COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Trout Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	confluence with an unnamed tributary at UTM North: 4457645.23 UTM East: 323578.92
LOWER TERMINUS:	Koll Ditch headgate UTM North: 4464276.41 UTM East: 329133.88
WATER DIVISION:	6
WATER DISTRICT:	57
COUNTY:	Routt
WATERSHED:	Upper Yampa
EXISTING ISF:	77W1338, 5 cfs (01/01 - 12/31)
CWCB ID:	19/6/A-009
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	6.64 miles
FLOW RECOMMENDATION:	2.0 cfs (11/01 - 03/31) 8.0 cfs (04/01 - 07/31) 7.0 cfs (08/01 - 10/31)

Trout Creek

Introduction

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "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 Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The BLM recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Trout Creek. Trout Creek is located within Routt County and originates in the Flat Tops Mountains at an elevation of approximately 11,250 ft. The stream flows north 43 miles to the confluence with the Yampa River at an elevation of approximately 6,500 ft (See Vicinity Map). The proposed reach extends from the confluence with an unnamed tributary downstream to the Koll Ditch headgate. The BLM manages 11 percent of the land on the 6.64 mile proposed reach, and 89 percent is privately owned (See Land Ownership Map). The current ISF water right does not provide sufficient physical habitat during the warm weather portions of the year when the fish populations are feeding, growing, and spawning. The proposed increase in flow rates during winter is warranted to make much of the physical habitat in the stream channel less susceptible to freezing.

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/2019ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Trout Creek is a cold water, moderate gradient stream. The reach that is the subject of this recommendation flows through a valley that ranges from 1/8 to 1/2 mile in width. The upper part of the reach flows through agricultural lands used for livestock grazing, while the lower part of the reach flows through a confined canyon that is largely in natural condition. Substrate is generally from medium to large size, ranging from 4-inch cobbles to small boulders. Water quality is good for supporting salmonid fish species, but during July and August, temperatures can approach the maximum temperatures that trout can tolerate.

Fish surveys indicate a diverse and self-sustaining fish community. Trout Creek provides habitat for brook trout, brown trout, Colorado River cutthroat trout, mottled sculpin, speckled dace, and mountain sucker. Spot surveys have indicated abundant populations of stonefly and caddisfly.

Table 1. List of species identified in Trout Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	None
brown trout	*Salmo trutta*	None
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern Federal - Sensitive Species
mottled sculpin	*Cottus bairdii*	None
mountain sucker	*Catostomus platyrhynchus*	State - Species of Special Concern Federal – Sensitive Species
speckled dace	*Rhinichthys osculus*	None

ISF Quantification

CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

Methodology

BLM staff used the R2Cross methodology to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996). Riffles are most easily visualized as the stream habitat types that would dry up first should streamflow cease. The field data collected consists of streamflow measurements and surveys of channel geometry at a transect and of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides the biological quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

Data Analysis
R2Cross data was collected at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 7.53 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 13.04 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

Table 2. Summary of R2Cross transect measurements and results for Trout Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	08/12/2017 #1	9.43	3.77 - 23.58	9.27	13.28
BLM	08/12/2017 #2	8.58	3.43 - 21.45	5.79	12.80
			Mean	7.53	13.04

ISF Recommendation
The BLM recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

8.0 cubic feet per second increase is recommended during the snowmelt runoff period and early summer, from April 1 to July 31. This recommendation is driven by the average depth criteria. In many locations, the Trout Creek channel is wide with large substrate, so meeting the depth criteria is important for passage between rocks and between pools. Implementing this recommendation would increase the instream flow rate during this time period to a total of 13.0 cubic feet per second.

7.0 cubic feet per second increase is recommended during late summer and early fall, from August 1 to October 31. This recommendation is driven by limited water availability. This flow rate will maintain sufficient physical habitat in the creek for the fish population to complete important parts of their life cycle before cold temperatures reduce fish activity for the winter. Implementing this recommendation would increase the instream flow rate during this time period to a total of 12.0 cubic feet per second.

