COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Coal Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Lake Irwin Outlet UTM North: 4304958.01	UTM East: 317839.25
LOWER TERMINUS:	Spann Nettick Ditch hdgt UTM North: 4304124.83	UTM East: 326937.36
WATER DIVISION:	4	
WATER DISTRICT:	59	
COUNTY:	Gunnison	
WATERSHED:	East-Taylor	
CWCB ID:	17/4/A-003	
RECOMMENDER:	American Rivers, High Country Conservation Advocates (HCCA)	
LENGTH:	7.67 miles	
Existing ISF:	80CW0102, 2 cfs (1/1-12/31)	
FLOW RECOMMENDATION:	1.3 (01/01 - 03/31) 5.9 (04/01 - 08/15) 3.7 (08/16 - 11/30) 2.0 (12/01 - 12/31)	

Coal 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.

American Rivers and HCCA recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Coal Creek. The CWCB currently holds an instream flow water right on Coal Creek for 2.0 cfs (1/1-12/31), decreed in Case No. 80CW0102. The recommenders do not consider the current ISF water right to be sufficiently protective of the natural environment in Coal Creek, in light of CWCB's current application of R2Cross. The current instream flow water right does not meet all three instream flow criteria during the spring and summer, which is a critical growth and spawning period for the fish population.

Coal Creek originates near Lake Irwin at an elevation of approximately 10,250 ft. The creek flows in an easterly direction as it drops to an elevation of approximately 8,860 ft where it joins the Slate River. The proposed reach is located within Gunnison County (See Vicinity Map) and extends from the Outlet of Lake Irwin downstream to the Spann Nettick Ditch headgate. Sixty-three percent of the land on the 7.67 mile proposed reach is publicly owned and managed by the U.S. Forest Service (USFS); the remaining land is privately held (See Land Ownership Map). American Rivers and HCCA recommended this reach of Coal Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

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/2017ProposedISFRecommendations.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.

Coal Creek supports a brook and brown trout fishery (See Table 1). Colorado Parks and Wildlife (CPW) has done stream sampling on Coal Creek and has reported that the Coal Creek stream ecosystem supports a healthy brook trout population. Coal Creek joins the Slate River in the Town of Crested Butte. Fishery surveys in the Slate River drainage have revealed self-sustaining populations of brook trout and brown trout, with individuals up to 20 inches in length.

In addition to supporting a healthy aquatic ecosystem, flows in Coal Creek support a robust riparian area. The Coal Creek watershed is predominantly a subalpine spruce-fir forest with drier, primarily south facing slopes being dominated by sagebrush steppe and grasslands. The riparian zones are dominated by willows and alders with some active and abandoned beaver ponds along with wet meadows. There are many wetland plants in the narrow riparian corridor that are not found in drier soils found upslope. As a result, and as is typical of most riparian areas, wildlife use of these wetlands is high, which contributes to local biodiversity and high plant and animal productivity. The riparian zone is also important for essential functions such as dissipating flood energy and filtering sediment and pollution.

Table 1. List of species identified in Coal Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	None
brown trout	*Salmo trutta*	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

American Rivers and HCCA 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). American Rivers and HCAA interpret 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 one transect for this proposed ISF reach (Table 2). The R2Cross model results in a winter flow of 6.81 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 7.85 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 Coal Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
HCCA	10/07/2015	3.85	1.54 - 9.63	6.81	7.85
			Mean	6.81	7.85

ISF Recommendation
American Rivers and HCCA recommended an instream flow of 7.85 cfs between April 15 and October 15. This flow rate would protect all three of the CWCB's R2Cross hydrologic criteria (average velocity, average depth, and wetted perimeter). Protecting this flow rate would require an increase of 5.85 cfs between April 15 and October 15. 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.

HCCA also recommends that the current instream flow water right of 2 cfs be increased to 4 cfs for the winter period between October 16 and April 14. R2Cross results indicate that a flow of 6.81 cfs would satisfy 2 of the CWCB's R2Cross hydrologic criteria (wetted perimeter and average depth). However, a preliminary analysis of water availability suggests that only 4 cfs is physically available between Oct 16 and April 14. A flow rate of 4 cfs would continue to satisfy the average depth criteria and would result in only a small decrease in wetted perimeter from 50% to 48%. Therefore, HCCA recommends that the existing 2 cfs instream flow water right be increased by 2 cfs to 4 cfs during the October 16 to April 14 time period. Thus, HCCA is requesting an additional 2 cfs appropriation on Coal Creek between October 16 and April 14.

The American Rivers and HCCA recommendation was modified by staff as a result of water availability and to conform to a standard number of significant digits in ISF water court applications. The final recommended flow rates are as follows:

An increase of 1.3 cfs to the existing 2.0 cfs ISF water right is recommended 1/1 to 3/31 to bring the total ISF water right up to 3.3 cfs.

An increase of 5.9 cfs to the existing 2.0 cfs ISF water right is recommended 4/1 to 8/15 to bring the total water right up to 7.9 cfs.

An increase of 3.7 cfs to the existing 2.0 cfs ISF water right is recommended 8/16 to 11/30 to bring the total ISF water right up to 5.7 cfs.

An increase of 2 cfs to the existing 2.0 cfs ISF water right is recommended 12/1 to 12/31 to bring the total ISF water right up to 4 cfs.

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 Coal Creek is 20.2 square miles, with an average elevation of 10,400 ft and average annual precipitation of 31.834 inches (See the Vicinity Map). The Coal Creek basin supports agriculture and municipal uses, among other uses. Surface water diversions in the basin include Bench Ditch (appropriation date 1989, 2 cfs absolute), the Crested Butte Water Ditch and Wild Cat Pipeline (appropriation date 1893, 6 cfs absolute), and the Rayder Pipeline (appropriation date 1984, 0.067 cfs absolute). In addition, some water in Coal Creek is imported from District 40 via Lake Irwin. Hydrology is altered by water use within the basin.

Available Data
Coal Creek has a USGS gage located approximately 0.7 miles downstream from the proposed lower terminus (USGS 09111250 Coal Creek abv McCormick Ditch at Crested Butte, CO) This gage was installed in the fall of 2014 and is operated seasonally from April 1 to November 15. The gage is located downstream from the Spann Nettick Ditch (appropriation date 1954, 13.17 cfs absolute decreed water rights) and the Halazon Ditch (appropriation date 1907, 2.933 absolute decreed water

rights). In addition, a historic gage was located upstream about midway through the proposed ISF reach. The Coal Creek near Crested Butte, CO gage (USGS 09111000) was operated from 1941 to 1946. Streamflow estimates from this gage were determined to be less representative of the current proposed reach compared to the new gage due to location.

Downstream on the Slate River, two additional gages provide information. The upstream most gage is the Slate River near Crested Butte, CO (USGS 09111500, operated from 1940 to 1951 and again from 1993 to 2006). This gage has a 68.9 square miles drainage basin, with an average elevation of 10,300 ft and average annual precipitation of 33.66 inches. The drainage basin includes the Slate River, Coal Creek, and Washington Gulch. In 2006, USGS 09111500 was discontinued and a new gage was installed approximately 1.5 miles (straight line distance) downstream, Slate River above Baxter Gulch at Highway 135 near Crested Butte, CO (USGS 385106106571000, operated 2006 to present). This gage has a 73.3 square miles drainage basin, with an average elevation of 10,300 ft and average annual precipitation of 33.14 inches. This gage includes approximately 4.4 additional square miles of drainage basin and a few minor tributaries.

Data Analysis

Streamflow at the proposed lower terminus was estimated by adding the daily diversion records from the Spann Nettick Ditch to the Coal Creek gage. This analysis was done from 10/1/2014 to 11/15/2016, for days the gage was operational. The gage data was not scaled due to small differences in drainage basin size between the gage location and the proposed lower terminus (less than 1% difference in size). Because the available record is relatively short, nearby gages were assessed to see if any were suitable for use in extending the record. The Slate River above Baxter Gulch gage (USGS 385106106571000) was the nearest gage that operated concurrently with the Coal Creek gage and produced a reasonable regression coefficient ($r^2=0.92$). Streamflow measurements from the Slate River above Baxter Gulch and the Slate River near Crested Butte gages (USGS 385106106571000 and USGS USGS 09111500) were combined to produce a longer period of record on the Slate River. Combining the gage data assumes that streamflow measured between the two gages is essentially the same despite a small difference in drainage basin area (less than 1%). The only intervening water right structures between the two gages are either conditional, non-existent, or related to CWCB's acquisition on Washington Gulch, which should not affect streamflow. The regression equation developed using the Slate River above Baxter gage data was applied to the combined Slate River dataset to estimate streamflow on Coal Creek from 1940 to 1951 and 1993 to 2016). It should be noted that the regression equation is based on seasonal gage data, but the equation is applied to extend the gage record during the entire year. Median streamflow and 95% confidence intervals for median streamflow were calculated using the extended record. Confidence intervals were not calculated due to record length.

Water Availability Summary

The hydrographs (See Complete Hydrograph and Detailed Hydrograph) show median streamflow and 95% confidence intervals for median streamflow based on the extended diversion adjusted gage record. The proposed ISF rates are below the median at most times and below the 95% confidence interval at all times. Staff has concluded that water is available for appropriation.

Material Injury

Because the proposed ISF on Coal 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. (2016), 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.

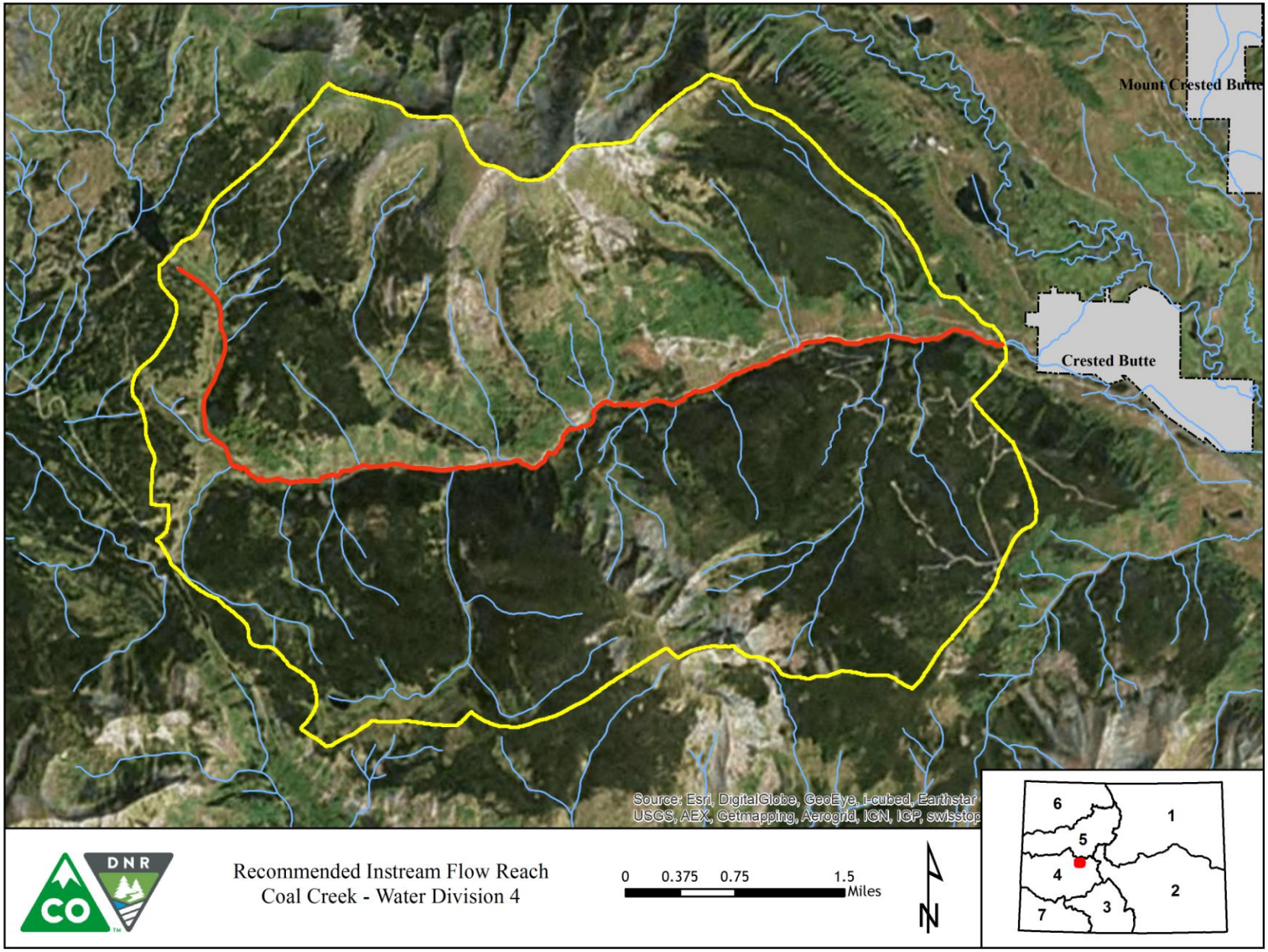
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

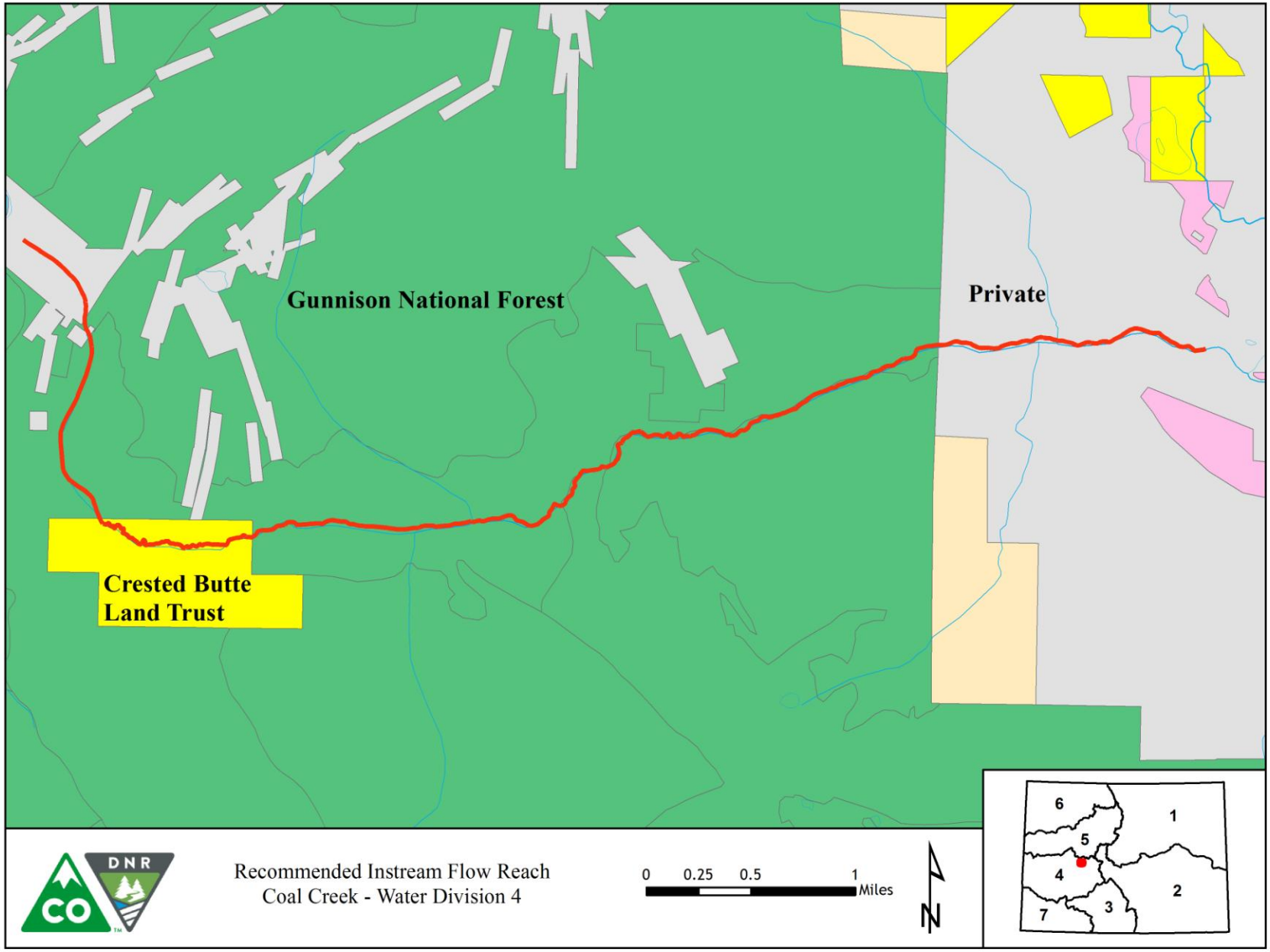
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

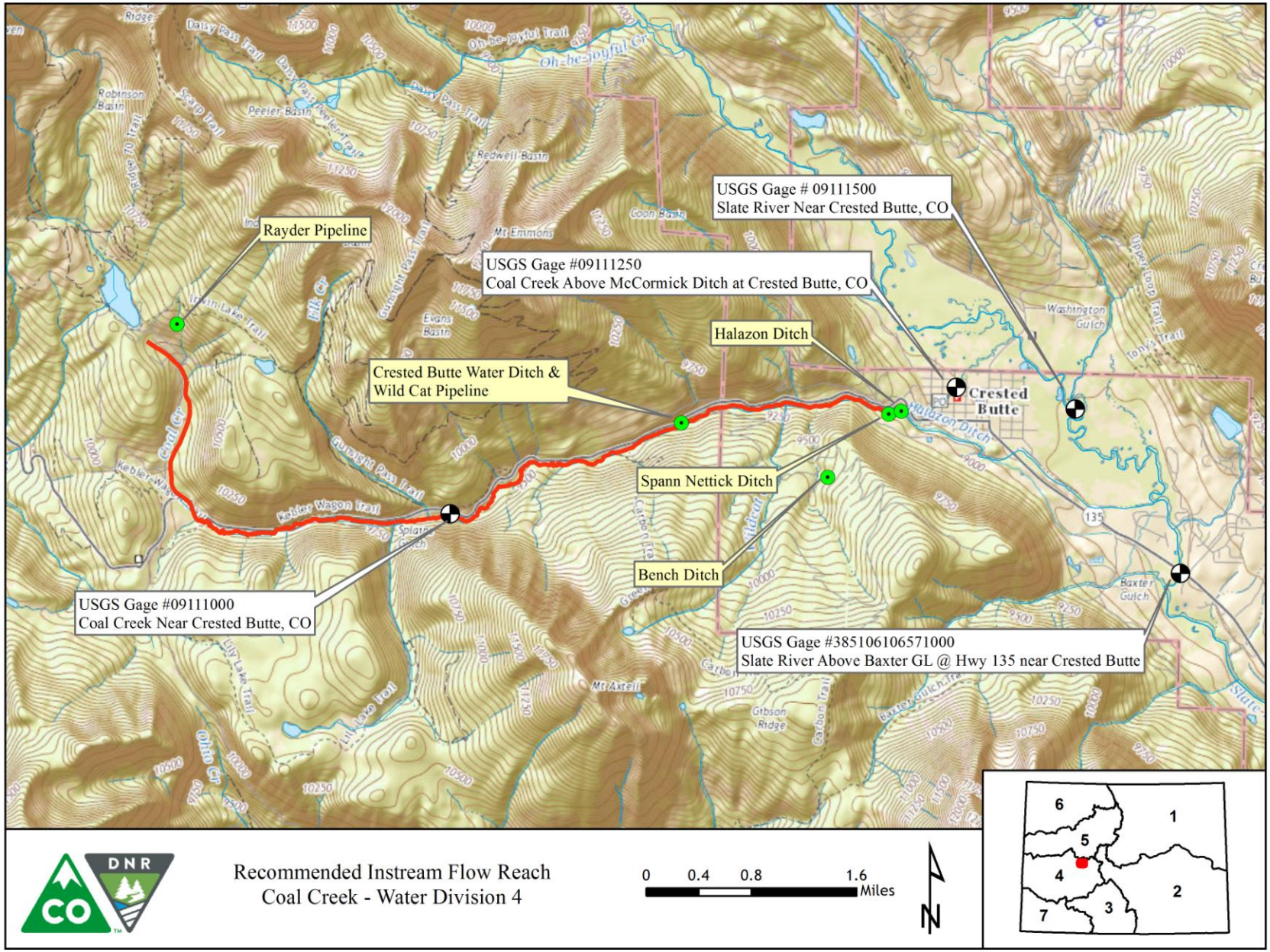
VICINITY MAP



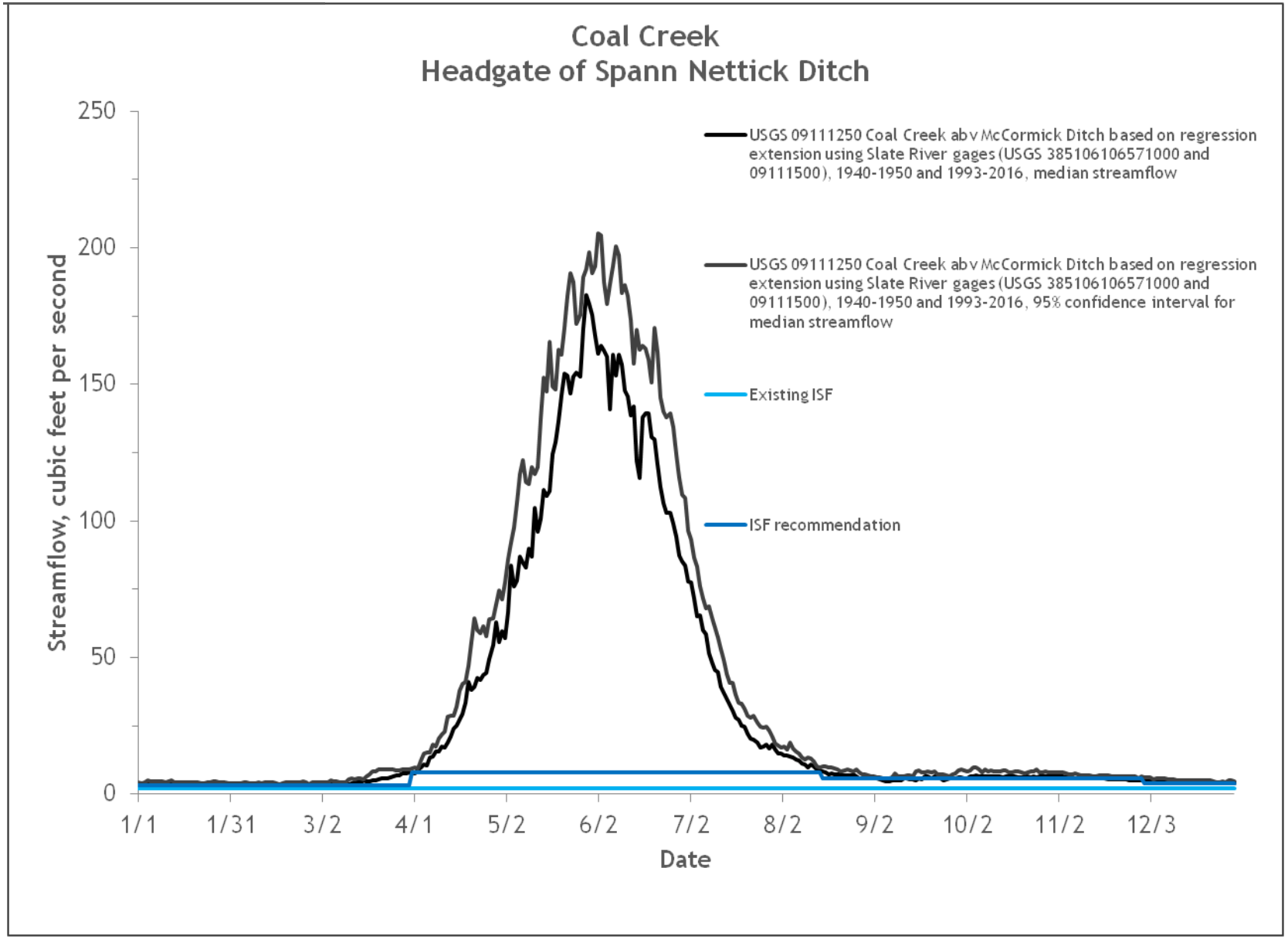
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH