<u>Stream:</u> Red Creek

Executive Summary

Water Division: 6
Water District: 58
CDOW#: 21600
CWCB ID: 13/6/A-002

Segment: U.S. FOREST SERVICE BOUNDARY TO CONFLUENCE WITH WILLOW CREEK
Upper Terminus: USFS BOUNADRY AT
UTM North: 4514949.39 UTM East: 332549.21

Lower Terminus: CONFLUENCE WITH WILLOW CREEK AT
UTM North: 4515585.43 UTM East: 336949.19

Watershed: Upper Yampa (HUC#: 14050001)
Counties: Routt
Length: 4.0 miles
USGS Quad(s): Hahns Peak
Flow Recommendation: 1.85 cfs (April 1 – July 15)
0.7 cfs (July 16 – March 31)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2013ProposedInstreamFlowAppropriations.aspx) 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 Red Creek to the CWCB for a water right under the Instream Flow Program. Red Creek is being considered because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Red Creek is approximately 8 miles long and originates on Sand Mountain at an elevation of 9,000 feet. It flows in an easterly direction as it drops to an elevation of 7,900 feet where it joins Willow Creek. Thirty-four percent of the land on the 4.0 mile segment addressed by this report is publicly owned. Red Creek is located within Routt County and the total drainage area of the creek is approximately 9.28 square miles and is oriented west to east.

The subject of this report is a segment of Red Creek beginning at the USFS Boundary and extending downstream to the confluence with Willow Creek. The proposed segment is located approximately 15 miles northwest of Steamboat Springs. 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 a flow of 1.85 cfs (April 1 – July 15) and 0.7cfs (July 16 – March 31) based on its August 17, 2011 data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
USFS Boundary	Confluence with Willow Creek	4.0	66%	34%

All of the public lands in this segment are managed by the BLM.

Biological Data

Red Creek is a cold-water, low gradient stream in rolling foothills below the Routt National Forest. The stream meanders through a valley floor that is approximately 200 feet wide. Red Creek has substrate ranging from gravels to small cobbles. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery. The creek also supports an active beaver community.

Fishery surveys revealed a self-sustaining native fishery which included mountain suckers, mottled sculpin, and speckled dace. White suckers, which are native to the Front Range, were also documented in the creek. Even though Red Creek is a small stream, the fish population survived the 2002-2003 drought, indicating that base flows are sufficient to support the trout fishery through all types of climate conditions. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Red Creek is in good condition, and provides adequate cover, overhanging banks, and habitat diversity for the fish population. The riparian community is comprised mainly of willows and sedges and occupies the entire valley bottom.

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, two 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 (250% 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: R2Cross Results

Party	Date	Q (cfs)	Accuracy Range (cfs)	Winter (2/3) (cfs)	Summer(3/3) (cfs)
BLM	8/17/2011	1.15	0.46 – 2.88	1.30	2.01
BLM	8/17/2011	0.98	0.39 – 2.45	1.68	1.70
			Averages	1.5	1.85

1.85 cubic feet per second is recommended for the snowmelt runoff period from April 1 through July 15. This recommendation is driven by the average depth criteria. Because of its small size and low flows during the base flow period, it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available.

0.7 cubic feet per second is recommended for the remainder of the year, from July 16 to March 31. This recommendation is driven by water availability, because insufficient water is available to meet two of three flow criteria at 1.5 cfs, as recommended by the R2Cross modeling effort. 0.7 cubic feet per second come close to meeting the average velocity and wetted perimeter criteria, but provides an average depth of only 0.135 feet. This flow rate should prevent excessively high water temperatures during the late summer period and it should protect overwintering fish by preventing pools from freezing.

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 Red Creek, 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 Red Creek LT can be indirectly described through reference to a "representative" gage station. There are two USGS gage stations that measure tributaries in reasonably close proximity to Red Creek, either of which could represent the hydrology of Red Creek. The first of these is Elkhead Creek Near Clark, CO (USGS 09244500). This gage is at an elevation of 7,800 ft above mean sea level (amsl), has a generally East – West orientation, and a drainage area of 46 mi^2. The period of record (POR) of 16 years was collected between 1942 and 1973. 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 South Fork Elk River Near Clark, CO (USGS 09240800) This gage is at an elevation of 7,980 ft amsl, has a generally Southeast – Northwest orientation, and a drainage area of 34 mi^2. The POR of 5 years was collected between 1966 and 1973. 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.

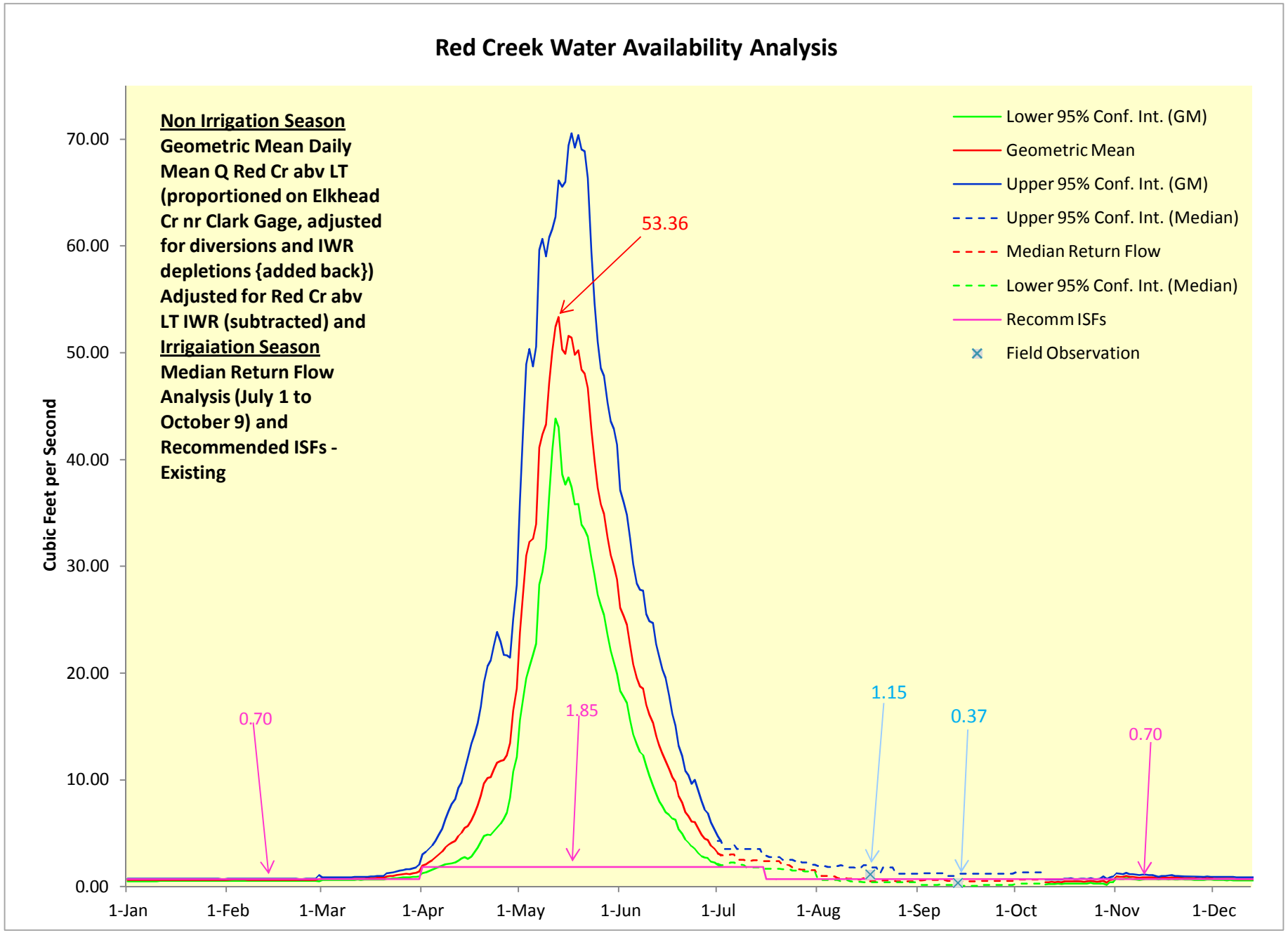
The gages described above were found to have certain limitations that compromised their potential for use as gages "representative" of the hydrology of Red Creek. The greatest limitation for the Elkhead Creek gage was found in the irrigation season – a period of great importance to instream flow recommendations. Based on spot discharge measurements of Red Creek, the apportionment from the Elkhead Creek gage seems to under predict available water. Otherwise, the Elkhead Creek watershed was well suited to serve as "representative" of Red Creek (similar areal elevation distribution, and a shared location boundary, etc).

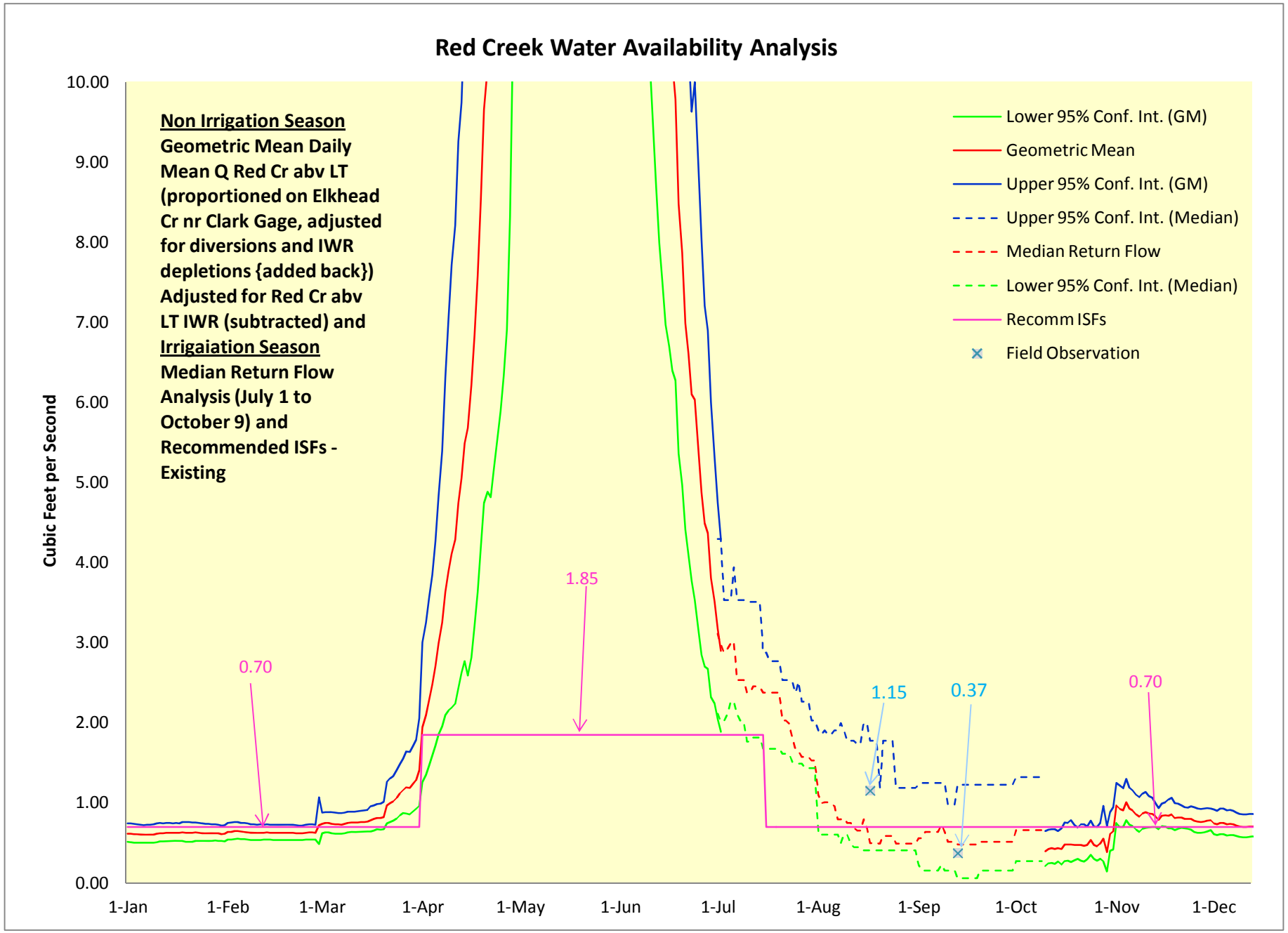
The significant problem with the South Fork Elk River gage was that its elevation was distributed considerably higher than Red Creek. This gage did not suffer from the same irrigation season problem as Elkhead Creek. However, the gage record was short and the slope orientation was different than the subject creek.

Hydrograph development for ungaged streams becomes more difficult when Staff finds itself with a lack of gage data on a recommended stream and a seemingly unrepresentative season from the "representative" gage. Recognizing the limitations of the Elkhead Creek gage for this analysis, it is the best available data and was used for the proration as the "representative" gage in the non irrigation portion of the year. Staff then employed a water balance analysis, using diversion records and irrigation water requirements, to determine the likely irrigation season flows on Red Creek.

The water balance analysis examined the historic diversion records: daily diversion records, the irrigated acres records, crop and irrigation method. These were used to determine the portion of water consumed. The NRCS soil maps and USGS geologic maps were consulted to confirm the assumption that water is traveling through the shallow alluvial system and returning to Red Creek is reasonable. This information is used to determine the median amount of water left in the basin. For the water balance analysis, median was selected as the representative statistic because the diversion record was examined and making Gaussian distribution assumption in normal or log space was not appropriate.

For Red Creek, Staff's water balance analysis resulted in a median monthly hydrograph for the irrigation season, which when coupled with the areal apportionment was used to help determine a more representative hydrograph, as judged by field observation, than was obtained from using a simple area proration of the daily data from the Elkhead Creek gage. The prorated geometric mean (solid lines) and median return water (dashed lines) hydrograph utilizing the Elkhead Creek gage and diversion record data shows that water is available for appropriation (See Figures 1 and 1a).


Red Creek Water Availability Analysis
Non Irrigation Season
Geometric Mean Daily Mean Q Red Cr abv LT (proportioned on Elkhead Cr nr Clark Gage, adjusted for diversions and IWR depletions {added back}) Adjusted for Red Cr abv LT IWR (subtracted) and
Irrigaiation Season
Median Return Flow Analysis (July 1 to October 9) and Recommended ISFs - Existing
Cubic Feet per Second
70.00
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
53.36
0.70
1.85
1.15
0.37
0.70
Lower 95% Conf. Int. (GM)
Geometric Mean
Upper 95% Conf. Int. (GM)
Upper 95% Conf. Int. (Median)
Median Return Flow
Lower 95% Conf. Int. (Median)
Recomm ISFs
Field Observation


Red Creek Water Availability Analysis
Non Irrigation Season
Geometric Mean Daily Mean Q Red Cr abv LT (proportioned on Elkhead Cr nr Clark Gage, adjusted for diversions and IWR depletions {added back}) Adjusted for Red Cr abv LT IWR (subtracted) and
Irrigaiation Season
Median Return Flow Analysis (July 1 to October 9) and Recommended ISFs - Existing
Cubic Feet per Second
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
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
Lower 95% Conf. Int. (GM)
Geometric Mean
Upper 95% Conf. Int. (GM)
Upper 95% Conf. Int. (Median)
Median Return Flow
Lower 95% Conf. Int. (Median)
Recomm ISFs
Field Observation
0.70
1.85
1.15
0.37
0.70

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 Red Creek between the USFS Boundary to Confluence with Willow Creek, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

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

Segment: U.S. FOREST SERVICE BOUNDARY TO CONFLUENCE WITH WILLOW CREEK
Upper Terminus: USFS BOUNADRY AT
UTM North: 4514949.39 UTM East: 332549.21
(Latitude 40° 46' 6.5"N) (Longitude 106° 59' 2.65"W)
NE SW Section 1, Township 9 North, Range 86 West 6th PM
2,609' East of the West Section Line; 2,516' North of the South Section Line

Lower Terminus: CONFLUENCE WITH WILLOW CREEK AT
UTM North: 4515585.43 UTM East: 336949.19
(Latitude 40° 46' 30.3"N) (Longitude 106° 55' 55.67"W)
NW NW Section 4, Township 9 North, Range 85 West 6th PM
1,096' East of the West Section Line; 372' South of the North Section Line

Watershed: Upper Yampa (HUC#: 14050001)
Counties: Routt
Length: 4.0 miles
USGS Quad(s): Hahns Peak
Flow Recommendation: 1.85 cfs (April 1 – July 15)
0.7 cfs (July 16 – March 31)

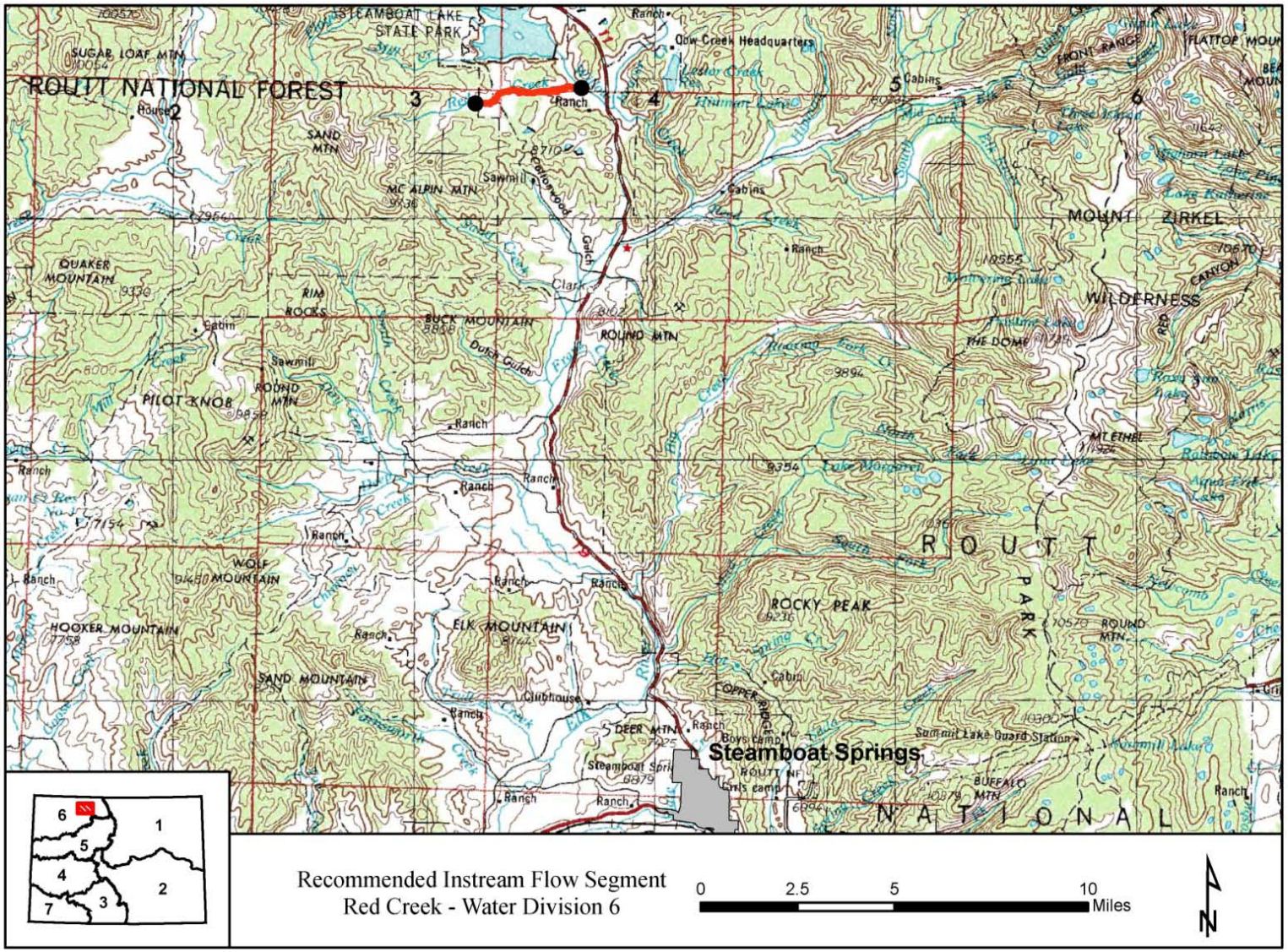
Metadata Descriptions:

a) The UTM, PLSS and Lat/Long locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

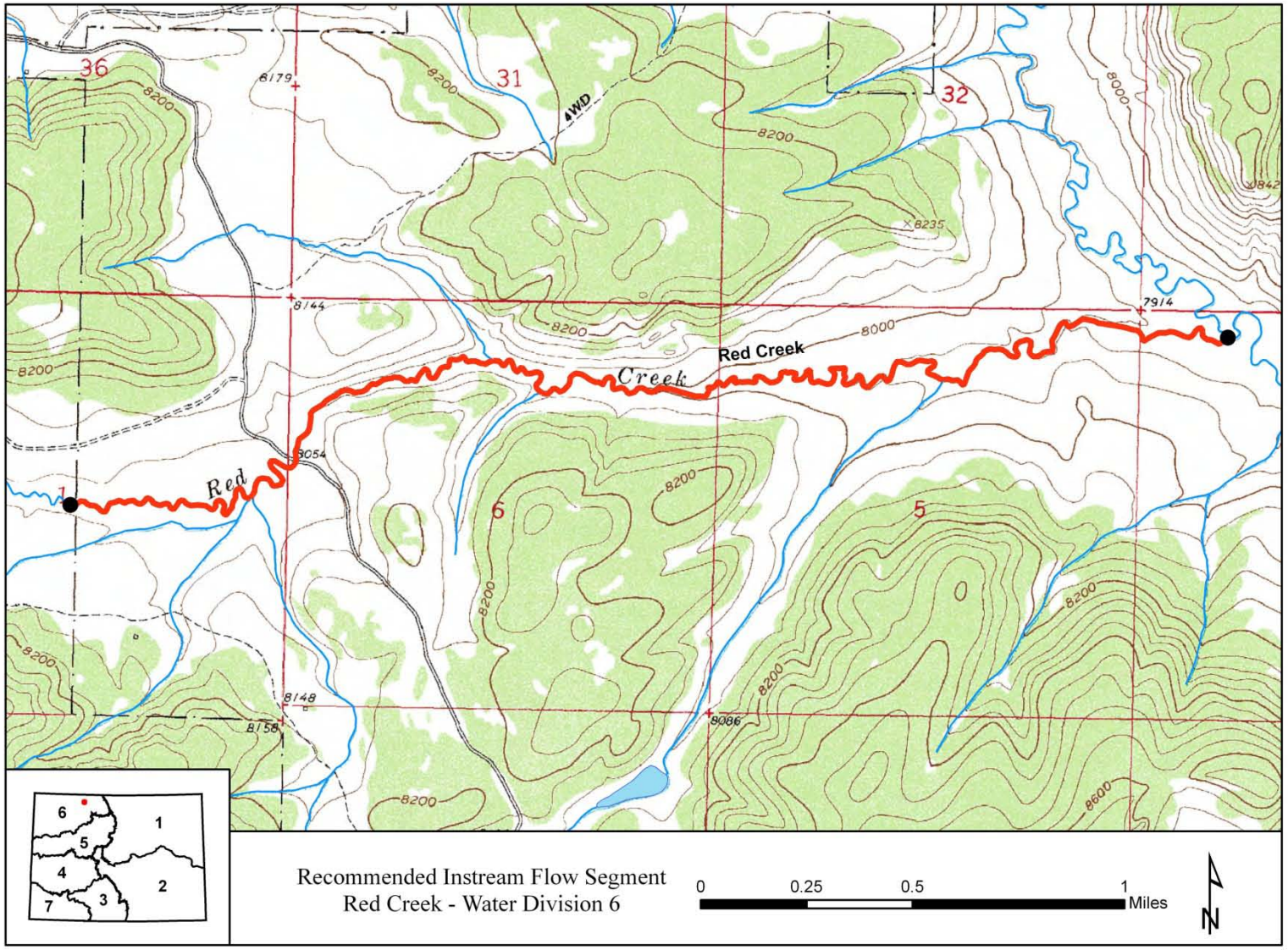
b) The PLSS locations were derived from CWCB GIS using 2005 PLSS data from the U.S. Bureau of Land Management's Geographic Coordinate Database

c) Projected Coordinate System: NAD 1983 UTM Zone 13N

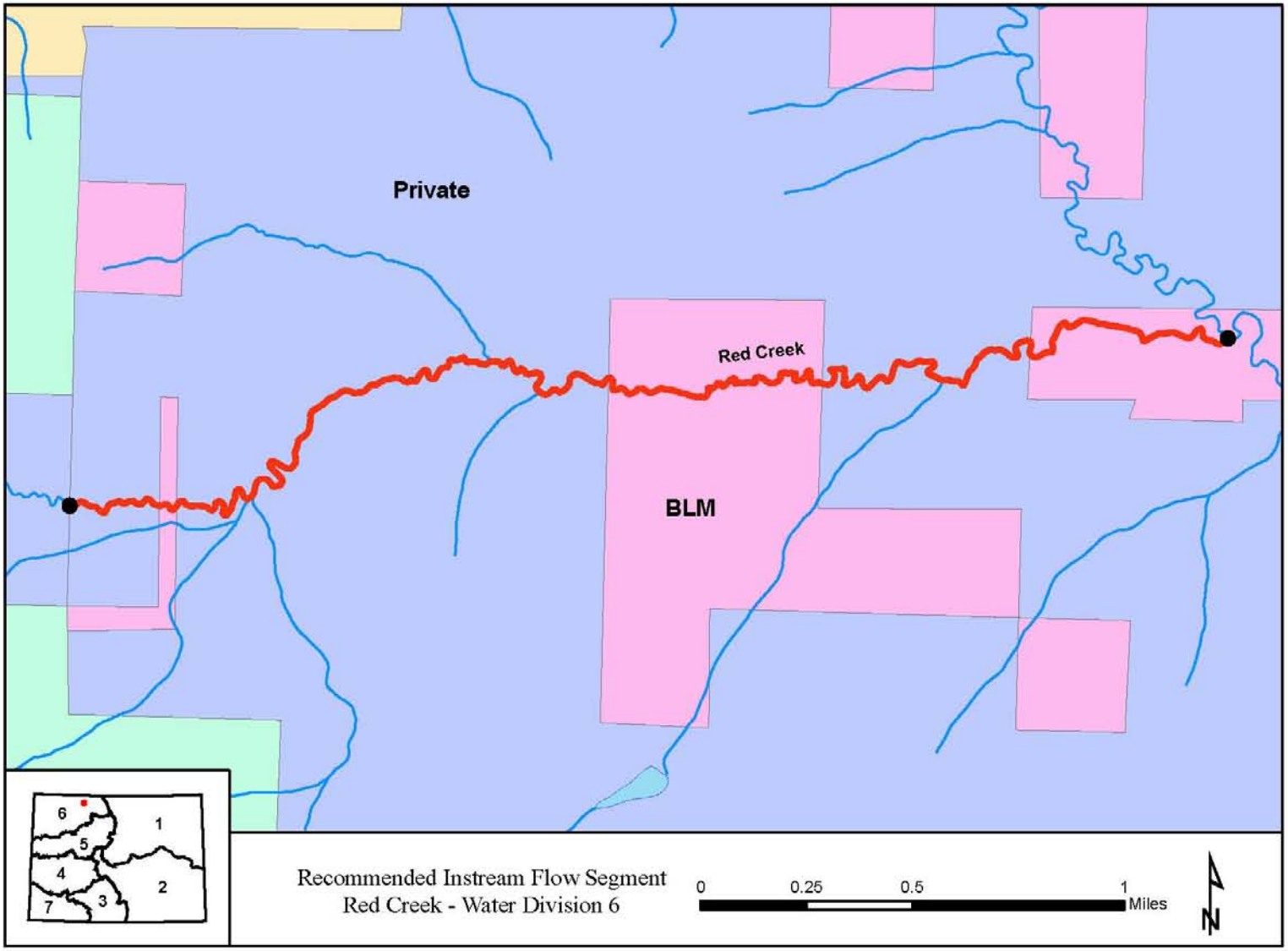
Vicinity Map



Water Rights Map



Land Use Map


Private
Red Creek
BLM
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Red Creek - Water Division 6
0
0.25
0.5
1
Miles
N