2.0 cubic feet per second increase is recommended during the cold temperature portion of the year, from November 1 through March 31. This recommendation is driven by limited water availability but comes very close to meeting the wetted perimeter criteria and the velocity criteria. This flow rate should prevent complete icing of the numerous pools in this reach, allowing the fish population to overwinter. Implementing this recommendation would increase the instream flow rate during this time period to a total of 7.0 cubic feet per second.

The BLM believes an instream flow increase for Trout Creek is warranted because of physical habitat characteristics. The R2Cross data summarized above clearly indicates that the current instream flow water right does not provide sufficient physical habitat during the warm weather portions of the year when the fish populations are feeding, growing, and spawning. When the existing instream flow rights are applied to the cross-sections that were collected, the stream would exhibit 40 percent to 66 percent wetted perimeter. However, this habitat is not highly usable by the fish population, because 5.0 cfs constrains the habitat to an average depth of 0.22 to 0.26 feet. An average habitat

depth of 0.22 to 0.26 feet is not sufficient in a stream that averages 35 to 40 feet in top width. During the warm weather season, the fish populations need to have access to as much of the stream channel as possible for feeding, resting, and spawning if they are to survive the pronounced cold winters in this canyon. The increase in flow rates during winter is warranted because the average depths associated with 7.0 cfs make much of the physical habitat in the stream channel less susceptible to freezing.

Water Availability
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

Methodology
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This approach focuses on streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Trout Creek is 32.2 square miles, with an average elevation of 9,477 ft and average annual precipitation of 33.55 inches (See the Vicinity Map). There are a number of known surface water diversions in the drainage basin tributary to the proposed ISF on Trout Creek. These structures potentially divert approximately 105.5 cfs and include the Sheriff Reservoir (986 AF) and an additional 61 AF in other storage. The Alex Ditch (1.28 cfs, appropriation

dates 1912 and 1948) is the only diversion structure located within the proposed reach. This water right is relatively small and has sporadic diversion records.

Available Data
There is not a current or historic daily streamflow gage on Trout Creek. However, the Edna Mine measured streamflow at a location near the proposed lower terminus from 1989 to 2009 (Edna Mine site identifier TR-a). These measurements were reported to the Department of Reclamation, Mining and Safety on an approximately monthly basis for April through October (Edna Mine, 2010).

The Koll Ditch (WDID 5700635, 13.22 cfs, appropriation dates 1894, 1903, and 1949) is the proposed lower terminus. This structure has diversion records between 1938 and 2017.

CWCB staff made two streamflow measurements on the proposed reach of Trout Creek as summarized in Table 3.

Table 3. Summary of Streamflow Measurement Visits and Results for Trout Creek.

Visit Date	Flow (cfs)	Collector
05/07/2018	64.58	CWCB
10/09/2018	9.59	CWCB

Data Analysis
The Edna Mine made 144 streamflow measurements between 1989 and 2009. These measurements were made at various times throughout the month, but typically on the first of the month from 1999 to 2009. All measurements for a given month were used to determine the median measured streamflow for that month.

The Koll Ditch is located near the proposed lower terminus, but does not sweep the stream (personal communication, Brian Romig, November 2018). Therefore, the diversion record is not a good proxy for the total amount of water available at that location. The diversions also typically start in late May and end by early September which limit information during runoff, late fall, and winter. Because of these limitations, the Koll Ditch was not used as a primary source of information about water availability.

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show the median of monthly measured streamflow values from the Edna Mine data and mean-monthly streamflow from StreamStats. There is good agreement between the mean of the measured values and StreamStats values between April and October. However, StreamStats is generally higher, which is not unexpected given that StreamStats does not explicitly account for water diversions. During the winter, there is little water use in the Trout Creek basin and StreamStats provides an estimate of streamflow conditions. The proposed ISF rate is below the median monthly streamflow measurements from April through October and below the StreamStats mean-monthly flow from November through March. Staff concludes that water is available for appropriation on Trout Creek.

Material Injury
Because the proposed ISF on Trout Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2018), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

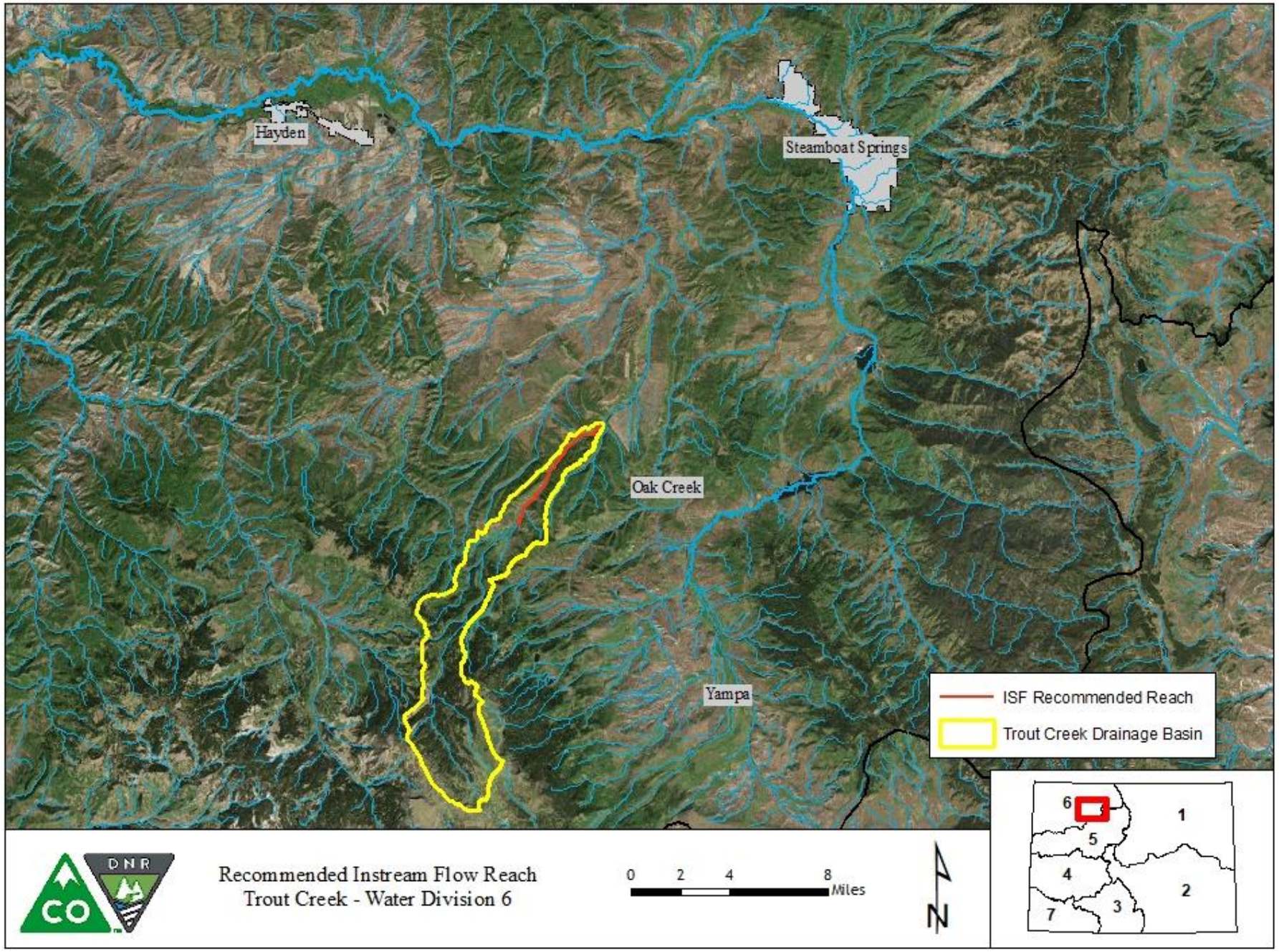
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

WWC Engineering, 2010, 2009 Annual Hydrology Report – Edna Mine. Available at DMRS laserfiche: http://10.14.11.214/drmsimaging/0/doc/904586/Page1.aspx?searchid=faed753d-29fc-4589-95ea-c127f0e3c102.

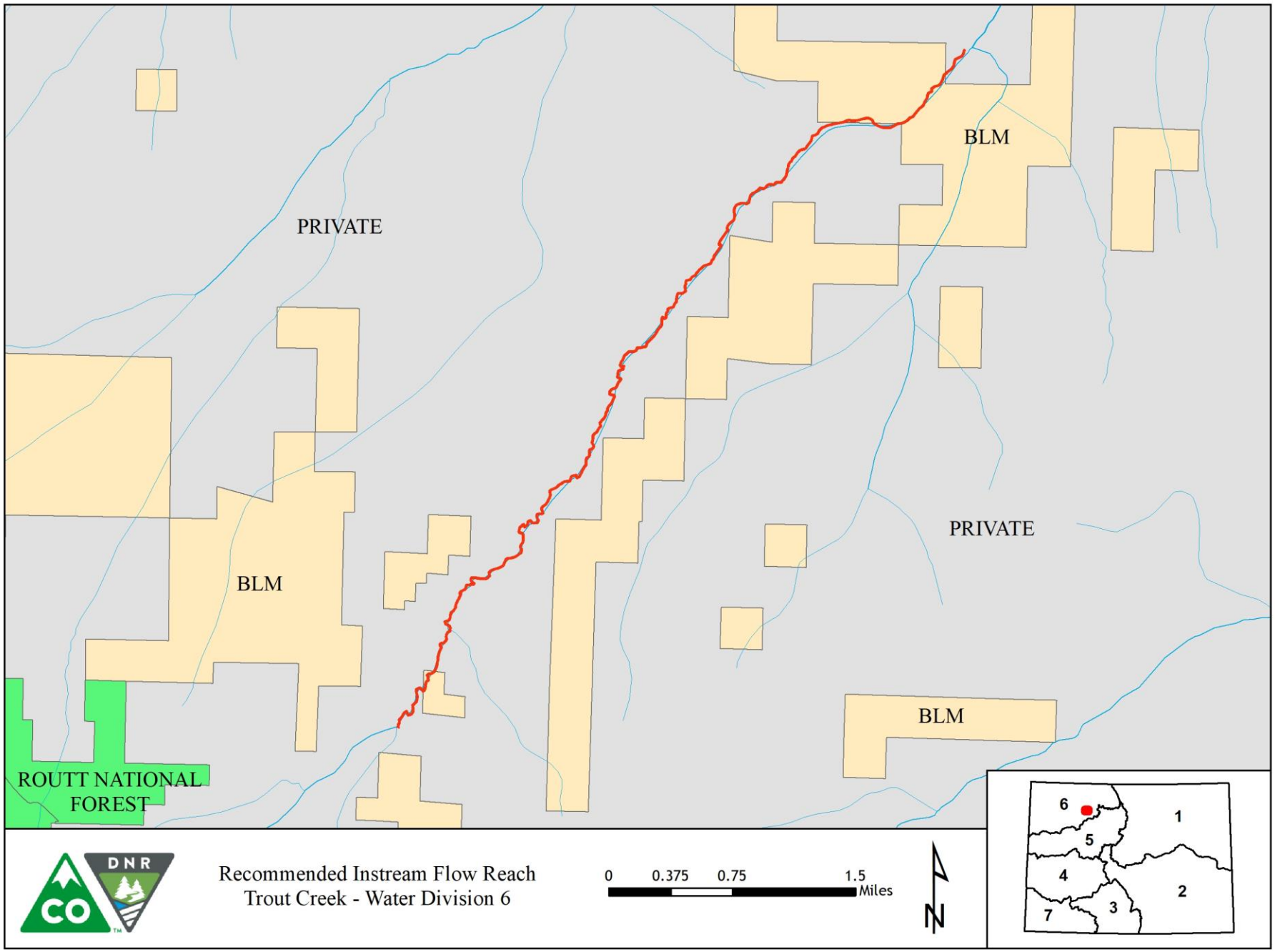
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

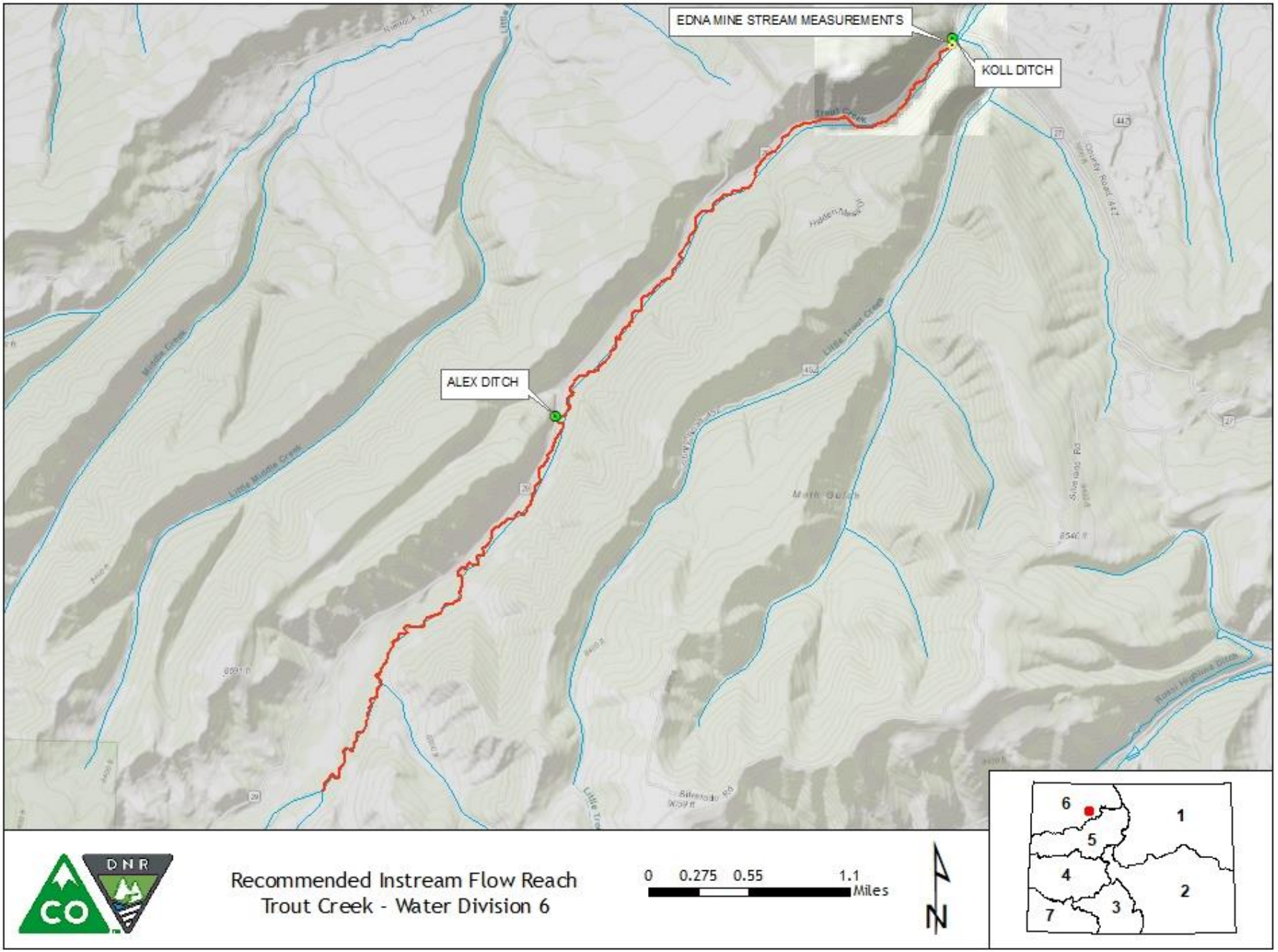
VICINITY MAP



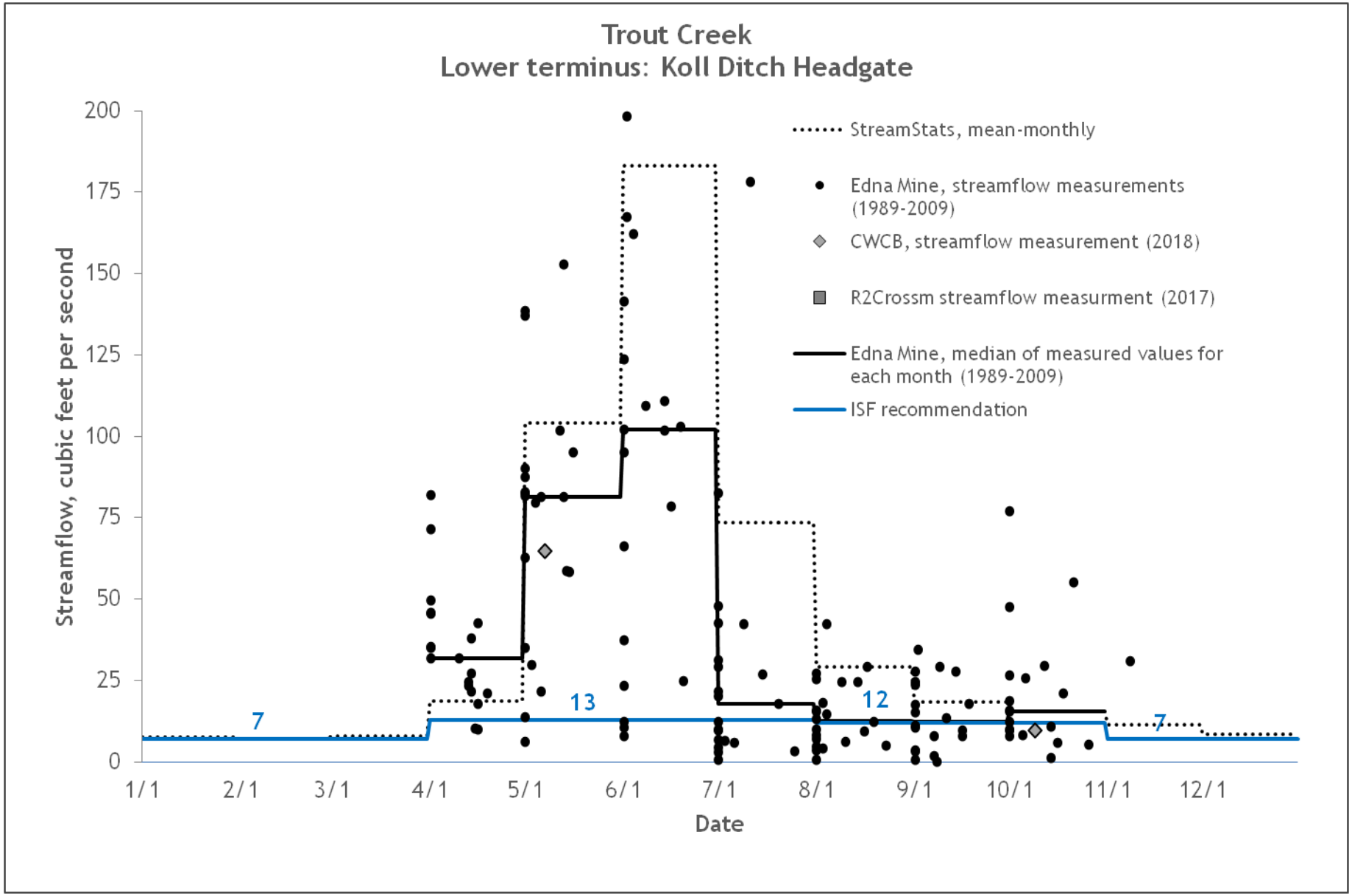
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH