0.15	0.07	0.20	0.15	0.03	0.00	0.6%
	8.00	7.04	0.15	0.24	0.20	0.15	0.03	0.01	1.9%
	8.20	7.05	0.15	0.29	0.20	0.15	0.03	0.01	2.3%
	8.40	7.06	0.15	0.57	0.20	0.15	0.03	0.02	4.5%
	8.60	7.15	0.25	0.84	0.22	0.25	0.05	0.04	11.1%
	8.80	7.10	0.20	0.91	0.21	0.20	0.04	0.04	9.6%
	9.00	7.22	0.30	0.61	0.23	0.30	0.06	0.04	9.7%
	9.20	7.29	0.40	0.66	0.21	0.40	0.08	0.05	14.0%
	9.40	7.30	0.40	0.70	0.20	0.40	0.08	0.06	14.8%
	9.60	7.33	0.45	0.44	0.20	0.45	0.09	0.04	10.5%
	9.80	7.26	0.35	0.43	0.21	0.35	0.07	0.03	8.0%
	10.00	7.26	0.35	0.33	0.20	0.35	0.07	0.02	6.1%
	10.20	7.25	0.35	0.22	0.20	0.35	0.07	0.02	4.1%
	10.40	7.24	0.35	0.08	0.20	0.35	0.07	0.01	1.5%
	10.60	7.18	0.30	0.06	0.21	0.30	0.06	0.00	1.0%
	10.80	7.20	0.30	0.02	0.20	0.30	0.06	0.00	0.3%
	11.00	7.21	0.30	0.01	0.20	0.30	0.06	0.00	0.2%
	11.20	7.14	0.25	0.00	0.21	0.25	0.08	0.00	0.0%
	11.60	6.99	0.10	0.00	0.43	0.10	0.04	0.00	0.0%
	12.00	6.98	0.10	0.00	0.40	0.10	0.04	0.00	0.0%
	12.40	6.90	0.10	0.00	0.41	0.10	0.04	0.00	0.0%
	12.80	7.01	0.10	0.00	0.41	0.10	0.03	0.00	0.0%
W	12.90	6.90			0.15		0.00	0.00	0.0%
1 G	14.20	5.98			0.00		0.00	0.00	0.0%
	15.00	4.40			0.00		0.00	0.00	0.0%
RS	16.50	4.02			0.00		0.00	0.00	0.0%
TOTALS ----------					6.24	0.45 (Max.)	1.29	0.38	100.0%

Manning's n = 0.1155
Hydraulic Radius= 0.20595349

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Gulch
XS NUMBER: 3

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.29	1.20	-6.9%
6.66	1.29	2.84	120.9%
6.68	1.29	2.70	109.9%
6.70	1.29	2.56	99.0%
6.72	1.29	2.42	88.2%
6.74	1.29	2.28	77.6%
6.76	1.29	2.15	67.2%
6.78	1.29	2.02	56.8%
6.80	1.29	1.88	46.6%
6.82	1.29	1.76	36.6%
6.84	1.29	1.63	26.7%
6.86	1.29	1.50	16.9%
6.87	1.29	1.44	12.1%
6.88	1.29	1.38	7.3%
6.89	1.29	1.32	2.5%
6.90	1.29	1.26	-2.2%
6.91	1.29	1.20	-6.9%
6.92	1.29	1.14	-11.5%
6.93	1.29	1.08	-16.0%
6.94	1.29	1.02	-20.4%
6.95	1.29	0.97	-24.7%
6.96	1.29	0.91	-28.9%
6.98	1.29	0.81	-37.0%
7.00	1.29	0.71	-44.4%
7.02	1.29	0.63	-51.0%
7.04	1.29	0.55	-57.3%
7.06	1.29	0.48	-62.9%
7.08	1.29	0.41	-67.8%
7.10	1.29	0.36	-72.3%
7.12	1.29	0.30	-76.6%
7.14	1.29	0.25	-80.6%
7.16	1.29	0.20	-84.2%

WATERLINE AT ZERO
AREA ERROR = 6.890

STREAM NAME: Willow Creek
XS LOCATION: Below Pole Gulch
XS NUMBER: 3

Constant Manning's n

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

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.98	10.17	0.85	1.35	8.68	10.85	100.0%	0.80	6.31	0.73
	5.99	10.12	0.85	1.34	8.57	10.80	99.5%	0.79	6.20	0.72
	6.04	9.90	0.82	1.29	8.07	10.55	97.2%	0.77	5.70	0.71
	6.09	9.67	0.78	1.24	7.58	10.30	94.9%	0.74	5.22	0.69
	6.14	9.45	0.75	1.19	7.11	10.05	92.7%	0.71	4.76	0.67
	6.19	9.22	0.72	1.14	6.64	9.80	90.4%	0.68	4.32	0.65
	6.24	9.00	0.69	1.09	6.18	9.55	88.1%	0.65	3.90	0.63
	6.29	8.77	0.65	1.04	5.74	9.30	85.8%	0.62	3.51	0.61
	6.34	8.55	0.62	0.99	5.31	9.06	83.5%	0.59	3.14	0.59
	6.39	8.32	0.59	0.94	4.88	8.81	81.2%	0.55	2.78	0.57
	6.44	8.10	0.55	0.89	4.47	8.56	78.9%	0.52	2.45	0.55
	6.49	7.87	0.52	0.84	4.07	8.31	76.6%	0.49	2.14	0.52
	6.54	7.65	0.48	0.79	3.69	8.06	74.3%	0.46	1.85	0.50
	6.59	7.42	0.45	0.74	3.31	7.81	72.0%	0.42	1.58	0.48
	6.64	7.20	0.41	0.69	2.94	7.56	69.7%	0.39	1.32	0.45
	6.69	6.97	0.37	0.64	2.59	7.31	67.4%	0.35	1.09	0.42
	6.74	6.75	0.33	0.59	2.25	7.07	65.1%	0.32	0.88	0.39
	6.79	6.52	0.29	0.54	1.91	6.82	62.8%	0.28	0.69	0.36
	6.84	6.30	0.25	0.49	1.59	6.57	60.6%	0.24	0.52	0.33
WL	6.89	6.07	0.21	0.44	1.28	6.32	58.3%	0.20	0.37	0.29
	6.94	5.51	0.18	0.39	0.99	5.72	52.7%	0.17	0.26	0.26
	6.99	4.52	0.16	0.34	0.74	4.69	43.2%	0.16	0.18	0.25
	7.04	3.76	0.14	0.29	0.53	3.90	35.9%	0.14	0.12	0.22
	7.09	2.87	0.13	0.24	0.37	2.98	27.4%	0.12	0.08	0.21
	7.14	2.39	0.10	0.19	0.24	2.47	22.7%	0.10	0.04	0.18
	7.19	1.97	0.06	0.14	0.13	2.02	18.6%	0.06	0.02	0.13
	7.24	1.34	0.04	0.09	0.05	1.36	12.5%	0.04	0.00	0.09
	7.29	0.51	0.02	0.04	0.01	0.52	4.8%	0.02	0.00	0.05

STREAM NAME:	Willow Creek
XS LOCATION:	Below Pole Gulch
XS NUMBER:	3

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.38	cfs
CALCULATED FLOW (Qc)=	0.37	cfs
(Qm-Qc)/Qm * 100 =	0.9	%
MEASURED WATERLINE (WLm)=	6.91	ft
CALCULATED WATERLINE (WLc)=	6.89	ft
(WLm-WLc)/WLm * 100 =	0.2	%
MAX MEASURED DEPTH (Dm)=	0.45	ft
MAX CALCULATED DEPTH (Dc)=	0.44	ft
(Dm-Dc)/Dm * 100	2.3	%
MEAN VELOCITY=	0.29	ft/sec
MANNING'S N=	0.115	
SLOPE=	0.0043	ft/ft
.4 * Qm =	0.2	cfs
2.5 * Qm=	0.9	cfs

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

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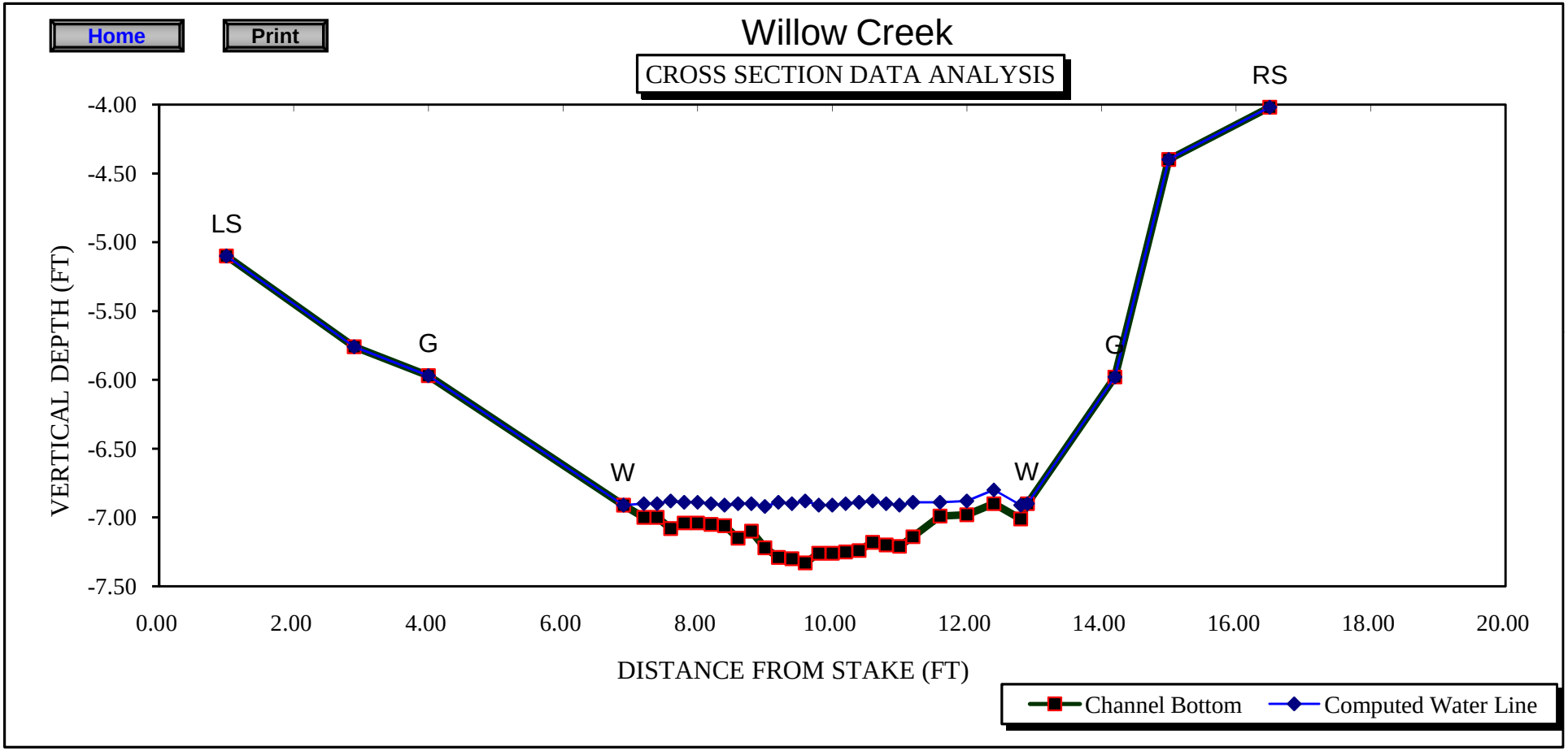
RECOMMENDATION BY: ……………………...………..……............................... AGENCY...………………………......……...…...……...... DATE:......…...…......……………

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


Home
Print
Willow Creek
CROSS SECTION DATA ANALYSIS
RS
LS
G
G
W
W
-4.00
-4.50
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
VERTICAL DEPTH (FT)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line

Home Print

Percent Wetted Perimeter vs. Discharge