COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Elkhead Creek (Lower)

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Confluence North Fork Elkhead Creek UTM North: 4504451.45 UTM East: 306665.08
LOWER TERMINUS:	USGS Gage # 09246200 UTM North: 4496025.75 UTM East: 303600.63
WATER DIVISION:	6
WATER DISTRICT:	44
COUNTY:	Routt
WATERSHED:	Upper Yampa
CWCB ID:	16/6/A-002
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	15.83 miles
FLOW RECOMMENDATION:	6.4 (10/01 - 02/29) 10 (03/01 - 03/15) 24 (03/16 - 06/30) 10 (07/01 - 07/15) 2.5 (07/16 - 09/30)

Elkhead Creek (Lower)

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.

CPW recommended that the CWCB appropriate an ISF water right on a reach of Elkhead Creek. Elkhead Creek originates from Saddle Mountain at an elevation of approximately 8,900 ft and flows in a southwesterly direction as it drops to an elevation of approximately 6,200 ft where it joins the Yampa River. The proposed reach is located within Routt County (See Vicinity Map) and extends from the confluence with North Fork Elkhead Creek downstream to USGS Gage # 09246200. Nine percent of the land on the 15.83 mile proposed reach is publicly owned and managed by the State Land Board; the remaining land is privately owned (See Land Ownership Map). CPW recommended this reach of Elkhead 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 the 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.

Elkhead Creek is a third order single thread stream in an unconfined valley. The land use in the Elkhead Creek valley ranges from natural habitat conditions on public lands to agricultural uses on private lands. The channel has a well connected and fairly intact floodplain with a healthy riparian corridor. The riparian community consists of cottonwood galleries and willows. Elkhead Creek is an excellent example of a transitional stream where the channel habitat changes from a substrate consisting of small cobbles and boulders in the upper reaches to sand and finer sediment in the lower reaches.

The Elkhead Creek Basin has been designated both by CPW and U.S. Forest Service (USFS) as a priority basin for native species conservation projects. The target fish species in upper Elkhead Creek basin is the Colorado River cutthroat trout (CRCT) (see Table 1). In addition, CPW and the USFS are engaged in habitat protection projects for boreal toad (*Bufo boreas boreas*), a state endangered species in the Elkhead basin. The management of CRCT is covered by a multi-state (Colorado,

Wyoming, and Utah) and federal interagency conservation agreement. The states consider CRCT to be of special concern and the federal agencies consider CRCT to be a sensitive species (CRCT Conservation Team 2006). While CRCT is the main species of concern in this basin, other native species identified in Table 1 will benefit from CRCT conservation efforts. These species include mottled sculpin, speckled dace, mountain sucker, bluehead sucker, and flannelmouth sucker (all suckers are native species of special concern). The Elkhead CRCT is identified in conservation planning documents as a population of high genetic purity and is considered a conservation population (CRCT Conservation Team 2006).

Since this reach is highly characteristic of a transition zone, the aquatic environment near the upper terminus differs from the aquatic environment near the lower terminus. Near the upper terminus, the aquatic environment is cold-water habitat, and at the lower terminus of the reach, the aquatic environment is cool-water habitat. Fish sampling records in this reach are indicative of these changes in the aquatic environment where upstream sites have cold water species and the lower sites have more cool-water species, including species that have relocated in Elkhead Creek from Elkhead Reservoir. The most upstream fish sample in CPW's records dates back to 1977 (located very close to the upstream terminus of this ISF segment), when Colorado River cutthroat trout and rainbow trout were sampled. The next sample downstream (above Routt CR 56) was sampled in 2011 and contained a large number of cutthroat trout and one black bullhead catfish. CPW also has several fish surveys from 2011 in the vicinity of "Brome Pasture" near the middle of the ISF segment, which included Colorado River cutthroat trout, bluehead sucker, creek chub, mountain sucker, fathead minnow, white sucker, mottled sculpin, redside shiner, and speckled dace. The most downstream sampling station on Elkhead Creek, in the vicinity of the lower terminus of the ISF reach, was near the CR 76 bridge crossing. In this location, CPW collected native species, including mottled sculpin, mountain sucker, and speckled dace. However, many nonnative species were also collected, such as black crappie, bluegill, creek chub, fathead minnow, largemouth bass, smallmouth bass, northern pike, white sucker, and rainbow trout. Many of these species likely came from the Elkhead Reservoir sport fishery.

