<u>Stream:</u> Johnson Creek (Upper Segment)

Executive Summary

Water Division: 1
Water District: 48
CDOW#: 11320
CWCB ID: 12/1/A-006

Segment: Confluence with an Unnamed Tributary to the Confluence with Fish Creek
Upper Terminus: CONFLUENCE WITH AN UNNAMED TRIBUTARY
(Latitude 40° 59’ 21.65”N) (Longitude 106° 06’ 11.99”W)

Lower Terminus: CONFLUENCE WITH FISH CREEK
(Latitude 40° 58’ 55.77”N) (Longitude 106° 04’ 36.17”W)

Watershed: Upper Laramie (HUC#: 10180010)
Counties: Larimer
Length: 1.69 miles
USGS Quad(s): Old Roach
Flow Recommendation: 2.3 cfs (April 1 – October 31)
1.6 cfs (November 1 – March 31)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located on the enclosed CD) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

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

Johnson Creek is approximately 11.7 miles long and originates on the east side of the Medicine Bow Mountains at an elevation of 9,590 feet. It flows generally northeasterly through the Roosevelt National Forest as it drops to an elevation of 8,180 feet at the Colorado-Wyoming border. Approximately 94.8 % of the land on the 1.69 mile segment addressed by this report is publicly owned. Johnson Creek is located within Larimer County and the total drainage area of the creek is approximately 26 square miles.

The subject of this report is a segment of Johnson Creek beginning at the confluence with an unnamed tributary and extending downstream to the confluence with Fish Creek. The proposed segment is located approximately 20 miles northeast of the town of Walden. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended 2.3 cfs (April 1 – October 31), and 1.6 cfs (November 1 – March 31) based on its August 3, 2010, and September 17, 2010 data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence with Unnamed Tributary	Confluence with Fish Creek	1.69	5.2%	94.8%

51.3% of the lands are managed by the USFS, 43.5% of the lands are managed by the BLM.

Biological Data

Johnson Creek is a cold-water stream with moderate to high gradients. The stream includes moderate gradient valleys with wider floodplains, but the stream also includes high gradient reaches in narrow gulches that are constrained by bedrock. The stream has a good mixture of pool, riffle, and run habitat. Fish surveys show that Johnson Creek supports a higher diversity of fish species that any other creek managed by BLM on the west side of the Laramie River valley. Fish surveys documented naturally reproducing population of brown trout, brook trout, creek chubs, and white suckers. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, stonefly, and caddisfly. The riparian community is approximately 150 feet wide and is comprised primarily of willows, alders, spruce, and sedges.

Field Survey Data

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Biological Flow Recommendation

The CWCB staff relied upon the biological expertise of the BLM to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. Colorado Parks and Wildlife has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, three data sets were collected, with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon 2 of 3 hydraulic criteria. Recommendations that fall outside of the accuracy range of the model, over 250% of the measured discharge or under 40% of the measured discharge may not give an accurate estimate of the necessary instream flow required.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	8/3/2010 #1	5.28	13.2 – 2.1	2.1	Out of Range
BLM	8/3/2010 #2	5.63	14.1 – 2.3	2.3	Out of Range
BLM	9/17/2010	1.79	4.5 – 0.7	2.5	1.95
			Averages	2.30	1.95

2.30 cubic feet per second is recommended for the annual warm temperature period, from April 1 through October 31. This recommendation is driven by the average velocity criteria and average depth criteria. It is important to maintain as much usable physical habitat as possible during the summer growing season for the four fish species found in the creek.

1.6 cubic feet per second is recommended for the annual cold temperature period, from November 1 to March 31. This flow rate meets the wetted perimeter criteria, provides an average velocity of 0.85 feet per second, and an average depth 0.18 feet. During winter, this flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

Hydrologic Data and Analysis

After receiving the cooperating agency's biologic recommendation, the CWCB Staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation. This evaluation was done through a computation that is, in essence, a "water balance". In concept, a "water balance" computation can be viewed as an accounting exercise. When done in its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), the balance tries to account for all water depletions (losses) until a selected end point is reached. Water losses include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. These losses are individually or collectively subtracted from the input to reveal the net amount of stream runoff as represented by the discharge measured by stream gages.

CWCB Staff attempts to use this idea of balancing inputs and losses to determine if water is available for the recommended instream flow appropriation. Of course, this effort must be a practical exercise rather than a lengthy, and costly, scientific investigation. As a result, Staff simplifies the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The process that is typically used by Staff incorporates, where possible, diversion records as well as the stream gage data collected by the US Geological Survey and DNR's Water Resources Division. All of these data are available in the DWR database called Hydrobase.

To determine water availability, Staff begins by characterizing the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case, this means looking at data that has been collected for a long period of time from a gage that is located at the LT. Preferably, the period of data collection includes both wet and dry conditions. However, in the case of Johnson Creek #1 there is no gage and hence no record of discharge collected by either the USGS or DWR. Lacking such data, the description of flow above the Johnson Creek #1 LT can only be indirectly described through reference to a "representative" gage station. There are two USGS gage stations in reasonably close

proximity to Johnson Creek #1, either of which could represent the hydrologic functioning of Johnson Creek #1. The first of these is LARAMIE RIVER NEAR GLENDEVEY, CO (USGS 06657500). This gage is at an elevation of 8230 ft above mean sea level (amsl), has a generally North – South orientation, and a drainage area of 101 mi^2. The period of record (POR) of 74 years was collected between 1904 and 1982. The hydrograph (plot of discharge over time) for this gage includes consumptive depletions from several diversions, although diversions and consumptive uses do not necessarily constitute a major limitation upon the use of the data from the gage.

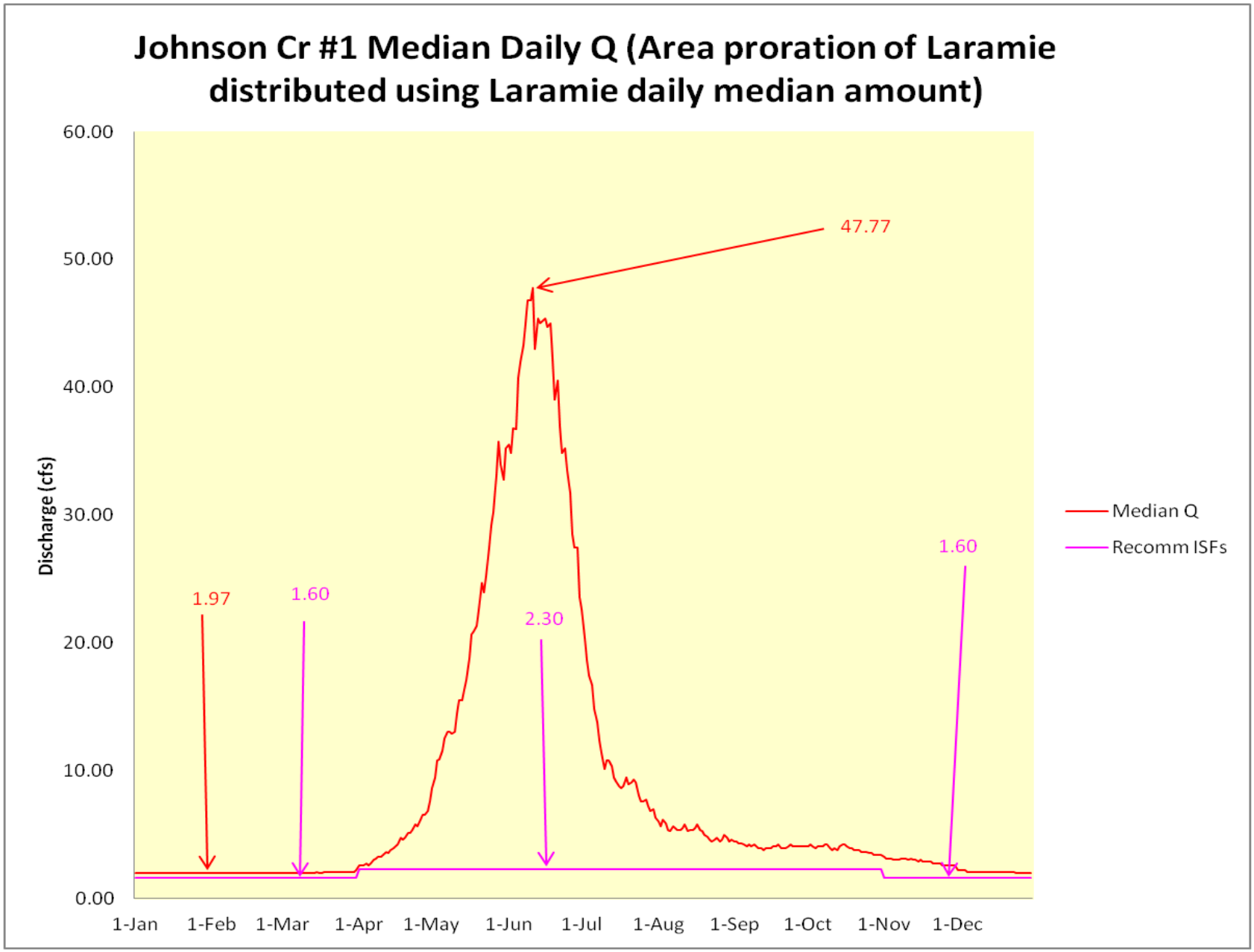
The second gage is SAND CREEK AT COLORADO – WYOMING STATE LINE (USGS 066595800) This gage is at an elevation of 7580 ft amsl, has a generally Southwest – Northeast orientation, and a drainage area of 29.2 mi^2. The POR of 44 years was collected between 1968 and 2011. The hydrograph for this gage includes consumptive depletions due to stockwater use and out-of-basin transfers, although such uses and transfers do not necessarily constitute a major limitation upon the use of the data from the gage.

The gages described above were found to have certain limitations that compromised their potential for use as gages "representative" of the hydrology of Johnson Creek #1. The greatest limitation was found in the low flow periods of Fall through Spring – the period of greatest importance to instream flow recommendations. With the exception of three years (1969 – 1971), the Sand Creek gage contained virtually no data from 1 October until 1 April. A plot of the annual hydrograph that relied upon those three years to represent the low flow period resulted in an uncharacteristic graph with low flow values that had high standard deviations and conflicted with on-the-ground observations. Even though the Sand Creek watershed was otherwise well suited to serve as "representative" of Johnson Creek #1 (similar size, orientation, shape, elevation, location, a long POR, etc), the paucity of low discharge values rendered the record of little or no value in the characterization of the hydrology of Johnson Creek #1.

The Laramie River gage had similar problems. This gage did not suffer from the same problem as Sand Creek with respect to the absence of low flow data. However, the gage record, although long, was not as current as that of Sand Creek and the basin orientation was nearly perpendicular to that of Johnson Creek #1 and the other Laramie River basin creeks being recommended. While the Laramie River gage low flow records were approved for publication, a certain uniformity in values, especially in the older data led to some concern that more estimates of flow may have been made than has been noted in the record. This is of importance because of the difficulty of verification due to the dearth of low flow season data in the Sand Creek record.

Hydrograph development for ungaged streams becomes more difficult when Staff finds itself with a lack of gage data on a recommended stream and no "representative" gage is available due to the absence of nearby gage stations or because the nearby gage station records are unusable. Under these circumstances, Staff may be forced to employ a basin characteristics approach to determine mean monthly discharge values for the ungaged watershed. The method used, called StreamStats, was developed by the USGS for the estimation of mean monthly discharge (and other flow-related parameters) at ungaged sites through the use of watershed attributes. The attributes used may include precipitation, basin area, amount of basin above 7,500 ft elevation, and other morphological indices.

For Johnson Creek #1, Staff's StreamStats analysis resulted in a mean monthly hydrograph, which was used to help determine the reasonableness of the results obtained by using a simple area proration of the daily data from the Laramie River Gage. The following prorated median flow hydrograph utilizing the Laramie River gage data shows that water is available for appropriation.


Johnson Cr #1 Median Daily Q (Area proration of Laramie distributed using Laramie daily median amount)
Discharge (cfs)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
47.77
1.97
1.60
2.30
1.60
Median Q
Recomm ISFs

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are no decreed surface diversions within this reach of stream. Staff has determined that water is available for appropriation on Johnson Creek between the confluence with an unnamed tributary down to its confluence with Fish Creek, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

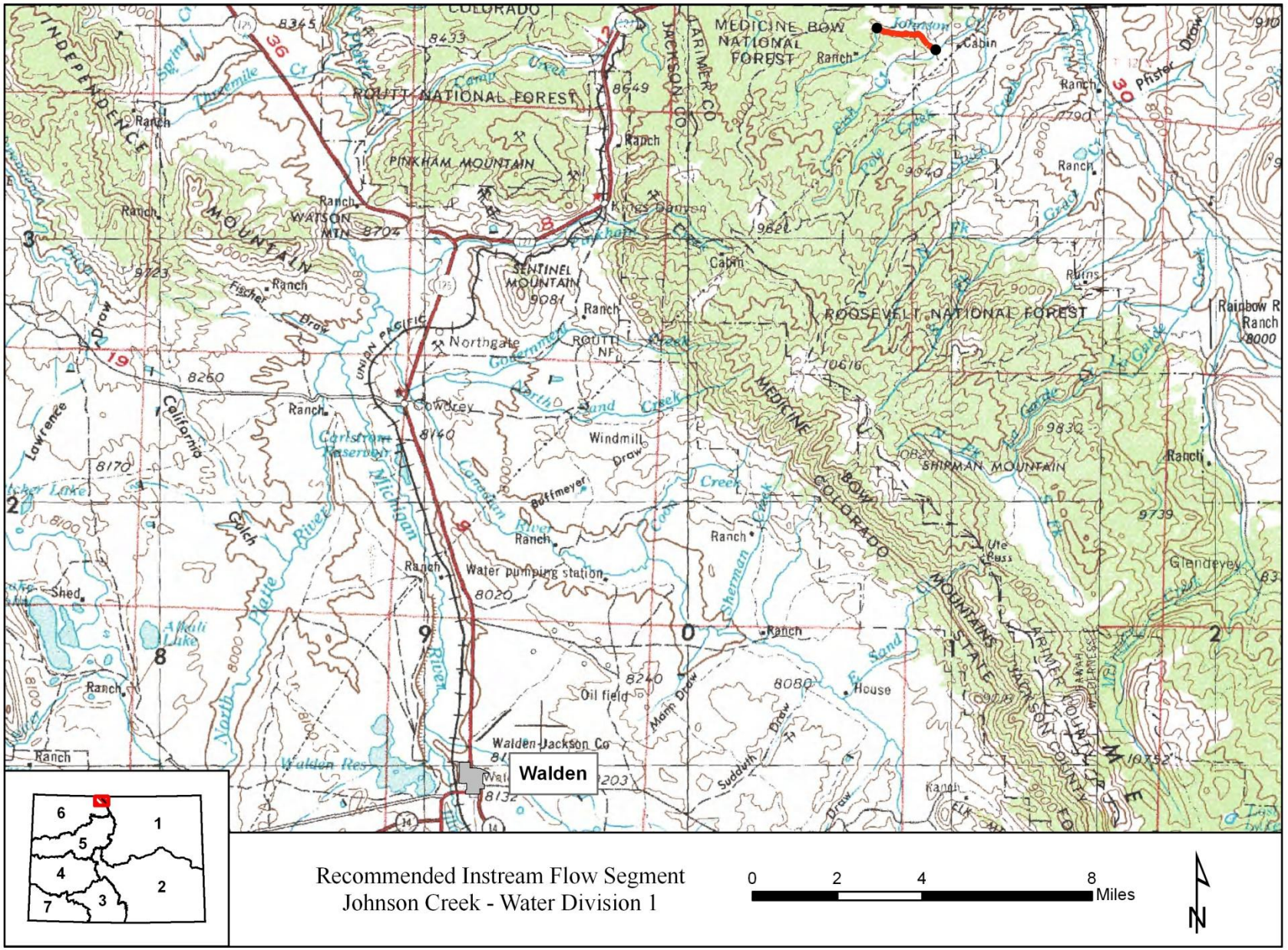
Staff recommends the Board form its intent to appropriate on the following stream reach:

Segment: Confluence with an Unnamed Tributary to the Confluence with Fish Creek
Upper Terminus: CONFLUENCE WITH AN UNNAMED TRIBUTARY
(Latitude 40° 59' 21.65"N) (Longitude 106° 06' 11.99"W
UTM North: 4538160.73 UTM East: 407192.50
NW NW Section 25, Township 12 North, Range 78 West 6th PM
1026' East of the West Section Line; 135' South of the North Section Line

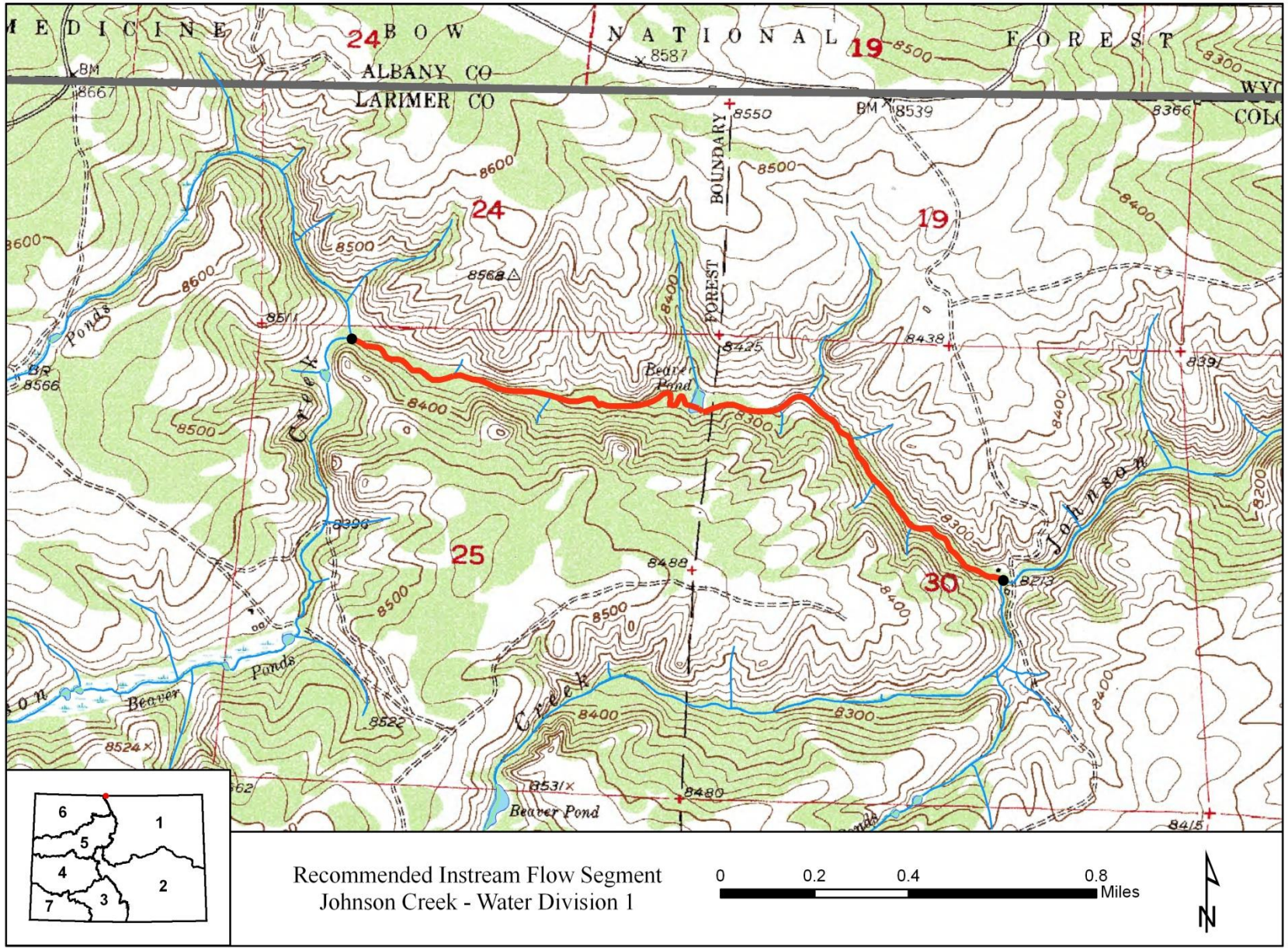
Lower Terminus: CONFLUENCE WITH FISH CREEK
(Latitude 40° 58' 55.77"N) (Longitude 106° 04' 36.17"W)
UTM North: 4537334.73 UTM East: 409421.54
NW SE Section 30, Township 12 North, Range 77 West 6th PM
2163' East of the West Section Line; 2555' North of the South Section Line

Watershed: Upper Laramie (HUC#: 10180010)
Counties: Larimer
Length: 1.69 miles
USGS Quad(s): Old Roach
Flow Recommendation: 2.3 cfs (April 1 – October 31)
1.6 cfs (November 1 – March 31)

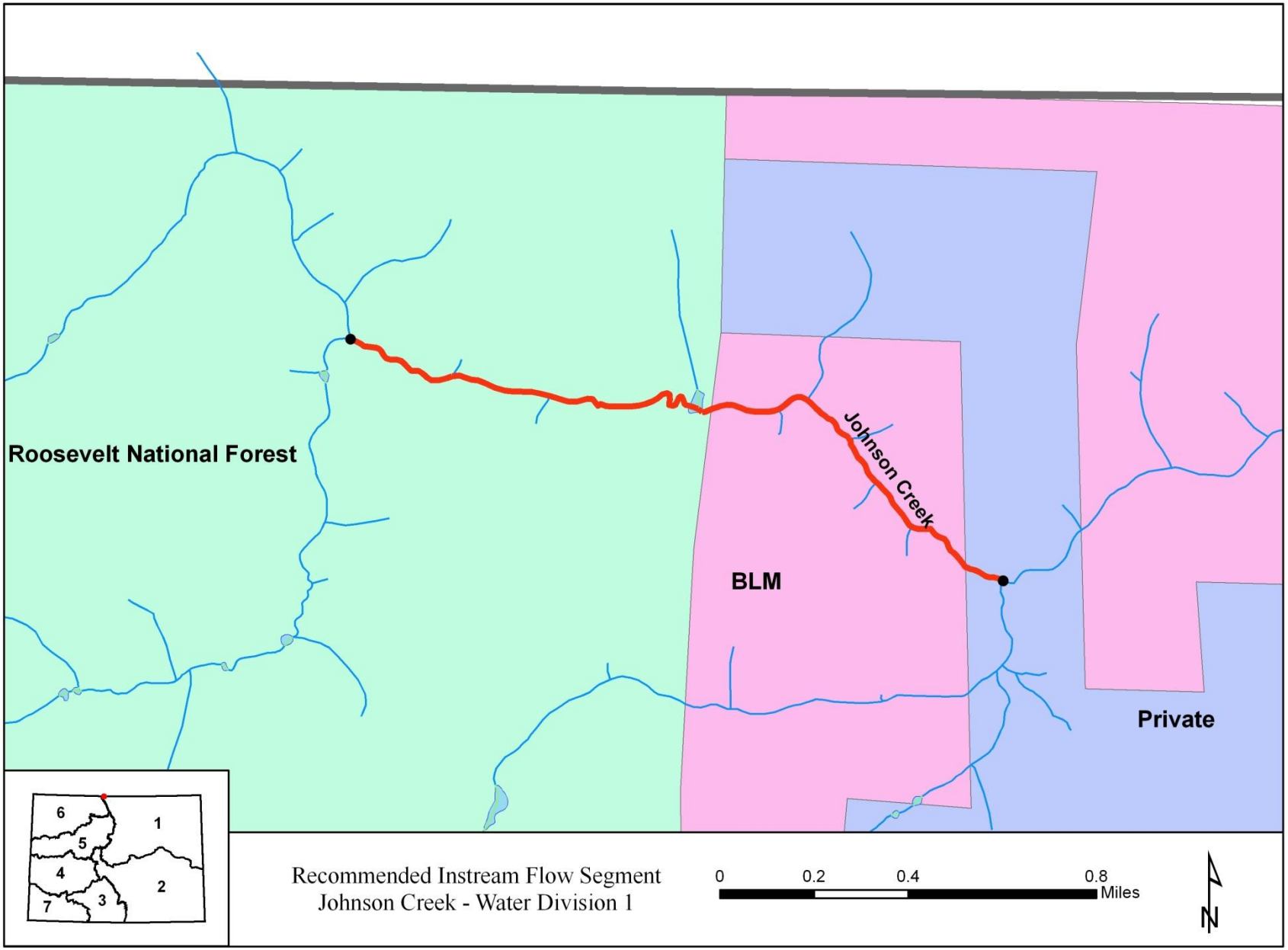
Vicinity Map



Water Rights Map



Land Use Map


Roosevelt National Forest
Johnson Creek
BLM
Private
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Johnson Creek - Water Division 1
0
0.2
0.4
0.8
Miles
N