January 13, 2016

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

Dear Ms. Bassi and Mr. Baessler,

High Country Conservation Advocates (HCCA), in conjunction with American Rivers (AR), is submitting this instream flow recommendation for Brush Creek, located in Gunnison County, Water Division 4.

HCCA's mission is to protect the health and natural beauty of the land, rivers, and wildlife in and around Gunnison County. Many of our members live and work here and enjoy recreational opportunities and a quality of life that is preserved by our valley's wildlife, habitat, and water resources. HCCA's over 24-year-old water program has a long history of protecting water resources in the Upper Gunnison Basin, negotiating federal water rights for the Black Canyon of the Gunnison National Park, working with local partners on water projects, and developing an environmental voice within key regional and state forums. HCCA has partnered with the Bureau of Land Management to support instream flow proposals on the Slate River and Oh-Be-Joyful Creek.

AR is America's largest river conservation organization. AR was founded in 1973 with a mission to protect wild rivers, restore damaged rivers, and to conserve clean water for people and nature. AR accomplishes this work through collaborative partnerships with many diverse organizations and individuals and has an innate ability to transform conflict into successful solutions that benefit rivers and the various uses that depend on those rivers.

The headwaters of Brush Creek originate in and adjacent to the Maroon Bells-Snowmass Wilderness area. Brush Creek forms at the confluence of East Brush Creek and Middle Brush Creek, both popular locations for local fly-fishing companies to take customers on guided fly-fishing excursions. Brush Creek hosts an important recreational fishery and a healthy riverine ecosystem. Brush Creek, East Brush Creek, and Middle Brush Creek also offer numerous recreational opportunities, including beautiful waterfalls that are easily accessible from hiking and single-track trails.[1]

[1] http://www.gunnisoncounty.org/DocumentCenter/View/3038

HCCA and AR recommend that Brush Creek be considered for further inclusion in the instream flow program. The adjustments described below would bring the existing Brush Creek decree up to today's standards to more fully "preserve the natural environment to reasonable degree."

Attached you will find copies of data sheets from Colorado Parks and Wildlife reporting on the Brush Creek aquatic environment. We have attached R2CROSS modeling runs, stream photos, and maps of the relevant reach. If you have any further questions regarding this recommendation, please feel free to contact Julie Nania at (509) 999-0012 or Ken Neubecker at (970) 230-9300.

HCCA and AR thank SGM, Inc., Greg Espegren, and the Colorado Water Conservation Board for their support in developing this recommendation.

Sincerely,

Julie Nania
High Country Conservation Advocates
Water Director

High Country Conservation Advocates

Protecting why you love it here since 1977

Ken Neubecker
American Rivers
Associate Director, Colorado River Basin Program

American Rivers
Rivers Connect Us

Enclosure

**ENCLOSURE**

Below is a description of the proposed instream flow. Additional details can be found in attachments A-G:

A – Location Map
B – Existing Brush Creek ISF Right Summary
C – Water Availability Summary
D – Middle Brush Creek Water Right Summary
E – CPW Biological Summary
F – R2CROSS Analysis Summary
G – Pearl Pass USGS Topographic Quadrangle Map
H – Gothic USGS Topographic Quadrangle Map

**Location**

Brush Creek is located within the East –Taylor Watershed. The upper terminus of the proposed instream flow appropriation is the confluence of East Brush Creek and Middle Brush Creek and the lower terminus is the confluence of Brush Creek and West Brush Creek (Attachment A). The exact location on Brush Creek can be seen on the attached map and on the USGS Pearl Pass and Gothic topographic quadrangle maps (Attachments G & H).

**Land Status**

<table>
<tr><th rowspan="2">Upper Terminus</th><th rowspan="2">Lower Terminus</th><th rowspan="2">Total Length (miles)</th><th colspan="2">Land Ownership</th></tr>
<tr><th>Private (%)</th><th>Public (%)</th></tr>
<tr><td rowspan="2">Confluence of M & E Brush Creeks at latitude 38° 54’ 44”N, longitude 106° 51’ 10”W</td><td rowspan="2">Confluence West Brush Creek at latitude 38° 54’ 01”N, longitude 106° 52’ 50”W</td><td rowspan="2">2.1 miles</td><td>Riparian Corridor<br><br>0%</td><td>Riparian Corridor<br><br>100% (USFS)</td></tr>
<tr><td>Watershed Composition<br><br>0.6%</td><td>Watershed Composition<br><br>99.4%</td></tr>
</table>

The stream reach covers a distance of approximately 2.1 miles. The riparian corridor consists of lands all managed by the United States Forest Service (USFS). Within the watershed, the land composition is 0.6% private and 99.4% public lands managed by the USFS.

**Existing Instream Flow Right**

There is an existing instream flow right on Brush Creek of 5 cfs (10/1 – 4/30) and 8 cfs (5/1 - 9/30) with an appropriation date of 6/3/1982 (4-83CW236). The ISF segment length is 2.1 miles, reaching from the confluence of Middle and East Brush Creeks at latitude 38° 54' 44"N, longitude 106° 51' 10"W, to the confluence of Brush Creek with West Brush Creek at latitude 38° 54' 01"N, longitude 106° 52' 50"W (Attachment B).

**Water Availability**

Since there are no stream flow records for Brush Creek, a regression equation program StreamStats was used to approximate the average monthly flows. StreamStats uses a regionally specific regression equation based on nearby active and historical stream gages and watershed basin characteristics. The average monthly flows resulting from the StreamStats calculation show sufficient flows to meet the requested tiered instream flows (Attachment C).

There are no known diversions on the proposed instream flow reach. There is one conditional diversion right upstream on Middle Brush Creek for 2 cfs with an appropriation date of 06/15/1999 (99CW0112) (Attachment D). Middle Brush Creek has an established instream flow of 8 cfs. East Brush Creek has an instream flow quantified at 5 cfs. When combined, the sum of these existing flows alone would provide for 13 cfs year-round at the confluence of Middle and East Brush Creeks. There are also significant senior water rights located downstream that will help to call water down past the lower terminus of the proposed instream flow.

**Biological Summary**

According to Colorado Parks and Wildlife (CPW) data, Brush Creek and its tributaries contains breeding populations of Colorado cutthroat trout. Please see the attached CPW spreadsheet containing this information (Attachment E).

**R2CROSS Analysis**

HCCA and AR have relied upon the expertise of consultant Greg Espegren and SGM, Inc. to collect flow data and interpret output from the R2CROSS methodology in order to develop an instream flow recommendation that will reasonably protect the natural environment of Brush Creek.

Our analysis of the data collected indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree (Attachment F):

An instream flow of 15.86 cubic feet per second (cfs) is recommended between April 15th and October 15th. This flow rate would protect all three of the CWCB's R2CROSS hydrologic criteria (Average Velocity, Average Depth, and Wetted Perimeter). Protection of a higher flow rate will help scour fine sediments from important spawning areas, provide opportunities for upstream and downstream fish passage, and promote aquatic macroinvertebrate and fish productivity during the summer months. Please see the table below for the required increases to meet this recommended flow.

HCCA recommends an instream flow water right of 8.31 cfs for the winter period between October 16st and December 31st. R2CROSS results indicate that a flow of 8.31 cfs would satisfy 2 of the CWCB's R2CROSS hydrologic criteria (Wetted Perimeter and Average Velocity). Please see the table below for the required increases to meet this recommended flow.

A preliminary analysis of water availability suggests that only 7.17 cfs is physically available between January 1st and April 14th. Therefore, HCCA recommends an instream flow water right of 7.17 cfs for the winter period between January 1st and April 14th (Attachment F). A flow rate of 7.17 cfs would continue to satisfy the Wetted Perimeter criteria and would result in only a small decrease in Average Velocity from 1 ft/sec to 0.96 ft/sec. Please see the table below for the required increases to meet this recommended flow.

**Table 1. R2CROSS instream flow recommendations and necessary increases.**

| Recommended flow | Current instream flow | Required Increase (on top of existing right) |
|---|---|---|
| April 15th- October 15th<br>15.86 cfs | April 15th-May 1st<br>5 cfs<br><br>May 1st- Sept. 30th<br>8 cfs<br><br>October 2nd-October 15th<br>5 cfs | April 15th-May 1st<br>10.86 cfs<br><br>May 1st- Sept. 30th<br>7.86 cfs<br><br>October 2nd-October 15th<br>10.86 cfs |
| October 16th- January 1st<br>8.31 cfs | October 16th- January 1st<br>5 cfs | October 16th- April 14th<br>3.31 cfs |
| January 1st- April 14th<br>7.17 cfs | January 1st- April 14th<br>5 cfs | January 1st- April 14th<br>2.17 cfs |

**Photographs**

Photos 1-3 display the unique natural environment of East Brush Creek above the confluence of East and Middle Brush Creek, mid-September.

Photo 1

Photo 2

Photo 3

Photos 5-7 display East Brush Creek below the confluence of East and Middle Brush Creeks, mid-September.

Photo 4

Photo 5

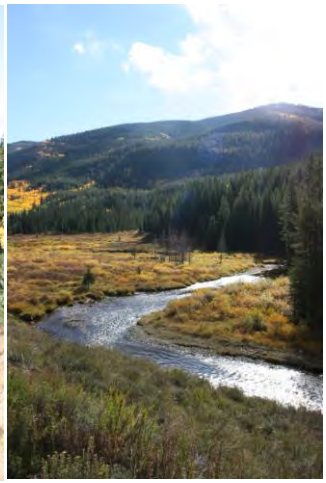


Photo 6

Photos 7 – 10 show Middle Brush Creek and trout caught on the proposed instream flow segment.

Photo 7

Photo 8

Photo 9

Photo 10

**Rationale for Enlargement of Instream Flow Water Right**

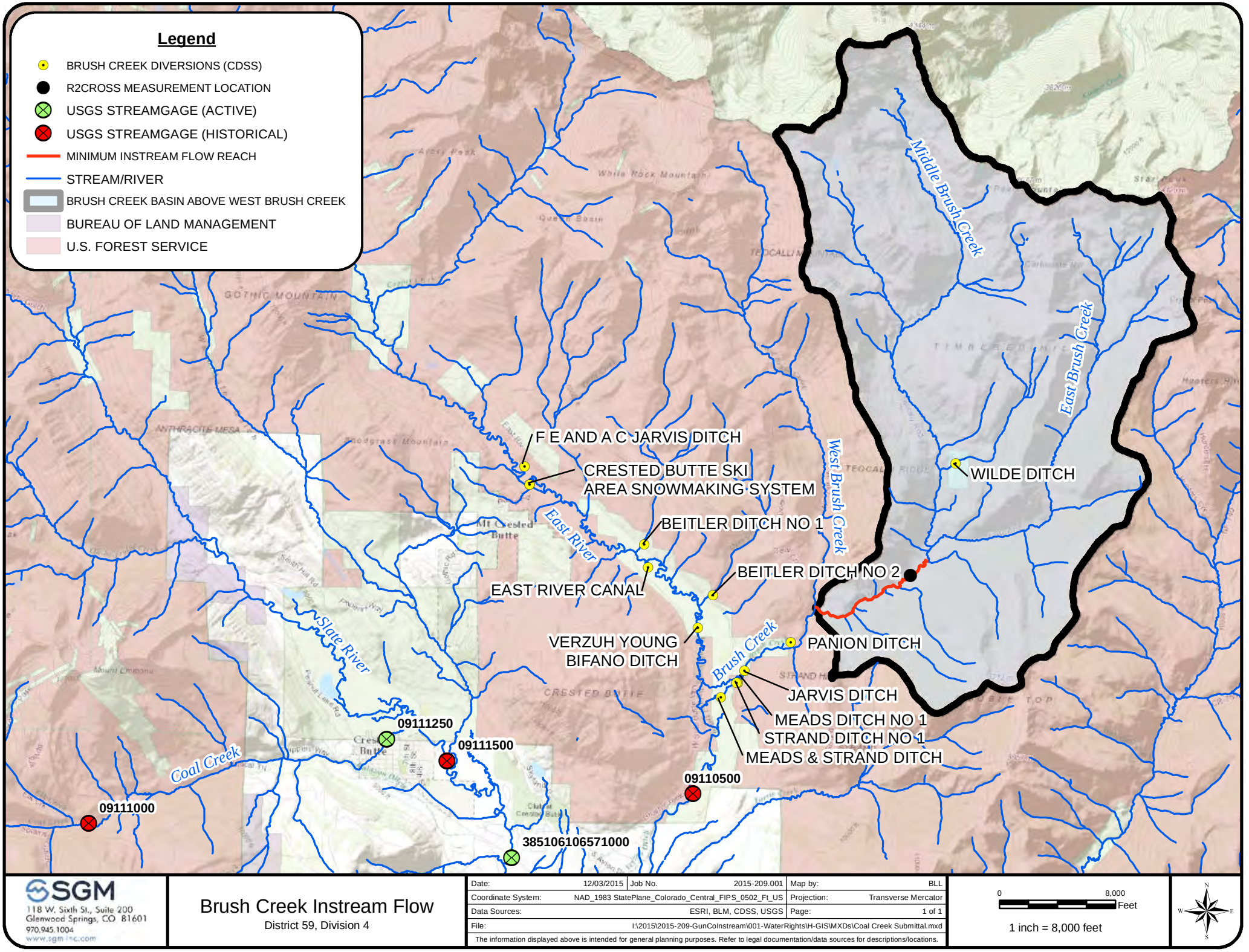
HCCA and AR do not consider the current instream flow water right to be fully protective of the natural environment on Brush Creek, pursuant to modern analytical procedures used by the CWCB. The current instream flow water right does not meet all three instream flow criteria during spring and summer. This period is especially critical for maintaining the fish population.

**Relationship to Existing State Policy**

HCCA and AR are proposing this instream flow to the CWCB in furtherance of the State of Colorado's policy "that the wildlife and their environment are to be protected, preserved enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors… and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities." C.R.S. 33-1-101(1).

Attachments:
A – Location Map
B – Existing Brush Creek ISF Right Summary
C – Water Availability Summary
D – Middle Brush Creek Water Right Summary
E – CPW Biological Summary
F – R2CROSS Analysis Summary
G – Pearl Pass USGS Topographic Quadrangle Map
H – Gothic USGS Topographic Quadrangle Map

# ATTACHMENT A




SGM
118 W. Sixth St., Suite 200
Glenwood Springs, CO 81601
970.945.1004
www.sgm-inc.com

# Brush Creek Instream Flow

District 59, Division 4

| | | | |
|---|---|---|---|
| Date: | 12/03/2015 | Job No. | 2015-209.001 |
| Map by: | BLL | | |
| Coordinate System: | NAD_1983 StatePlane_Colorado_Central_FIPS_0502_Ft_US | Projection: | Transverse Mercator |
| Data Sources: | ESRI, BLM, CDSS, USGS | Page: | 1 of 1 |
| File: | I:\2015\2015-209-GunCoInstream\001-WaterRights\H-GIS\MXDs\Coal Creek Submittal.mxd | | |

The information displayed above is intended for general planning purposes. Refer to legal documentation/data sources for descriptions/locations.

0 8,000 Feet

1 inch = 8,000 feet

N W E S

# ATTACHMENT B

COLORADO
Water Conservation Board
Department of Natural Resources



**Technical Resources**

Colorado River Water Availability Study

Decision Support Systems

**Instream Flow Water Rights Database**

Flood DSS

Colorado Risk MAP

Drought Planning Toolbox

Municipal Water Efficiency Plan Guidance Document

Floodplain Stormwater & Criteria Manual

Colorado Drought and Water Supply Assessment

Best Management Practices

R2CROSS

Portfolio Tool

**Questions?**
Rob Viehl
303-866-3441 x3237

## Instream Flow Water Rights Database

Use the database below to search for all instream flow (ISF) and natural lake level water rights that the CWCB has appropriated since the inception of the Instream Flow and Natural Lake Level Program in 1973.

Download GIS shapefiles of Instream Flow Reaches, Termini and Lakes here.

# CWCB Stream Cases

### Physical Information Summary:

Case Number: **4-83CW236**

Stream Name: **Brush Creek** CDOW #: **38580**

| | | |
|---|---|---|
| Water Division: | **4** | |
| Water District: | **59** | |
| Segment Length: | **2.1 miles** | |
| Watershed: | **East-Taylor (14020001)** | |
| County/ies: | Upper Terminus: | Lower Terminus: |
| **Gunnison** | **confl M & E Brush Creeks at lat 38 54 44N long 106 51 10W** | **confl West Brush Creek at lat 38 54 01N long 106 52 50W** |

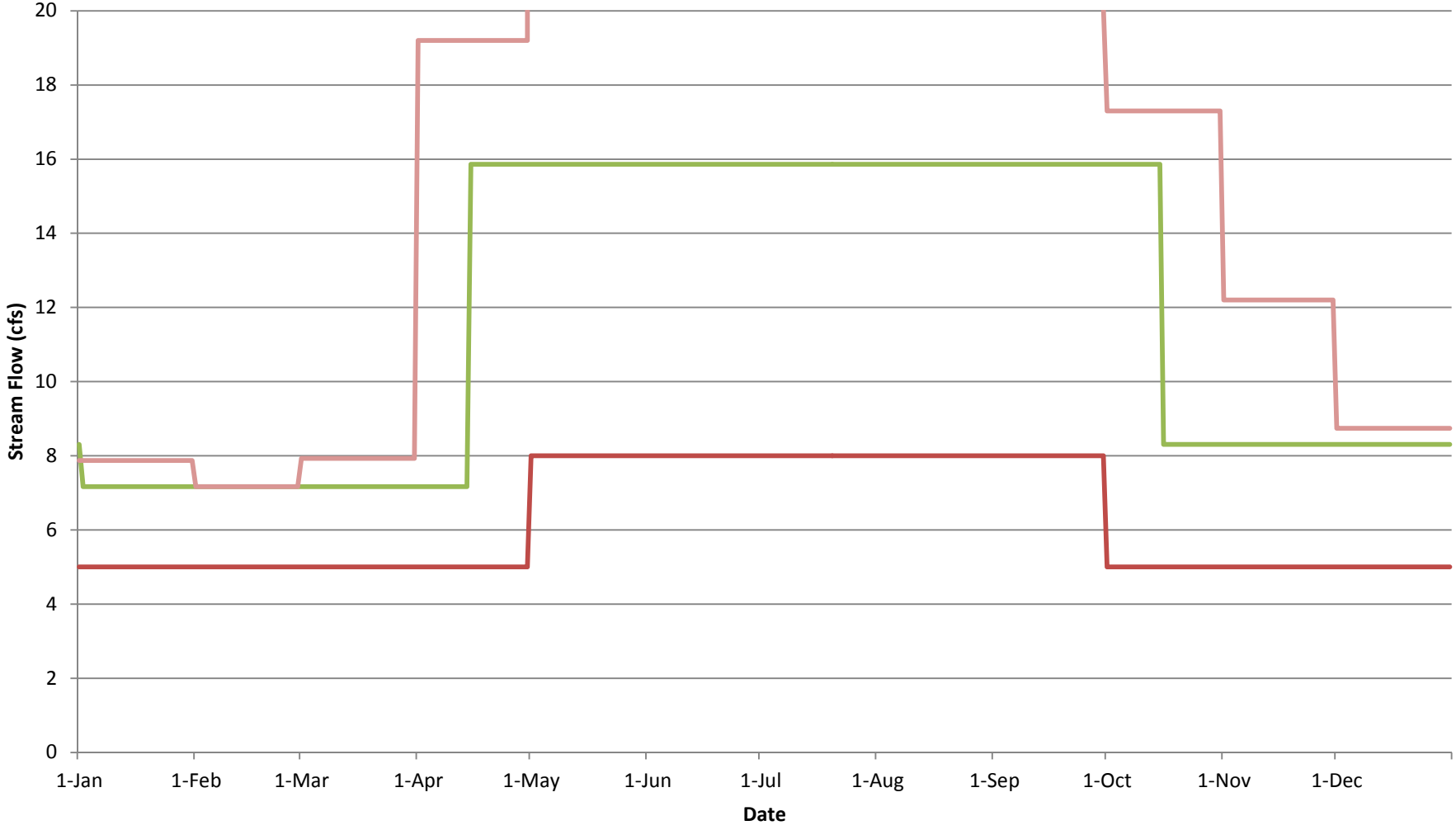
| | | | |
|---|---|---|---|
| Appropriation Date: | **6/3/1982** | | |
| Instream Flow Recommendation: | **5 cfs (10/1 - 4/30)**<br>**8 cfs (5/1 - 9/30)** | | |
| USGS Quad Name: | | Atlas Page:* | Map Coordinates:* |
| **Gothic** | | **58** | **A2** |
| **Pearl Pass** | | **58** | **A3** |
| Fish Species Present: | Colorado Species:? | | |
| **No Records** | | | |
| Public Lands: | | | |
| **None** | | | |

* - Colorado Atlas & Gazetteer(DeLorme Mapping - 2nd Edition)

Additional Information:
Recommended by: **CDOW**

# ATTACHMENT C

# Brush Creek Instream Flow Hydrology Assessment




**Requested Instream Flows:**

| | |
|---|---|
| *January 1 - April 14:* | *7.17 cfs* |
| *April 15 - October 15:* | *15.86 cfs* |
| *October 16 - December 31:* | *8.31 cfs* |

# ATTACHMENT D

# Structure Summary Report

State of Colorado

HydroBase

**Structure Name:** WILDE DITCH **Water District:** 59 **Structure ID Number:** 1827

Source: BRUSH CREEK

| Location: | Q10 | Q40 | Q160 | Section | Twnshp | Range | PM |
|---|---|---|---|---|---|---|---|
| | SE | NW | NW | 13 | 13S | 85W | S |

Distance From Section Lines: From N/S Line: 700 N From E/W Line: 850 W

UTM Coordinates (NAD 83): Northing (UTM y): 4310405 Easting (UTM x): 339825.9 Spotted from PLSS distances from section lines

Latitude/Longitude (decimal degrees): 38.927956 -106.847824

| Water Rights Summary: | | | | | | |
|---|---|---|---|---|---|---|
| Total Decreed Rate(s) (CFS): | Absolute: 0.0000 | Conditional: 2.0000 | AP/EX: 0.0000 |
| Total Decreed Volume(s) (AF): | Absolute: 0.0000 | Conditional: 0.0000 | AP/EX: 0.0000 |

## Water Rights -- Transactions

| Case Number | Adjudication Date | Appropriation Date | Administration Number | Order Number | Priority Number | Decreed Amount | Adjudication Type | Uses | Action Comment |
|---|---|---|---|---|---|---|---|---|---|
| 99CW0112 | 1999-12-31 | 1999-06-15 | 54587.00000 | 0 | | 2.0000 C | S,C | 1789 | |

## Water Rights -- Net Amounts

| Adjudication Date | Appropriation Date | Administration Number | Order Number | Priority/Case Number | Rate (CFS) | | | Volume (Acre-Feet) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Absolute | Conditional | AP/EX | Absolute | Conditional | AP/EX |
| 1999-12-31 | 1999-06-15 | 54587.00000 | 0 | 99CW0112 | 0 | 2.0000 | 0 | | | |

## Irrigated Acres Summary -- Totals From Various Sources

No data available for this report

GIS Total (Acres): Reported:

Diversion Comments Total (Acres): Reported:

Structure Total (Acres): Reported:

## Irrigated Acres From GIS Data

| Year | Land Use | Acres Flood | Acres Furrow | Acres Sprinkler | Acres Drip | Acres Groundwater | Acres Total |
|---|---|---|---|---|---|---|---|

No data available for this report

## *Diversion Summary in Acre-Feet - Total Water Through Structure*

| Year | FDU | LDU | DWC | Maxq & Day | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

No data available for this report

*Minimum:*

*Maximum:*

*Average:*

Notes: The average considers all years with diversion records, even if no water is diverted.
The above summary lists total monthly diversions.
* = Infrequent Diversion Record. All other values are derived from daily records.
Average values include infrequent data if infrequent data are the only data for the year.

## Diversion Comments

| IYR | NUC Code | Acres Irrigated | Comment |
|---|---|---|---|

No data available for this report

Note: Diversion comments and reservoir comments may be shown for a structure, if both are available.

# ATTACHMENT E

Colorado Parks and Wildlife Biological Assessment was provided as a large database file and is best viewed as an excel spreadsheet which has been provided as a separate appendix.

# ATTACHMENT F

COLORADO WATER CONSERVATION BOARD

# FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

## LOCATION INFORMATION

| | | | | | | |
|---|---|---|---|---|---|---|
| STREAM NAME: BRUSH CREEK | | | | | | CROSS-SECTION NO.: 1 |
| CROSS-SECTION LOCATION: U/S OF WEST BRUSH CREEK, D/S OF CONFL. EAST & MIDDLE BRUSH | | | | | | |
| 38° 54' 24" N -106° 51' 29" W | | | | | | |
| DATE: 10/8/15 | OBSERVERS: ESPEGREN, LANGENHUIZEN | | | | | |
| LEGAL DESCRIPTION | ¼ SECTION: NW¼ OF THE SE¼ | SECTION: 23 | TOWNSHIP: 13S N/S | RANGE: 85 E/W | PM: 6TH | |
| COUNTY: GUNNISON | WATERSHED: GUNNISON | WATER DIVISION: 4 | DOW WATER CODE: | | | |
| MAP(S): USGS: PEARL PASS | | | | | | |
| USFS: GUNNISON | | | | | | |

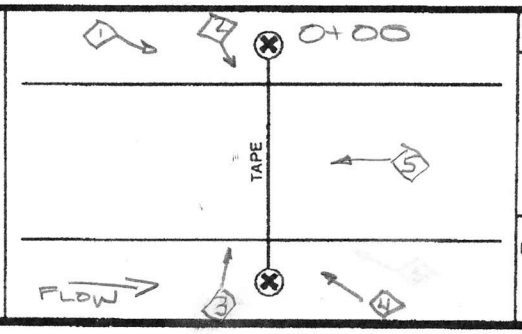
## SUPPLEMENTAL DATA

| | | | | |
|---|---|---|---|---|
| SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO | METER TYPE: PYGMY | | | |
| METER NUMBER: 511-059 | DATE RATED: | CALIB/SPIN: ____ sec | TAPE WEIGHT: ____ lbs/foot | TAPE TENSION: ____ lbs |
| CHANNEL BED MATERIAL SIZE RANGE: GRAVEL/COBBLE/BOULDER | 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 | 5.95/5.98 |
| ② WS Upstream | 3.0 | 5.94 |
| ③ WS Downstream | 20.0 | 6.60 |
| SLOPE | .028696 | |

SKETCH




LEGEND:
Stake - ⊗
Station - ①
Photo - ⟨i⟩
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

FORM #ISF ED 1-96

# DISCHARGE/CROSS SECTION NOTES

| STREAM NAME: Brush Creek | CROSS-SECTION NO.: 1 | DATE: 10/8/15 | SHEET 2 OF 2 |
|---|---|---|---|
| BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) (LEFT) / RIGHT | Gage Reading: 5.95 ft | TIME: 9:45 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 Observation (ft) | Revolutions | Time (sec) | Velocity (ft/sec) At Point | Velocity (ft/sec) Mean in Vertical | Area ($ft^2$) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S, G | 0.0 | | 5.56 | | | | | | | | |
| W | 2.0 | | 5.95 | 0 | | | | | 0 | | |
| | 3.5 | | 6.03 | 0.08 | | | | | 0 | | |
| | 5.0 | | 6.03 | 0.08 | | | | | 0 | | |
| | 7.0 | | 6.39 | 0.44 | | | | | 0.44 | | |
| | 8.0 | | 6.38 | 0.43 | | | | | 0.70 | | |
| | 9.0 | | 6.44 | 0.49 | | | | | 1.18 | | |
| | 10.0 | | 6.34 | 0.39 | | | | | 0.83 | | |
| | 11.0 | | 6.45 | 0.50 | | | | | 0.84 | | |
| | 12.0 | | 6.53 | 0.58 | | | | | 1.20 | | |
| | 13.0 | | 6.42 | 0.47 | | | | | 0.68 | | |
| | 14.0 | | 6.38 | 0.43 | | | | | 0.91 | | |
| | 15.0 | | 6.36 | 0.41 | | | | | 0.86 | | |
| | 16.0 | | 6.33 | 0.38 | | | | | 1.44 | | |
| | 17.0 | | 6.41 | 0.46 | | | | | 0.89 | | |
| | 18.0 | | 6.43 | 0.48 | | | | | 1.33 | | |
| | 19.0 | | 6.30 | 0.35 | | | | | 0.92 | | |
| | 20.0 | | 6.43 | 0.48 | | | | | 1.64 | | |
| | 21.0 | | 6.51 | 0.56 | | | | | 1.74 | | |
| | 22.0 | | 6.43 | 0.48 | | | | | 1.67 | | |
| | 23.0 | | 6.40 | 0.45 | | | | | 1.75 | | |
| | 24.0 | | 6.49 | 0.54 | | | | | 1.53 | | |
| | 25.0 | | 6.45 | 0.50 | | | | | 1.27 | | |
| | 26.0 | | 6.45 | 0.50 | | | | | 1.98 | | |
| | 27.0 | | 6.46 | 0.51 | | | | | 2.28 | | |
| | 28.0 | | 6.46 | 0.51 | | | | | 1.62 | | |
| | 29.0 | | 6.44 | 0.49 | | | | | 1.72 | | |
| | 30.0 | | 6.44 | 0.49 | | | | | 1.77 | | |
| | 31.0 | | 6.32 | 0.37 | | | | | 1.27 | | |
| | 32.0 | | 6.36 | 0.41 | | | | | 0.53 | | |
| | 33.0 | | 6.15 | 0.17 | | | | | 0.32 | | |
| | 34.0 | | 6.15 | 0.17 | | | | | 0.22 | | |
| W | 36.0 | | 5.98 | 0 | | | | | 0 | | |
| S, G | 38.0 | | 5.56 | | | | | | | | |
| TOTALS: | | | | | | | | | | | |

| End of Measurement | Time: 11:10 am | Gage Reading: 5.95 ft | CALCULATIONS PERFORMED BY: GOE | CALCULATIONS CHECKED BY: |
|---|---|---|---|---|

Brush Creek Cross Section,
(Between confluence of Middle / East Brush Creeks and confluence with West Brush Creek)


1. Standing on left bank facing downstream towards cross section

2. Standing on left bank facing right bank along cross section


3. Standing on right bank facing left bank along cross section


4. Standing on right bank facing upstream towards cross section

Brush Creek Cross Section,
(Between confluence of Middle / East Brush Creeks and confluence with West Brush Creek)


5. Standing in the middle of the channel facing upstream towards cross section

STREAM NAME: Brush Creek
XS LOCATION: U/S West Brush, D/S E.& Middle Brush
XS NUMBER: 1 Constant Manning's n

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

| | DIST TO WATER (FT) | TOP WIDTH (FT) | AVG. DEPTH (FT) | MAX. DEPTH (FT) | AREA (SQ FT) | WETTED PERIM. (FT) | PERCENT WET PERIM (%) | HYDR RADIUS (FT) | FLOW (CFS) | AVG. VELOCITY (FT/SEC) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *GL* | 5.56 | 38.00 | 0.72 | 0.97 | 27.18 | 38.21 | 100.0% | 0.71 | 50.34 | 1.85 | |
| | 4.95 | 41.11 | 1.22 | 1.58 | 50.24 | 41.38 | 108.3% | 1.21 | 132.89 | 2.65 | |
| | 5.00 | 40.86 | 1.18 | 1.53 | 48.34 | 41.12 | 107.6% | 1.18 | 125.15 | 2.59 | |
| | 5.05 | 40.60 | 1.14 | 1.48 | 46.44 | 40.86 | 106.9% | 1.14 | 117.55 | 2.53 | |
| | 5.10 | 40.34 | 1.10 | 1.43 | 44.54 | 40.60 | 106.2% | 1.10 | 110.12 | 2.47 | |
| | 5.15 | 40.09 | 1.06 | 1.38 | 42.64 | 40.33 | 105.6% | 1.06 | 102.84 | 2.41 | |
| | 5.20 | 39.83 | 1.02 | 1.33 | 40.74 | 40.07 | 104.9% | 1.02 | 95.73 | 2.35 | |
| | 5.25 | 39.57 | 0.98 | 1.28 | 38.84 | 39.81 | 104.2% | 0.98 | 88.79 | 2.29 | |
| | 5.30 | 39.32 | 0.94 | 1.23 | 36.94 | 39.55 | 103.5% | 0.93 | 82.03 | 2.22 | |
| | 5.35 | 39.06 | 0.90 | 1.18 | 35.04 | 39.29 | 102.8% | 0.89 | 75.45 | 2.15 | |
| | 5.40 | 38.80 | 0.85 | 1.13 | 33.14 | 39.03 | 102.1% | 0.85 | 69.07 | 2.08 | |
| | 5.45 | 38.55 | 0.81 | 1.08 | 31.24 | 38.77 | 101.5% | 0.81 | 62.87 | 2.01 | |
| | 5.50 | 38.29 | 0.77 | 1.03 | 29.34 | 38.51 | 100.8% | 0.76 | 56.89 | 1.94 | |
| | 5.55 | 38.04 | 0.72 | 0.98 | 27.44 | 38.24 | 100.1% | 0.72 | 51.11 | 1.86 | |
| | 5.60 | 37.57 | 0.68 | 0.93 | 25.55 | 37.77 | 98.9% | 0.68 | 45.75 | 1.79 | |
| | 5.65 | 37.08 | 0.64 | 0.88 | 23.68 | 37.27 | 97.5% | 0.64 | 40.68 | 1.72 | |
| | 5.70 | 36.58 | 0.60 | 0.83 | 21.84 | 36.76 | 96.2% | 0.59 | 35.87 | 1.64 | |
| | 5.75 | 36.09 | 0.55 | 0.78 | 20.02 | 36.26 | 94.9% | 0.55 | 31.33 | 1.56 | |
| | 5.80 | 35.60 | 0.51 | 0.73 | 18.23 | 35.75 | 93.6% | 0.51 | 27.05 | 1.48 | |
| | 5.85 | 35.10 | 0.47 | 0.68 | 16.47 | 35.25 | 92.3% | 0.47 | 23.04 | 1.40 | |
| | 5.90 | 34.61 | 0.43 | 0.63 | 14.72 | 34.75 | 90.9% | 0.42 | 19.30 | 1.31 | |
| *WL* | 5.95 | 34.07 | 0.38 | 0.58 | 13.00 | 34.20 | 89.5% | 0.38 | 15.86 | 1.22 | Summer Flow |
| | 6.00 | 32.73 | 0.35 | 0.53 | 11.33 | 32.86 | 86.0% | 0.34 | 12.95 | 1.14 | |
| | 6.05 | 30.01 | 0.33 | 0.48 | 9.77 | 30.13 | 78.9% | 0.32 | 10.71 | 1.10 | |
| | 6.10 | 29.14 | 0.28 | 0.43 | 8.29 | 29.26 | 76.6% | 0.28 | 8.31 | 1.00 | Winter Flow |
| | | | | | | | | | 7.17 | 0.96 | Hydology Limited Winter Flow |
| | 6.15 | 27.30 | 0.25 | 0.38 | 6.85 | 27.41 | 71.7% | 0.25 | 6.32 | 0.92 | |
| | 6.20 | 26.78 | 0.21 | 0.33 | 5.50 | 26.88 | 70.4% | 0.20 | 4.44 | 0.81 | |
| | 6.25 | 26.27 | 0.16 | 0.28 | 4.18 | 26.36 | 69.0% | 0.16 | 2.84 | 0.68 | |
| | 6.30 | 25.70 | 0.11 | 0.23 | 2.88 | 25.78 | 67.5% | 0.11 | 1.55 | 0.54 | |
| | 6.35 | 22.00 | 0.08 | 0.18 | 1.65 | 22.06 | 57.7% | 0.07 | 0.68 | 0.41 | |
| | 6.40 | 15.50 | 0.05 | 0.13 | 0.71 | 15.53 | 40.6% | 0.05 | 0.21 | 0.30 | |
| | 6.45 | 6.44 | 0.02 | 0.08 | 0.14 | 6.45 | 16.9% | 0.02 | 0.03 | 0.18 | |
| | 6.50 | 0.75 | 0.01 | 0.03 | 0.01 | 0.75 | 2.0% | 0.01 | 0.00 | 0.12 | |

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

LOCATION INFORMATION

| | |
|---|---|
| STREAM NAME: | Brush Creek |
| XS LOCATION: | 1 |
| XS NUMBER: | 0 |
| DATE: | 8-Oct-15 |
| OBSERVERS: | 0 |
| 1/4 SEC: | 0 |
| SECTION: | 0 |
| TWP: | 0 |
| RANGE: | 0 |
| PM: | 0 |
| COUNTY: | 0 |
| WATERSHED: | 0 |
| DIVISION: | 0 |
| DOW CODE: | 0 |
| USGS MAP: | 0 |
| 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: | 0.02869565 |

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

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

STREAM NAME: Brush Creek
XS LOCATION: 1
XS NUMBER: 0

# DATA POINTS= 34

VALUES COMPUTED FROM RAW FIELD DATA

| FEATURE | DIST | VERT DEPTH | WATER DEPTH | VEL | WETTED PERIM. | WATER DEPTH | AREA (Am) | Q (Qm) | % Q CELL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 5.56 | | | 0.00 | | 0.00 | 0.00 | 0.0% |
| | 2.00 | 5.95 | 0.00 | | 0.00 | | 0.00 | 0.00 | 0.0% |
| | 3.50 | 6.03 | 0.08 | | 1.50 | 0.08 | 0.12 | 0.00 | 0.0% |
| | 5.00 | 6.03 | 0.08 | | 1.50 | 0.08 | 0.14 | 0.00 | 0.0% |
| | 7.00 | 6.39 | 0.44 | 0.44 | 2.03 | 0.44 | 0.66 | 0.29 | 1.8% |
| | 8.00 | 6.38 | 0.43 | 0.70 | 1.00 | 0.43 | 0.43 | 0.30 | 1.9% |
| | 9.00 | 6.44 | 0.49 | 1.18 | 1.00 | 0.49 | 0.49 | 0.58 | 3.6% |
| | 10.00 | 6.34 | 0.39 | 0.83 | 1.00 | 0.39 | 0.39 | 0.32 | 2.0% |
| | 11.00 | 6.45 | 0.50 | 0.84 | 1.01 | 0.50 | 0.50 | 0.42 | 2.6% |
| | 12.00 | 6.53 | 0.58 | 1.20 | 1.00 | 0.58 | 0.58 | 0.70 | 4.4% |
| | 13.00 | 6.42 | 0.47 | 0.68 | 1.01 | 0.47 | 0.47 | 0.32 | 2.0% |
| | 14.00 | 6.38 | 0.43 | 0.91 | 1.00 | 0.43 | 0.43 | 0.39 | 2.5% |
| | 15.00 | 6.36 | 0.41 | 0.86 | 1.00 | 0.41 | 0.41 | 0.35 | 2.2% |
| | 16.00 | 6.33 | 0.38 | 1.44 | 1.00 | 0.38 | 0.38 | 0.55 | 3.5% |
| | 17.00 | 6.41 | 0.46 | 0.89 | 1.00 | 0.46 | 0.46 | 0.41 | 2.6% |
| | 18.00 | 6.43 | 0.48 | 1.33 | 1.00 | 0.48 | 0.48 | 0.64 | 4.0% |
| | 19.00 | 6.30 | 0.35 | 0.92 | 1.01 | 0.35 | 0.35 | 0.32 | 2.0% |
| | 20.00 | 6.43 | 0.48 | 1.64 | 1.01 | 0.48 | 0.48 | 0.79 | 4.9% |
| | 21.00 | 6.51 | 0.56 | 1.74 | 1.00 | 0.56 | 0.56 | 0.97 | 6.1% |
| | 22.00 | 6.43 | 0.48 | 1.67 | 1.00 | 0.48 | 0.48 | 0.80 | 5.0% |
| | 23.00 | 6.40 | 0.45 | 1.75 | 1.00 | 0.45 | 0.45 | 0.79 | 5.0% |
| | 24.00 | 6.49 | 0.54 | 1.53 | 1.00 | 0.54 | 0.54 | 0.82 | 5.2% |
| | 25.00 | 6.45 | 0.50 | 1.27 | 1.00 | 0.50 | 0.50 | 0.63 | 4.0% |
| | 26.00 | 6.45 | 0.50 | 1.98 | 1.00 | 0.50 | 0.50 | 0.99 | 6.2% |
| | 27.00 | 6.46 | 0.51 | 2.28 | 1.00 | 0.51 | 0.51 | 1.16 | 7.3% |
| | 28.00 | 6.46 | 0.51 | 1.62 | 1.00 | 0.51 | 0.51 | 0.83 | 5.2% |
| | 29.00 | 6.44 | 0.49 | 1.72 | 1.00 | 0.49 | 0.49 | 0.84 | 5.3% |
| | 30.00 | 6.44 | 0.49 | 1.77 | 1.00 | 0.49 | 0.49 | 0.87 | 5.5% |
| | 31.00 | 6.32 | 0.37 | 1.27 | 1.01 | 0.37 | 0.37 | 0.47 | 2.9% |
| | 32.00 | 6.36 | 0.41 | 0.53 | 1.00 | 0.41 | 0.41 | 0.22 | 1.4% |
| | 33.00 | 6.15 | 0.20 | 0.32 | 1.02 | 0.20 | 0.20 | 0.06 | 0.4% |
| | 34.00 | 6.15 | 0.20 | 0.22 | 1.00 | 0.20 | 0.30 | 0.07 | 0.4% |
| | 36.00 | 5.98 | 0.00 | | 2.01 | | 0.00 | 0.00 | 0.0% |
| 1 | 38.00 | 5.56 | | | 0.00 | | 0.00 | 0.00 | 0.0% |
| TOTALS ---------- | | | | | 34.13 | 0.58 (Max.) | 13.08 | 15.91 | 100.0% |

Manning's n = 0.1092
Hydraulic Radius= 0.38327457

STREAM NAME: Brush Creek
XS LOCATION: 1
XS NUMBER: 0

WATER LINE COMPARISON TABLE

| WATER LINE | MEAS AREA | COMP AREA | AREA ERROR |
|---|---|---|---|
| | 13.08 | 12.60 | -3.6% |
| 5.72 | 13.08 | 21.41 | 63.7% |
| 5.74 | 13.08 | 20.68 | 58.1% |
| 5.76 | 13.08 | 19.96 | 52.6% |
| 5.78 | 13.08 | 19.24 | 47.1% |
| 5.80 | 13.08 | 18.52 | 41.6% |
| 5.82 | 13.08 | 17.81 | 36.2% |
| 5.84 | 13.08 | 17.10 | 30.8% |
| 5.86 | 13.08 | 16.40 | 25.4% |
| 5.88 | 13.08 | 15.70 | 20.0% |
| 5.90 | 13.08 | 15.01 | 14.7% |
| 5.92 | 13.08 | 14.31 | 9.4% |
| 5.93 | 13.08 | 13.97 | 6.8% |
| 5.94 | 13.08 | 13.63 | 4.2% |
| 5.95 | 13.08 | 13.28 | 1.6% |
| 5.96 | 13.08 | 12.94 | -1.1% |
| 5.97 | 13.08 | 12.60 | -3.6% |
| 5.98 | 13.08 | 12.27 | -6.2% |
| 5.99 | 13.08 | 11.93 | -8.8% |
| 6.00 | 13.08 | 11.60 | -11.3% |
| 6.01 | 13.08 | 11.27 | -13.8% |
| 6.02 | 13.08 | 10.95 | -16.3% |
| 6.04 | 13.08 | 10.31 | -21.2% |
| 6.06 | 13.08 | 9.71 | -25.8% |
| 6.08 | 13.08 | 9.11 | -30.3% |
| 6.10 | 13.08 | 8.52 | -34.8% |
| 6.12 | 13.08 | 7.94 | -39.3% |
| 6.14 | 13.08 | 7.37 | -43.7% |
| 6.16 | 13.08 | 6.80 | -48.0% |
| 6.18 | 13.08 | 6.26 | -52.1% |
| 6.20 | 13.08 | 5.72 | -56.3% |
| 6.22 | 13.08 | 5.19 | -60.4% |

WATERLINE AT ZERO
AREA ERROR = 5.951

STREAM NAME: Brush Creek
XS LOCATION: 1
XS NUMBER: 0

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* | 5.56 | 38.00 | 0.72 | 0.97 | 27.18 | 38.21 | 100.0% | 0.71 | 49.92 | 1.84 |
| | 5.60 | 37.59 | 0.68 | 0.93 | 25.63 | 37.79 | 98.9% | 0.68 | 45.60 | 1.78 |
| | 5.65 | 37.10 | 0.64 | 0.88 | 23.76 | 37.29 | 97.6% | 0.64 | 40.56 | 1.71 |
| | 5.70 | 36.61 | 0.60 | 0.83 | 21.92 | 36.79 | 96.3% | 0.60 | 35.78 | 1.63 |
| | 5.75 | 36.11 | 0.56 | 0.78 | 20.10 | 36.28 | 95.0% | 0.55 | 31.26 | 1.55 |
| | 5.80 | 35.62 | 0.51 | 0.73 | 18.31 | 35.78 | 93.6% | 0.51 | 27.00 | 1.47 |
| | 5.85 | 35.12 | 0.47 | 0.68 | 16.54 | 35.27 | 92.3% | 0.47 | 23.01 | 1.39 |
| | 5.90 | 34.63 | 0.43 | 0.63 | 14.80 | 34.77 | 91.0% | 0.43 | 19.30 | 1.30 |
| *WL* | 5.95 | 34.12 | 0.38 | 0.58 | 13.08 | 34.25 | 89.6% | 0.38 | 15.87 | 1.21 |
| | 6.00 | 32.80 | 0.35 | 0.53 | 11.40 | 32.92 | 86.2% | 0.35 | 12.96 | 1.14 |
| | 6.05 | 30.05 | 0.33 | 0.48 | 9.83 | 30.17 | 79.0% | 0.33 | 10.73 | 1.09 |
| | 6.10 | 29.18 | 0.29 | 0.43 | 8.35 | 29.30 | 76.7% | 0.29 | 8.34 | 1.00 |
| | 6.15 | 27.32 | 0.25 | 0.38 | 6.91 | 27.43 | 71.8% | 0.25 | 6.36 | 0.92 |
| | 6.20 | 26.81 | 0.21 | 0.33 | 5.56 | 26.90 | 70.4% | 0.21 | 4.48 | 0.81 |
| | 6.25 | 26.29 | 0.16 | 0.28 | 4.23 | 26.38 | 69.0% | 0.16 | 2.88 | 0.68 |
| | 6.30 | 25.76 | 0.11 | 0.23 | 2.93 | 25.84 | 67.6% | 0.11 | 1.58 | 0.54 |
| | 6.35 | 22.28 | 0.08 | 0.18 | 1.70 | 22.33 | 58.4% | 0.08 | 0.71 | 0.41 |
| | 6.40 | 15.81 | 0.05 | 0.13 | 0.75 | 15.84 | 41.5% | 0.05 | 0.22 | 0.30 |
| | 6.45 | 6.95 | 0.02 | 0.08 | 0.15 | 6.97 | 18.2% | 0.02 | 0.03 | 0.18 |
| | 6.50 | 0.85 | 0.01 | 0.03 | 0.01 | 0.86 | 2.2% | 0.01 | 0.00 | 0.12 |

STREAM NAME: Brush Creek
XS LOCATION: 1
XS NUMBER: 0

SUMMARY SHEET

| | | |
|---|---|---|
| MEASURED FLOW (Qm)= | 15.91 | cfs |
| CALCULATED FLOW (Qc)= | 15.87 | cfs |
| (Qm-Qc)/Qm * 100 = | 0.2 | % |
| MEASURED WATERLINE (WLm)= | 5.97 | ft |
| CALCULATED WATERLINE (WLc)= | 5.95 | ft |
| (WLm-WLc)/WLm * 100 = | 0.2 | % |
| MAX MEASURED DEPTH (Dm)= | 0.58 | ft |
| MAX CALCULATED DEPTH (Dc)= | 0.58 | ft |
| (Dm-Dc)/Dm * 100 | 0.2 | % |
| MEAN VELOCITY= | 1.21 | ft/sec |
| MANNING'S N= | 0.109 | |
| SLOPE= | 0.02869565 | ft/ft |
| .4 * Qm = | 6.4 | cfs |
| 2.5 * Qm= | 39.8 | cfs |

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

| FLOW (CFS) | PERIOD |
|---|---|
| ========== | ======== |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

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

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

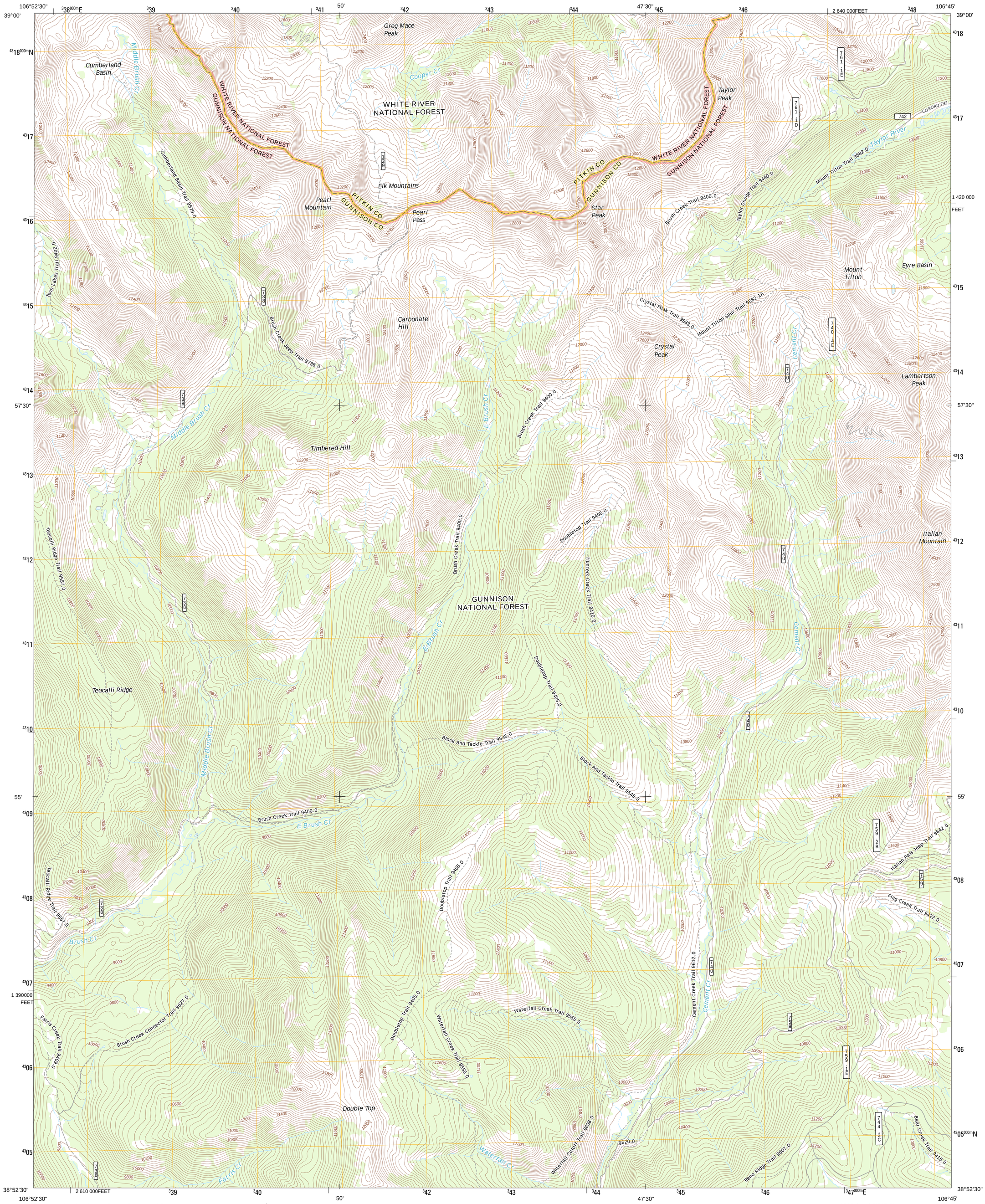
CWCB REVIEW BY: ..... DATE:.....

# ATTACHMENT G

U.S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

The National Map US Topo

# PEARL PASS QUADRANGLE
COLORADO
7.5-MINUTE SERIES




Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 13S
10 000-foot ticks: Colorado Coordinate System of 1983 (central zone)

Imagery.....NAIP, August 2011
Roads.....©2006-2012 TomTom
Roads within US Forest Service Lands.....FSTopo Data with limited Forest Service updates, 2013
Names.....GNIS, 2013
Hydrography.....National Hydrography Dataset, 2011
Contours.....National Elevation Dataset, 2005
Boundaries.....Census, IBWC, IBC, USGS, 1972 - 2012
Public Land Survey System.....BLM, 2011

UTM GRID AND 2013 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
MN 9° 33' 170 MILS
GN 1° 8' 20 MILS

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| CD |
| Grid Zone Designation 13S |

SCALE 1:24 000
1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1 MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 FEET

CONTOUR INTERVAL 40 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.14

COLORADO
QUADRANGLE LOCATION

| | | |
|---|---|---|
| Maroon Bells | Hayden Peak | New York Peak |
| Gothic | Pearl Pass | Italian Creek |
| Crested Butte | Cement Mountain | Matchless Mountain |

ADJOINING 7.5' QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route
FS Primary Route
FS Passenger Route
FS High Clearance Route

Check with local Forest Service unit for current travel conditions and restrictions.

PEARL PASS, CO
2013

# ATTACHMENT H

U.S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

The National Map US Topo

# GOTHIC QUADRANGLE
COLORADO
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 13S
10 000-foot ticks: Colorado Coordinate System of 1983 (central zone)

Imagery.....NAIP, August 2011
Roads.....©2006-2012 TomTom
Roads within US Forest Service Lands.....FSTopo Data with limited Forest Service updates, 2013
Names.....GNIS, 2013
Hydrography.....National Hydrography Dataset, 2011
Contours.....National Elevation Dataset, 2005
Boundaries.....Census, IBWC, IBC, USGS, 1972 - 2012
Public Land Survey System.....BLM, 2011

UTM GRID AND 2013 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| CD |
| Grid Zone Designation |
| 13S |

SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 40 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.14

COLORADO
QUADRANGLE LOCATION

| | | |
|---|---|---|
| Snowmass Mountain | Maroon Bells | Hayden Peak |
| Oh-be-joyful | Gothic | Pearl Pass |
| Mount Axtell | Crested Butte | Cement Mountain |

ADJOINING 7.5' QUADRANGLES

ROAD CLASSIFICATION
Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route
FS Primary Route — FS Passenger Route — FS High Clearance Route

Check with local Forest Service unit
for current travel conditions and restrictions.

GOTHIC, CO
2013

**Discharge Measurment Field Visit Data Report** *(Filters: Name begins with Brush Creek; Processing Status = Moving Forward;)*

| Div | Name | CWCB Case Number | Segment ID | Meas. Date | UTM | Location | Flow Amount (cfs) | Meas # | Rating | Station ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Brush Creek | | 17/4/A-002 | 07/13/2016 | UTMx: 337158.3852 UTMy: 4307276.0465 | Brush Creek Above ~1200' U/S of proposed LT | 47 | .001 | Poor (>8%) | BCABPRLT |
| 4 | Brush Creek | | 17/4/A-002 | 08/03/2016 | UTMx: 336935.3962 UTMy: 4307363.8014 | Brush Creek Above Proposed Lower Terminus | 24.7 | .002 | Good (<=5%) | BRCRNRLT |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

## File Information

| | |
|---|---|
| File Name | BRCRNRLT.002.WAD |
| Start Date and Time | 2016/08/03 10:37:51 |

## Site Details

| | |
|---|---|
| Site Name | BRUSH CR NR LOW TERM |
| Operator(s) | |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2354 |
| CPU Firmware Version | 3.9 |
| Software Ver | 2.30 |
| Mounting Correction | 0.0% |

## Units (English Units)

| | |
|---|---|
| Distance | ft |
| Velocity | ft/s |
| Area | ft^2 |
| Discharge | cfs |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.3% | 7.1% |
| Velocity | 1.0% | 6.6% |
| Width | 0.1% | 0.1% |
| Method | 1.8% | - |
| # Stations | 2.1% | - |
| **Overall** | **3.1%** | **9.8%** |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 24 |
| Start Edge | REW | Total Width | 20.300 |
| Mean SNR | 35.2 dB | Total Area | 13.602 |
| Mean Temp | 51.95 °F | Mean Depth | 0.670 |
| Disch. Equation | Mid-Section | Mean Velocity | 1.8183 |
| | | **Total Discharge** | **24.7331** |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 10:37 | 5.90 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 10:37 | 6.50 | 0.6 | 0.400 | 0.6 | 0.160 | 0.4741 | 1.00 | 0.4741 | 0.220 | 0.1043 | 0.4 |
| 2 | 10:38 | 7.00 | 0.6 | 0.530 | 0.6 | 0.212 | 1.2654 | 1.00 | 1.2654 | 0.397 | 0.5029 | 2.0 |
| 3 | 10:40 | 8.00 | 0.6 | 0.550 | 0.6 | 0.220 | 1.7152 | 1.00 | 1.7152 | 0.550 | 0.9431 | 3.8 |
| *4* | *10:41* | *9.00* | *0.6* | *1.100* | *0.6* | *0.440* | *0.4147* | *1.00* | *0.4147* | *1.100* | *0.4562* | *1.8* |
| 5 | 10:42 | 10.00 | 0.6 | 0.800 | 0.6 | 0.320 | 2.2142 | 1.00 | 2.2142 | 0.600 | 1.3283 | 5.4 |
| 6 | 10:43 | 10.50 | 0.6 | 1.000 | 0.6 | 0.400 | 2.0807 | 1.00 | 2.0807 | 0.500 | 1.0404 | 4.2 |
| 7 | 10:44 | 11.00 | 0.6 | 1.200 | 0.6 | 0.480 | 1.6119 | 1.00 | 1.6119 | 0.600 | 0.9672 | 3.9 |
| 8 | 10:45 | 11.50 | 0.6 | 1.100 | 0.6 | 0.440 | 2.0991 | 1.00 | 2.0991 | 0.550 | 1.1546 | 4.7 |
| 9 | 10:46 | 12.00 | 0.6 | 0.650 | 0.6 | 0.260 | 2.5715 | 1.00 | 2.5715 | 0.487 | 1.2535 | 5.1 |
| *10* | *10:48* | *13.00* | *0.6* | *0.950* | *0.6* | *0.380* | *1.9521* | *1.00* | *1.9521* | *0.950* | *1.8548* | *7.5* |
| 11 | 10:49 | 14.00 | 0.6 | 0.800 | 0.6 | 0.320 | 2.1024 | 1.00 | 2.1024 | 0.800 | 1.6816 | 6.8 |
| 12 | 10:50 | 15.00 | 0.6 | 0.950 | 0.6 | 0.380 | 2.1050 | 1.00 | 2.1050 | 0.950 | 2.0000 | 8.1 |
| 13 | 10:51 | 16.00 | 0.6 | 1.100 | 0.6 | 0.440 | 1.4452 | 1.00 | 1.4452 | 1.100 | 1.5898 | 6.4 |
| 14 | 10:52 | 17.00 | 0.6 | 0.450 | 0.6 | 0.180 | 2.0771 | 1.00 | 2.0771 | 0.450 | 0.9350 | 3.8 |
| 15 | 10:53 | 18.00 | 0.6 | 0.700 | 0.6 | 0.280 | 1.8238 | 1.00 | 1.8238 | 0.700 | 1.2769 | 5.2 |
| 16 | 10:54 | 19.00 | 0.6 | 0.800 | 0.6 | 0.320 | 1.6286 | 1.00 | 1.6286 | 0.800 | 1.3027 | 5.3 |
| 17 | 10:56 | 20.00 | 0.6 | 0.300 | 0.6 | 0.120 | 3.0974 | 1.00 | 3.0974 | 0.300 | 0.9288 | 3.8 |
| *18* | *10:57* | *21.00* | *0.6* | *0.700* | *0.6* | *0.280* | *2.1883* | *1.00* | *2.1883* | *0.700* | *1.5321* | *6.2* |
| 19 | 10:58 | 22.00 | 0.6 | 0.650 | 0.6 | 0.260 | 2.8291 | 1.00 | 2.8291 | 0.650 | 1.8387 | 7.4 |
| 20 | 10:59 | 23.00 | 0.6 | 0.600 | 0.6 | 0.240 | 2.2329 | 1.00 | 2.2329 | 0.600 | 1.3399 | 5.4 |
| *21* | *11:00* | *24.00* | *0.6* | *0.300* | *0.6* | *0.120* | *1.5276* | *1.00* | *1.5276* | *0.300* | *0.4581* | *1.9* |
| 22 | 11:01 | 25.00 | 0.6 | 0.270 | 0.6 | 0.108 | 0.8222 | 1.00 | 0.8222 | 0.297 | 0.2442 | 1.0 |
| 23 | 11:01 | 26.20 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

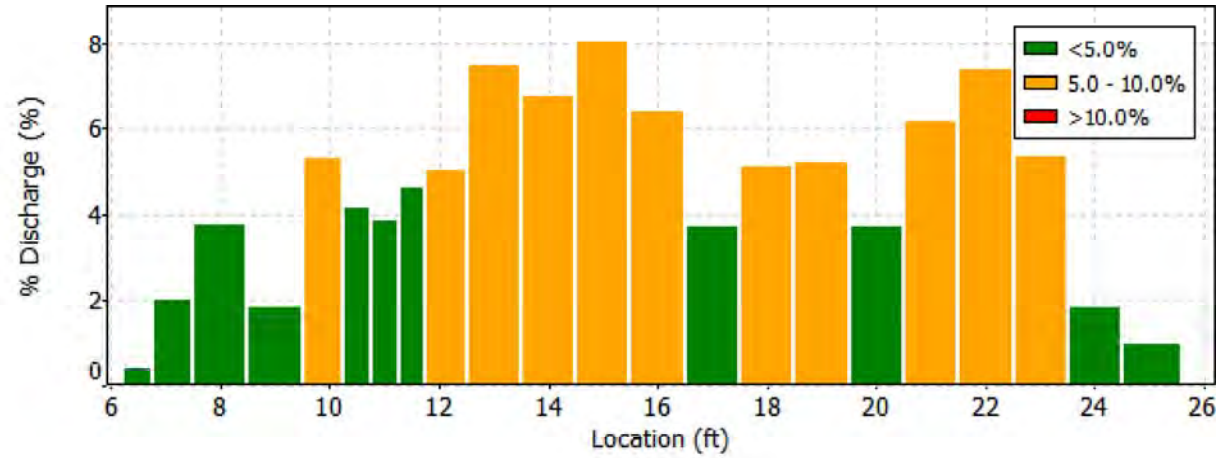
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

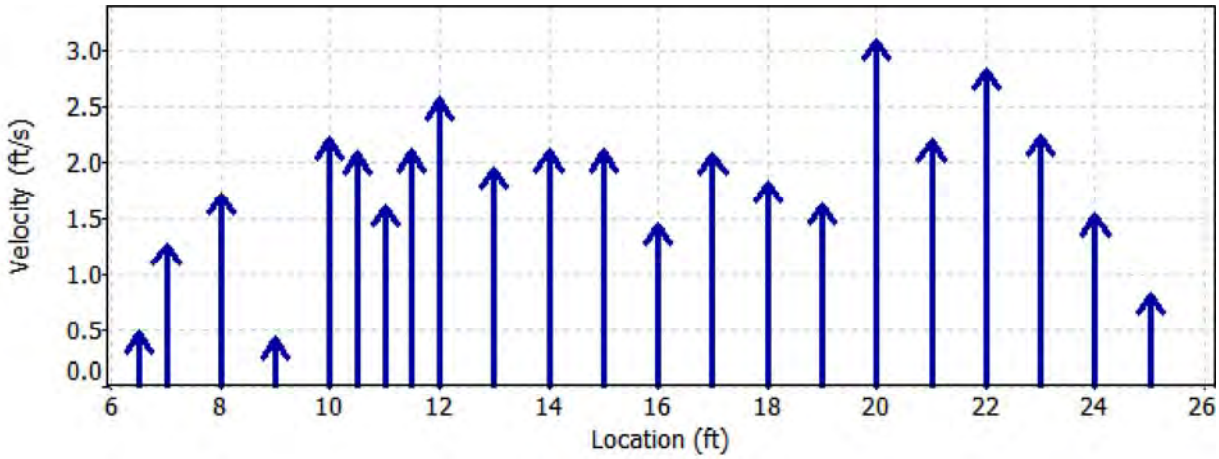
COLORADO
Colorado Water Conservation Board
Department of Natural Resources

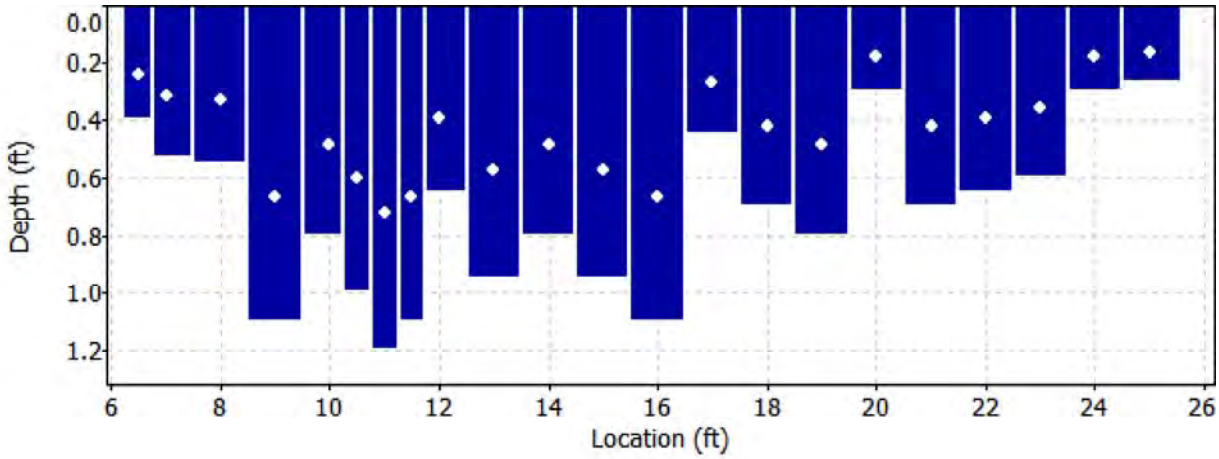
# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

| File Information | | Site Details | |
|---|---|---|---|
| File Name | BRCRNRLT.002.WAD | Site Name | BRUSH CR NR LOW TERM |
| Start Date and Time | 2016/08/03 10:37:51 | Operator(s) | |



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

## File Information

| | |
|---|---|
| File Name | BRCRNRLT.002.WAD |
| Start Date and Time | 2016/08/03 10:37:51 |

## Site Details

| | |
|---|---|
| Site Name | BRUSH CR NR LOW TERM |
| Operator(s) | |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 4 | 9.00 | 0.6 | High number of spikes: 5 |
| 10 | 13.00 | 0.6 | High number of spikes: 6 |
| 18 | 21.00 | 0.6 | High standard error: 0.150 |
| 21 | 24.00 | 0.6 | High number of spikes: 5 |

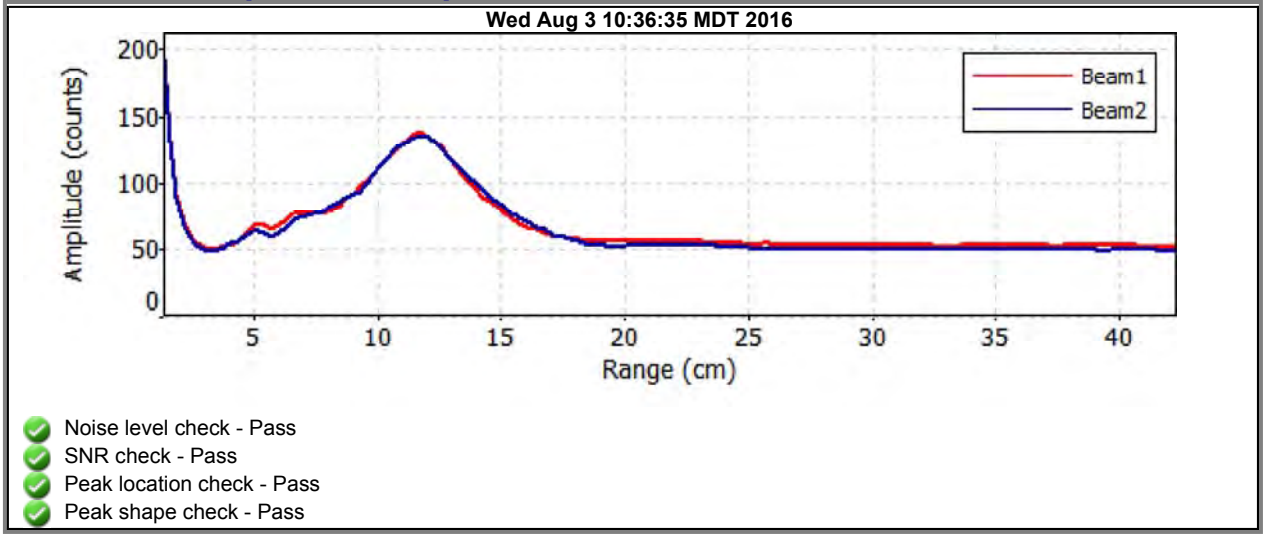
COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

| File Information | | Site Details | |
|---|---|---|---|
| File Name | BRCRNRLT.002.WAD | Site Name | BRUSH CR NR LOW TERM |
| Start Date and Time | 2016/08/03 10:37:51 | Operator(s) | |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

## File Information

| | |
|---|---|
| File Name | BCABPRLT.001.WAD |
| Start Date and Time | 2016/07/13 14:23:06 |

## Site Details

| | |
|---|---|
| Site Name | BRUSH C 1200 AB LT |
| Operator(s) | BJE |

## System Information

| | |
|---|---|
| Sensor Type | FlowTracker |
| Serial # | P2355 |
| CPU Firmware Version | 3.9 |
| Software Ver | 2.30 |
| Mounting Correction | 0.0% |

## Units (English Units)

| | |
|---|---|
| Distance | ft |
| Velocity | ft/s |
| Area | ft^2 |
| Discharge | cfs |

## Discharge Uncertainty

| Category | ISO | Stats |
|---|---|---|
| Accuracy | 1.0% | 1.0% |
| Depth | 0.2% | 2.9% |
| Velocity | 1.1% | 4.3% |
| Width | 0.1% | 0.1% |
| Method | 1.9% | - |
| # Stations | 2.0% | - |
| **Overall** | **3.1%** | **5.3%** |

## Summary

| | | | |
|---|---|---|---|
| Averaging Int. | 40 | # Stations | 25 |
| Start Edge | REW | Total Width | 24.600 |
| Mean SNR | 36.3 dB | Total Area | 21.290 |
| Mean Temp | 55.17 °F | Mean Depth | 0.865 |
| Disch. Equation | Mid-Section | Mean Velocity | 2.2011 |
| | | **Total Discharge** | **46.8606** |

## Measurement Results

| St | Clock | Loc | Method | Depth | %Dep | MeasD | Vel | CorrFact | MeanV | Area | Flow | %Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 14:23 | 9.80 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |
| 1 | 14:23 | 10.80 | 0.6 | 0.400 | 0.6 | 0.160 | 1.6263 | 1.00 | 1.6263 | 0.400 | 0.6504 | 1.4 |
| 2 | 14:24 | 11.80 | 0.6 | 0.550 | 0.6 | 0.220 | 1.2395 | 1.00 | 1.2395 | 0.550 | 0.6816 | 1.5 |
| 3 | 14:26 | 12.80 | 0.6 | 0.750 | 0.6 | 0.300 | 0.7579 | 1.00 | 0.7579 | 0.750 | 0.5684 | 1.2 |
| *4* | *14:27* | *13.80* | *0.6* | *0.800* | *0.6* | *0.320* | *0.3077* | *1.00* | *0.3077* | *0.800* | *0.2462* | *0.5* |
| 5 | 14:28 | 14.80 | 0.6 | 0.500 | 0.6 | 0.200 | 0.7457 | 1.00 | 0.7457 | 0.500 | 0.3729 | 0.8 |
| 6 | 14:29 | 15.80 | 0.6 | 0.900 | 0.6 | 0.360 | 1.1191 | 1.00 | 1.1191 | 0.900 | 1.0071 | 2.1 |
| 7 | 14:30 | 16.80 | 0.6 | 0.950 | 0.6 | 0.380 | 2.3373 | 1.00 | 2.3373 | 0.950 | 2.2207 | 4.7 |
| 8 | 14:32 | 17.80 | 0.6 | 1.300 | 0.6 | 0.520 | 2.7297 | 1.00 | 2.7297 | 1.300 | 3.5482 | 7.6 |
| 9 | 14:33 | 18.80 | 0.6 | 1.200 | 0.6 | 0.480 | 3.6224 | 1.00 | 3.6224 | 1.320 | 4.7823 | 10.2 |
| 10 | 14:35 | 20.00 | 0.6 | 1.200 | 0.6 | 0.480 | 2.6791 | 1.00 | 2.6791 | 1.320 | 3.5371 | 7.5 |
| 11 | 14:37 | 21.00 | 0.6 | 0.950 | 0.6 | 0.380 | 1.6594 | 1.00 | 1.6594 | 0.950 | 1.5767 | 3.4 |
| *12* | *14:38* | *22.00* | *0.6* | *1.150* | *0.6* | *0.460* | *1.7297* | *1.00* | *1.7297* | *1.150* | *1.9890* | *4.2* |
| 13 | 14:40 | 23.00 | 0.6 | 1.400 | 0.6 | 0.560 | 2.7182 | 1.00 | 2.7182 | 1.400 | 3.8053 | 8.1 |
| 14 | 14:41 | 24.00 | 0.6 | 1.300 | 0.6 | 0.520 | 3.2677 | 1.00 | 3.2677 | 1.300 | 4.2476 | 9.1 |
| *15* | *14:43* | *25.00* | *0.6* | *1.250* | *0.6* | *0.500* | *2.4990* | *1.00* | *2.4990* | *1.250* | *3.1238* | *6.7* |
| 16 | 14:45 | 26.00 | 0.6 | 1.200 | 0.6 | 0.480 | 3.3310 | 1.00 | 3.3310 | 1.200 | 3.9977 | 8.5 |
| *17* | *14:46* | *27.00* | *0.6* | *1.150* | *0.6* | *0.460* | *2.1129* | *1.00* | *2.1129* | *1.150* | *2.4297* | *5.2* |
| 18 | 14:47 | 28.00 | 0.6 | 1.150 | 0.6 | 0.460 | 2.5427 | 1.00 | 2.5427 | 1.150 | 2.9239 | 6.2 |
| 19 | 14:48 | 29.00 | 0.6 | 0.700 | 0.6 | 0.280 | 2.5449 | 1.00 | 2.5449 | 0.700 | 1.7818 | 3.8 |
| 20 | 14:49 | 30.00 | 0.6 | 0.600 | 0.6 | 0.240 | 2.3488 | 1.00 | 2.3488 | 0.600 | 1.4094 | 3.0 |
| 21 | 14:50 | 31.00 | 0.6 | 0.800 | 0.6 | 0.320 | 1.2474 | 1.00 | 1.2474 | 0.800 | 0.9977 | 2.1 |
| 22 | 14:51 | 32.00 | 0.6 | 0.550 | 0.6 | 0.220 | 1.4065 | 1.00 | 1.4065 | 0.550 | 0.7734 | 1.7 |
| 23 | 14:52 | 33.00 | 0.6 | 0.250 | 0.6 | 0.100 | 0.6329 | 1.00 | 0.6329 | 0.300 | 0.1899 | 0.4 |
| 24 | 14:52 | 34.40 | None | 0.000 | 0.0 | 0.0 | 0.0000 | 1.00 | 0.0000 | 0.000 | 0.0000 | 0.0 |

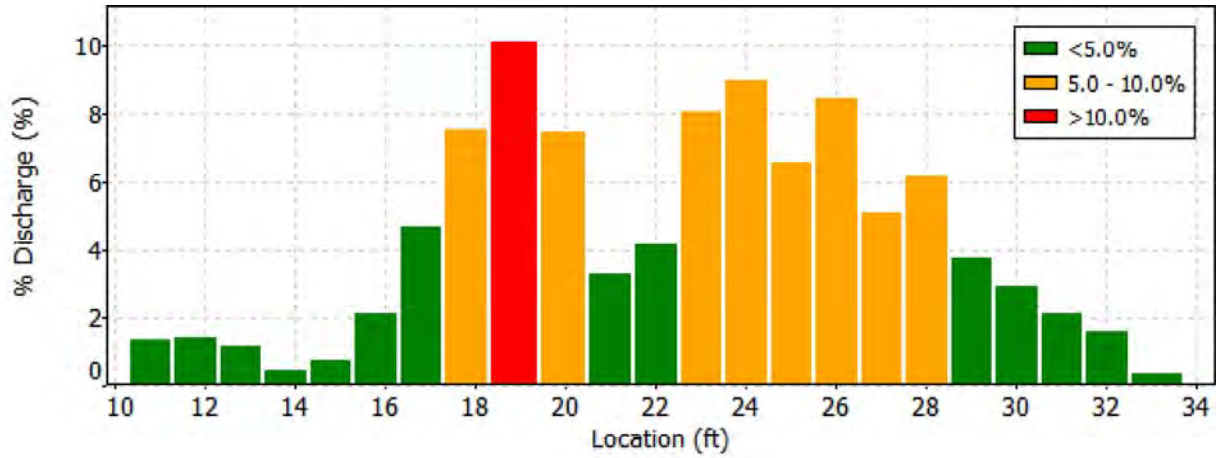
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

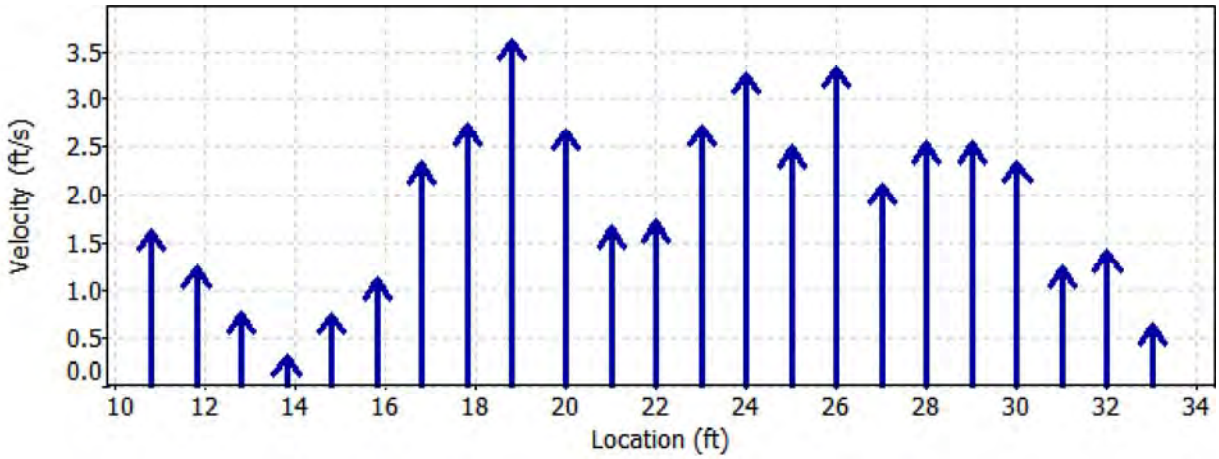
COLORADO
Colorado Water Conservation Board
Department of Natural Resources

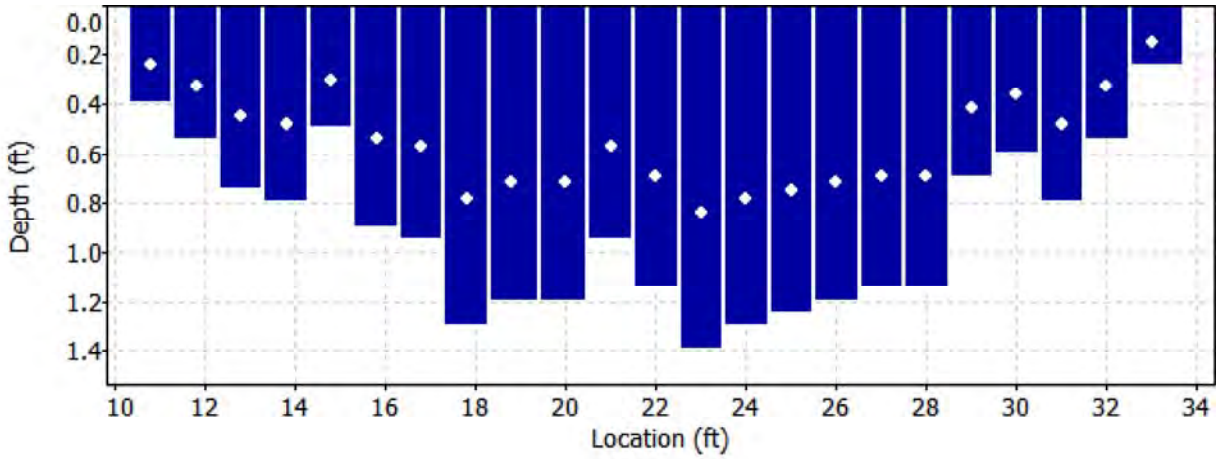
# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

| File Information | | Site Details | |
|---|---|---|---|
| File Name | BCABPRLT.001.WAD | Site Name | BRUSH C 1200 AB LT |
| Start Date and Time | 2016/07/13 14:23:06 | Operator(s) | BJE |



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

## File Information

| | |
|---|---|
| File Name | BCABPRLT.001.WAD |
| Start Date and Time | 2016/07/13 14:23:06 |

## Site Details

| | |
|---|---|
| Site Name | BRUSH C 1200 AB LT |
| Operator(s) | BJE |

## Quality Control

| St | Loc | %Dep | Message |
|---|---|---|---|
| 4 | 13.80 | 0.6 | High angle: -37 |
| 12 | 22.00 | 0.6 | High angle: -24 |
| 15 | 25.00 | 0.6 | High standard error: 0.156 |
| 17 | 27.00 | 0.6 | High standard error: 0.141 |

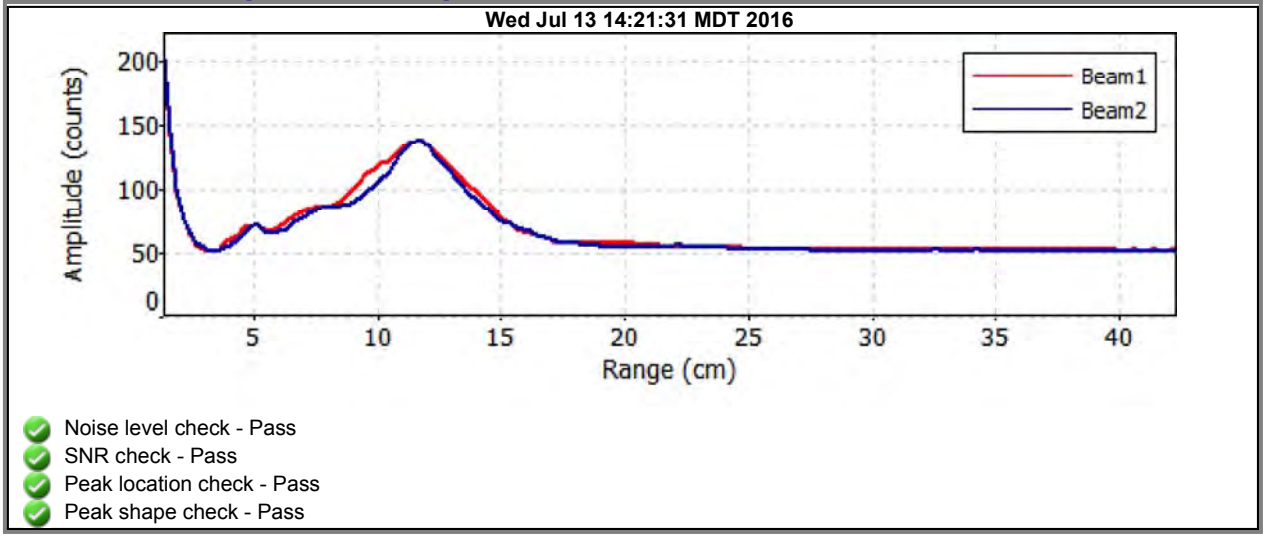
COLORADO
Colorado Water Conservation Board
Department of Natural Resources

# Discharge Measurement Summary

Date Generated: Mon Dec 19 2016

| File Information | | Site Details | |
|---|---|---|---|
| File Name | BCABPRLT.001.WAD | Site Name | BRUSH C 1200 AB LT |
| Start Date and Time | 2016/07/13 14:23:06 | Operator(s) | BJE |

## Automatic Quality Control Test (BeamCheck)




- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

**General Site Field Visit Data Report** *(Filters: Name begins with Brush;)*

| Type | | Div | Name | CWCB Case Number | Segment ID | Visit Date | Location Description |
|---|---|---|---|---|---|---|---|
| Stream | | 4 | Brush Creek | | 17/4/A-002 | 7/13/2016 | Brush Creek |

Remarks

| Date | Remark |
|---|---|
| 13/07/16 14:20 | Arrive at site, proposed lower terminus. |
| 13/07/16 15:16 | Hiked in creek from the proposed lower terminus upstream about 900 feet. The creek characteristics: stable, single channel, boulder/cobble bed, plunge pool, moderate woody debris in creek, plenty of contributable woody debris, rushes-sedges-pines-willows stabilizing the banks (variety of life stages), thick moss on rocks in shaded areas, minimum 4% slope for section hiked (~5' drop per ~120' of creek), and no visible surface water inflow. |
| 13/07/16 17:22 | Return truck and 15:27 depart site. |

GPS Log

| GPS Date | Device | GPSPoint Name | Latitude | Longitude | UTM Zone | UTM Easting | UTMNorthing | Horizontal Accuracy | GPSDescription |
|---|---|---|---|---|---|---|---|---|---|
| 13/07/16 14:54 | Phone (BJE) | BC001 | 38.900227 | -106.880735 | | | | 10.000000 | Truck parking spot. |
| 13/07/16 15:09 | Phone (BJE) | BC002 | 38.898927 | -106.878985 | | | | 5.000000 | Photos of Brush Creek |
| 13/07/16 15:43 | Phone (BJE) | BC003 | 38.899301 | -106.877873 | | | | 5.000000 | Spot discharge measurement location. |

Photo Log

| Photo Date | Camera | Media Type | Photo Video ID | Caption | Photo Comment |
|---|---|---|---|---|---|
| 13/07/16 15:10 | iPhone (BJE) | Photograph | | Brush Creek approx. 900 ft. upstream of LT | Standing in creek near left bank, looking upstream. Taken from GPS BC002. |
| Link: https://620638672b84d7ed4da9-bca54e529e5752f1e6d63fb4a534334b.ssl.cf2.rackcdn.com/iformbuilder.com/461577/_data461577_cwcb_general_subform_photos/field_5536346815786c44f2e9e9.jpg | | | | | |
| 13/07/16 15:13 | iPhone (BJE) | Photograph | | Brush Creek approx. 900 ft upstream of LT | Taken from GPS BC002, standing in creek near left bank. Looking downstream. |
| Link: https://620638672b84d7ed4da9-bca54e529e5752f1e6d63fb4a534334b.ssl.cf2.rackcdn.com/iformbuilder.com/461577/_data461577_cwcb_general_subform_photos/field_17798828255786c45123c21.jpg | | | | | |
| 13/07/16 16:05 | Panasonic Lumix DMC-TS2 (BJE) | Photograph | 684 | Spot discharge measurement cross section | Standing on right bank and looking across the creek. |
| Link: | | | | | |
| 13/07/16 16:05 | Panasonic Lumix DMC-TS2 (BJE) | Photograph | 683 | Spot discharge measurement cross section | Standing in center of creek 20 feet downstream of q measurement section, looking upstream. |
| Link: | | | | | |
| 13/07/16 16:06 | Panasonic Lumix DMC-TS2 (BJE) | Photograph | 685 | Example of riparian vegetation diversity | Taken 0.5 feet upstream of spot discharge measurement tape, on right bank. |
| Link: | | | | | |
| 13/07/16 17:15 | Panasonic Lumix DMC-TS2 (BJE) | Photograph | 686 | Scenic view Brush Creek | Photo taken from cliff side above spot discharge measurement location, on right side of creek. |
| Link: | | | | | |

| | Div | Name | CWCB Case Number | Segment ID | Visit Date | Location Description |
|---|---|---|---|---|---|---|
| | 4 | Brush Creek | | 17/4/A-002 | 7/12/2016 | General Site visit no discharge measurement taken |

Remarks

No Remarks for this site visit.

| | | |
|---|---|---|
| Stream | GPS Log | No GPS Log records for this visit. |
| | Photo Log | No Photo Log records for this visit. |