Table 1. List of native species identified in Elkhead Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State – Species of Special Concern
mountain sucker	*Catostomus platyrhynchus*	State – Species of Special Concern
bluehead sucker	*Catostomus discobolus*	None
flannelmouth sucker	*Catostomus latipinnis*	None
mottled sculpin	*Cottus bairdii*	None
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
CPW 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). CPW 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 five 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 15.80 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 24.22 cfs.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW/CWCB	10/27/2015 # 1	11.15	4.46 - 27.90	24.50	27.90[2]
CPW/CWCB[3]	10/27/2015 # 2	11.00	4.40 - 27.50	7.20	14.10
CPW/CWCB	10/27/2015 # 3	11.08	4.43 - 27.70	39.30[1]	27.70[2]
CPW/CWCB	10/27/2015 # 4	14.33	5.73 - 35.83	13.70	20.00
CPW/CWCB	10/27/2015 # 5	12.55	5.00 - 31.40	17.70	31.40[2]
			Mean	15.80	24.20

[1] This flow is above the accuracy range of the R2Cross model. This result is not used to calculate the mean R2Cross winter value.
[2] This flow is derived from the upper limit of the R2CROSS modeling accuracy and is used in the computation of the summer flow recommendation. The flow that meets all three instream flow criteria is outside of the confidence interval for this data set.
[3] Cross section located slightly downstream (approximately 700 feet) from lower terminus for this ISF recommendation; data from this cross section was used in ISF calculations because the stream channel geometry is still representative of the reach.

ISF Recommendation
CPW recommended flow rates based on R2Cross modeling analyses, biological expertise, and a preliminary water availability analysis. CPW recommended a summer rate of 24 cfs from March 16 through July 15 and a winter rate of 15.8 cfs with the knowledge that this flow rate may not be available.

The CPW recommendation was modified by staff as a result of water availability. The final recommendation flow rates are as follows:

6.4 cfs is recommended for the period October 1 to February 29.

10 cfs is recommended for the period March 1 to March 15.

24 cfs is recommended for the period March 16 to June 30.

10 cfs is recommended for the period July 1 to July 15.

2.5 cfs is recommended for the period July 16 to September 30.

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 Elkhead Creek is 171 square miles, with an average elevation of 7,950 ft and average annual precipitation of 28.22 inches (See the Hydrologic Features Map). The Elkhead Creek basin supports agriculture, among other uses. According to the water commission, Kathy Bower (contacted 9/07/2016), there is not very much irrigation use in the basin in the later part of the summer and early fall. Hydrology is altered by water use within the basin.

Available Data
Elkhead Creek has a USGS gage located at the lower terminus (USGS 09246200 Elkhead Creek above Long Gulch, near Hayden, CO). The proximity of the gage to the lower terminus and relatively long period of record (1995 to present) make this gage ideally suited for water availability analysis.

CWCB staff made streamflow measurements during the 2015 site visit when R2Cross data was collected. These measurements are included in the water availability analysis.

Data Analysis
The Elkhead Creek gage was analyzed from 9/1/1995 to 8/9/2016 based on USGS approved data available through HydroBase on 12/20/2016. Median streamflow and 95% confidence intervals for median streamflow were calculated for the Elkhead Creek gage record.

Water Availability Summary
The hydrographs (See Complete Hydrograph and Detailed Hydrograph) show median streamflow and 95% confidence intervals for the median streamflow based on the Elkhead Creek gage record. The proposed ISF rate is below the median streamflow the majority of the time. The proposed ISF rate is below the 95% confidence interval of the median at all times. Staff has concluded that water is available for appropriation.

Material Injury
Because the proposed ISF on Elkhead 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.

CRCT Conservation Team, 2006, Conservation agreement for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the states of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins.

CRCT Conservation Team, 2006, Conservation strategy for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the states of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins.

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

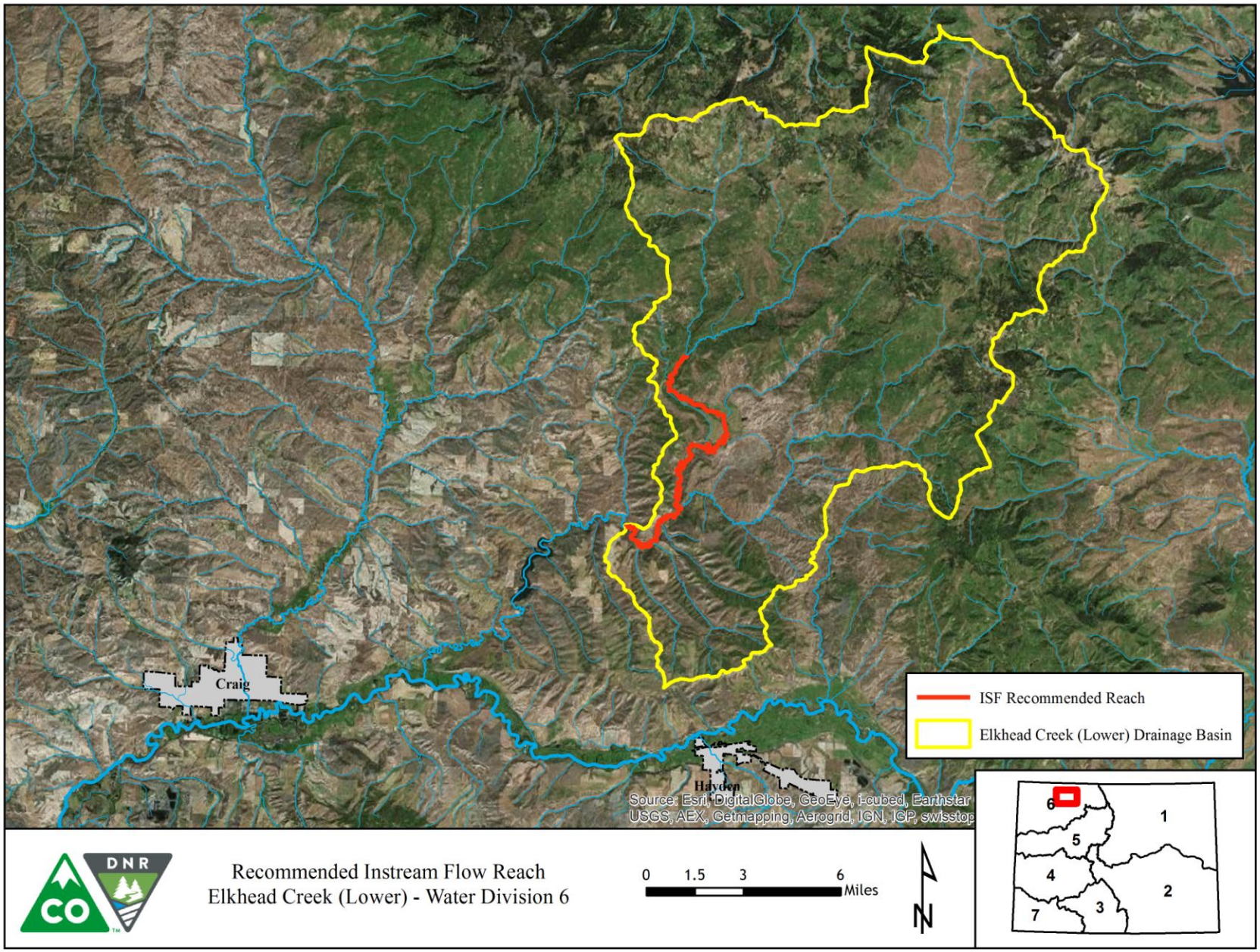
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

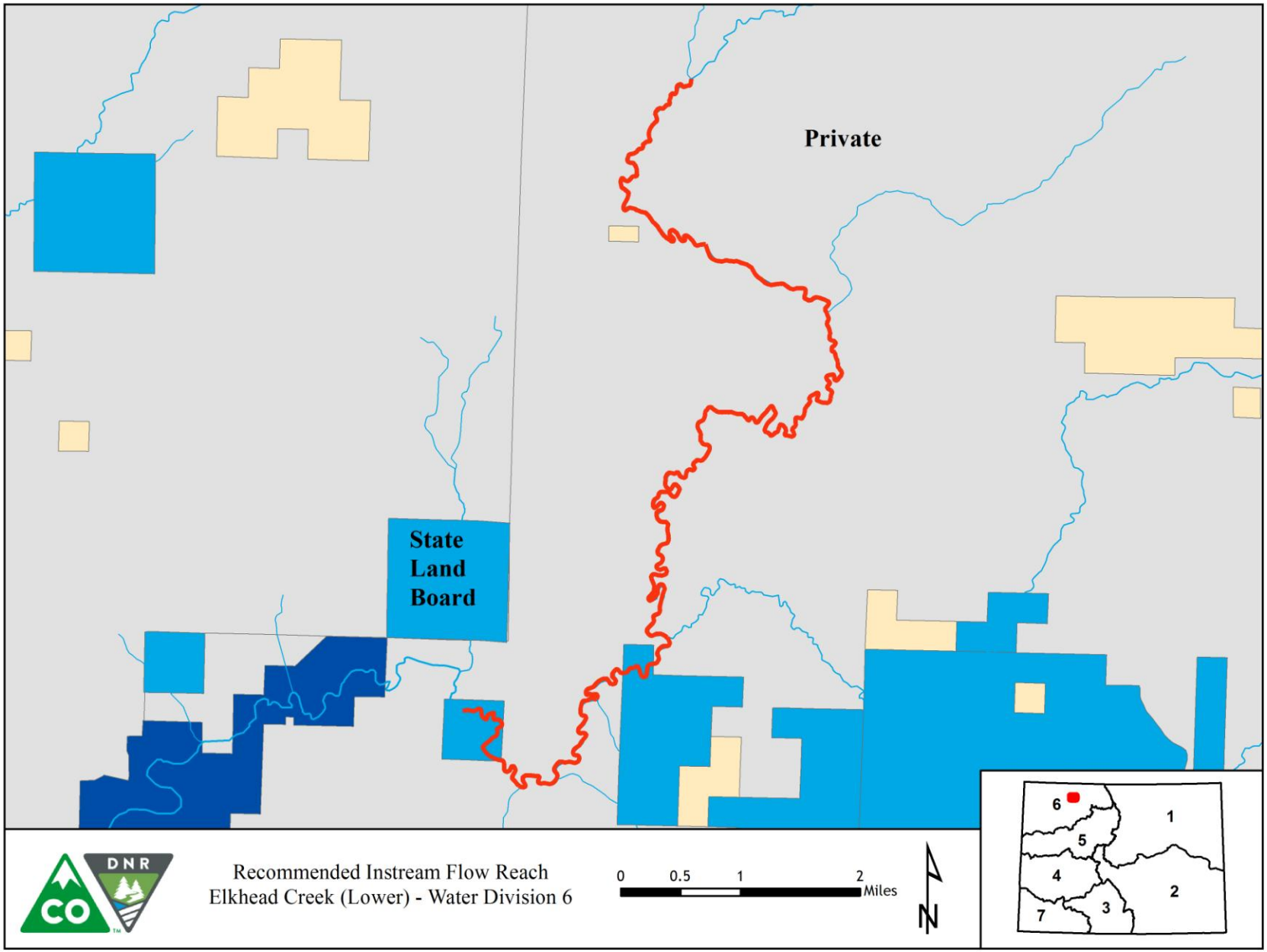
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

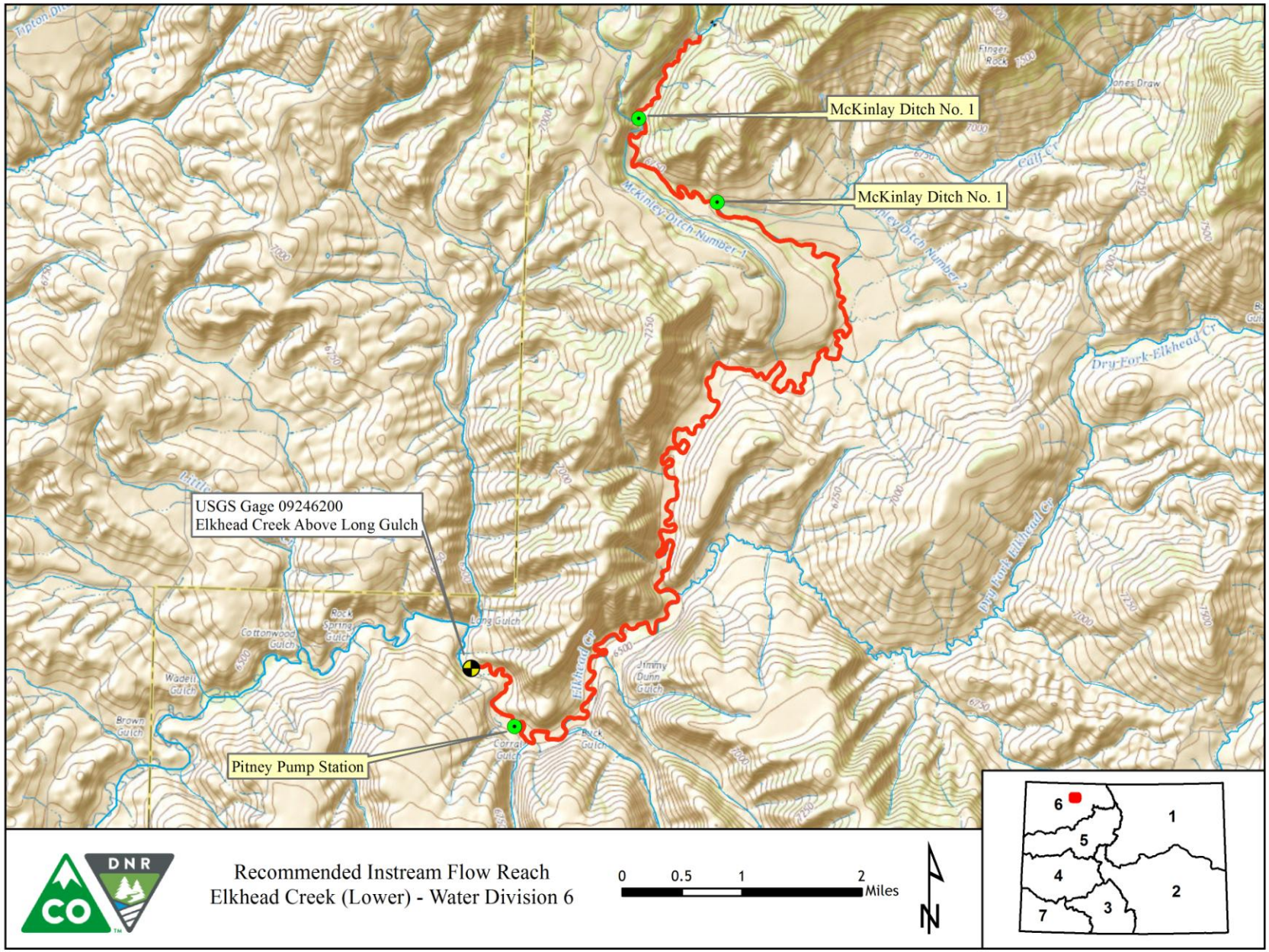
VICINITY MAP



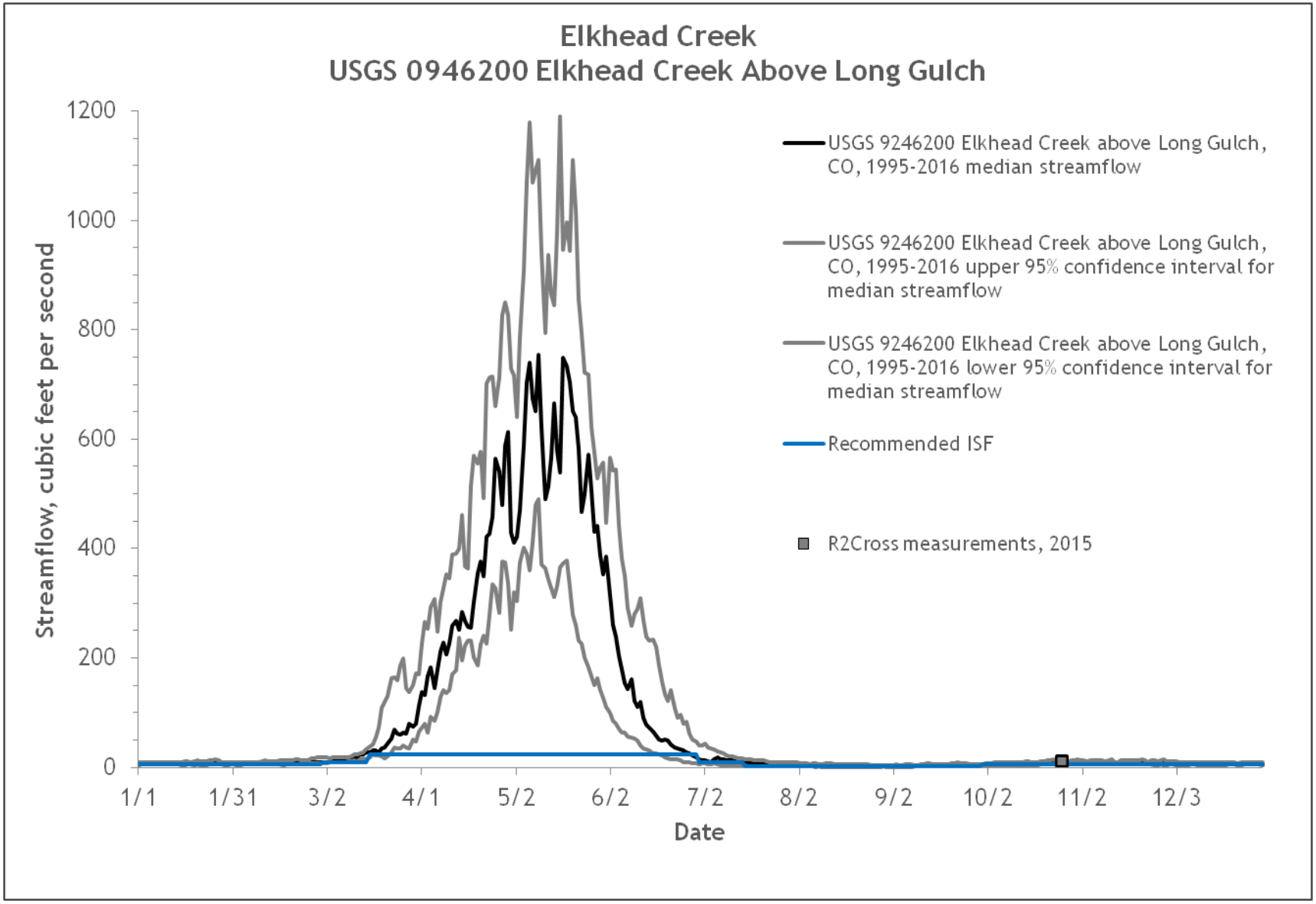
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH