COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Slater Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Confluence Beaver Creek UTM North: 4529487.44	UTM East: 303385.46
LOWER TERMINUS:	USGS Gage # 09255000 UTM North: 4539540.79	UTM East: 299527.79
WATER DIVISION:	6	
WATER DISTRICT:	54	
COUNTY:	Moffat	
WATERSHED:	Little Snake	
CWCB ID:	17/6/A-004	
RECOMMENDER:	Bureau of Land Management (BLM)	
LENGTH:	12.58 miles	
FLOW RECOMMENDATION:	25 (03/16 – 04/15) 74 (04/16 - 06/30) 25 (07/01 - 07/15) 10 (07/16 - 07/31) 6.5 (08/01 - 09/15) 8.5 (09/16 - 10/15) 16 (10/16 - 03/15)	

Slater 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 ISF water right on a reach of Slater Creek. Slater Creek originates on the west side of Diamond Mountain in the Elkhead Mountains at an elevation of approximately 8,400 ft, about 25 miles northeast of Hayden. The Creek flows in a northerly direction as it drops to an elevation of approximately 6,600 ft where it joins the Little Snake River. The proposed reach is located within Moffat County (See Vicinity Map) and extends from the confluence with Beaver Creek downstream to USGS Gage # 09255000. Seven percent of the land on the 12.58 mile proposed reach is publicly owned and managed by the BLM; the remaining land is privately held (See Land Ownership Map). The BLM recommended this reach of Slater 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.

Slater Creek is a cold-water, moderate to high gradient stream. It flows through a canyon with a valley floor approximately one-fourth mile to one-half mile in width. The stream cuts through alluvial deposits in the valley and is confined by bedrock in some locations. The stream generally has large substrate, consisting of mostly of small cobbles and boulders of up to two feet in diameter. The stream has a good mix of swift runs, riffles, and pools in meander bends.

Fisheries surveys have revealed a self-sustaining native fish population comprised of bluehead sucker, speckled dace, and mottled sculpin. The fish population also includes fathead minnow and creek chub, which are nonnative species (See Table 1). Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community is generally comprised of narrowleaf cottonwood, alder, willows, sedges, and rushes. The riparian community is in generally in good condition. Given the wide channel, the riparian community provides some, but not extensive, shading and cover for fish.

Table 1. List of species identified in Slater Creek.

Species Name	Scientific Name	Status
bluehead sucker	*Catostomus discobolus*	BLM - Sensitive Species
speckled dace	*Rhinichthys osculus*	None
mottled sculpin	*Cottus bairdii*	None
fathead minnow	*Pimephales promelas*	None
creek chub	*Semotilus atromaculatus*	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 three 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 51.36 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 73.69 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 Slater Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	06/16/2015	123.16	49.26 - 307.90	57.50	109.27
BLM	07/08/2015 # 1	50.47	20.19 - 126.18	out of range	34.06
BLM	07/08/2015 # 2	50.93	20.37 - 127.33	45.21	77.75
			Mean	51.36	73.69

ISF Recommendation

BLM's analysis of this data, coordinated with Colorado Parks and Wildlife, indicates that the following flows are needed to preserve the fishery and natural environment to a reasonable degree.

74.0 cfs is recommended during the snow melt runoff period from April 16 to June 30. This recommendation is driven by the average depth criteria. Slater Creek experiences significant icing during the winter months and habitat is extremely limited. During ice-free periods, it is important to protect a flow rate that makes as much habitat as possible available to the fish population while it is completing critical life history functions. It is also important to make as much physical habitat as possible available to fish that enter Slater Creek from the Little Snake River. Finally, this flow rate should help recharge alluvial aquifers along Slater Creek that are important for sustaining the riparian community during annual low flow periods.

25.0 cfs is recommended from July 1 through July 15. This recommendation is driven by water availability. Protecting this intermediate flow rate on the descending limb of the hydrograph is important before fish are stressed by very low flows in mid-summer.

10.0 cfs is recommended from July 16 to July 31. This recommendation is driven by water availability. While this flow rate does not meet the instream flow criteria, it is critical in preventing significant fish kills along the creek. If additional water becomes available in the future, the BLM recommends that the CWCB increase the flow rate during this time period.

6.5 cfs is recommended from August 1 through September 15. This recommendation is driven by water availability. While this flow rate does not meet the instream flow criteria, it is critical in preventing significant fish kills along the creek. If additional water becomes available in the future, the BLM recommends that the CWCB increase the flow rate during this time period.

8.5 cfs is recommended from September 16 to October 15. This recommendation is driven by water availability. While this flow rate does not meet the instream flow criteria, it is critical in preventing significant fish kills along the creek. If additional water becomes available in the future, the BLM recommends that the CWCB increase the flow rate during this time period.

16.0 cfs is recommended during the period from October 16 to March 15. This recommendation is driven by limited water availability. This flow rate should prevent pools from freezing, allowing the fish population to successfully overwinter.

25.0 cfs is recommended from March 16 through April 15. This recommendation is driven by water availability. Protecting this intermediate flow rate on the ascending limb of the hydrograph is important because the fish population starts to actively feed and put on weight during this period, which prepares them for low flow periods that occur during mid-summer.

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 Slater Creek is 151 square miles, with an average elevation of 8,380 ft and average annual precipitation of 30.4 inches (See the Vicinity Map). The Slater Creek basin supports agriculture, among other uses. Hydrology is altered by water use within the basin.

Available Data
Slater Creek has a USGS gage located at the lower terminus (USGS 0255000 Slater Fork near Slater, CO). The proximity of the gage to the lower terminus and an extensive period of record (1931 to present) make this gage ideally suited for water availability analysis.

CWCB staff made one streamflow measurement on the proposed reach of Slater Creek as summarized in Table 3.

Table 3. Summary of streamflow measurement visits and results for Slater Creek

Visit Date	Flow (cfs)	Method
07/20/2016	11.93	Wading, Marsh McBirney

Data Analysis
The USGS Slater Creek gage was analyzed from 1/1/1931 to 8/8/2016 based on USGS approved data available through HydroBase on 10/14/2016. Median streamflow and 95% confidence intervals for median streamflow were calculated for the Slater 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 Slater 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 Slater 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.

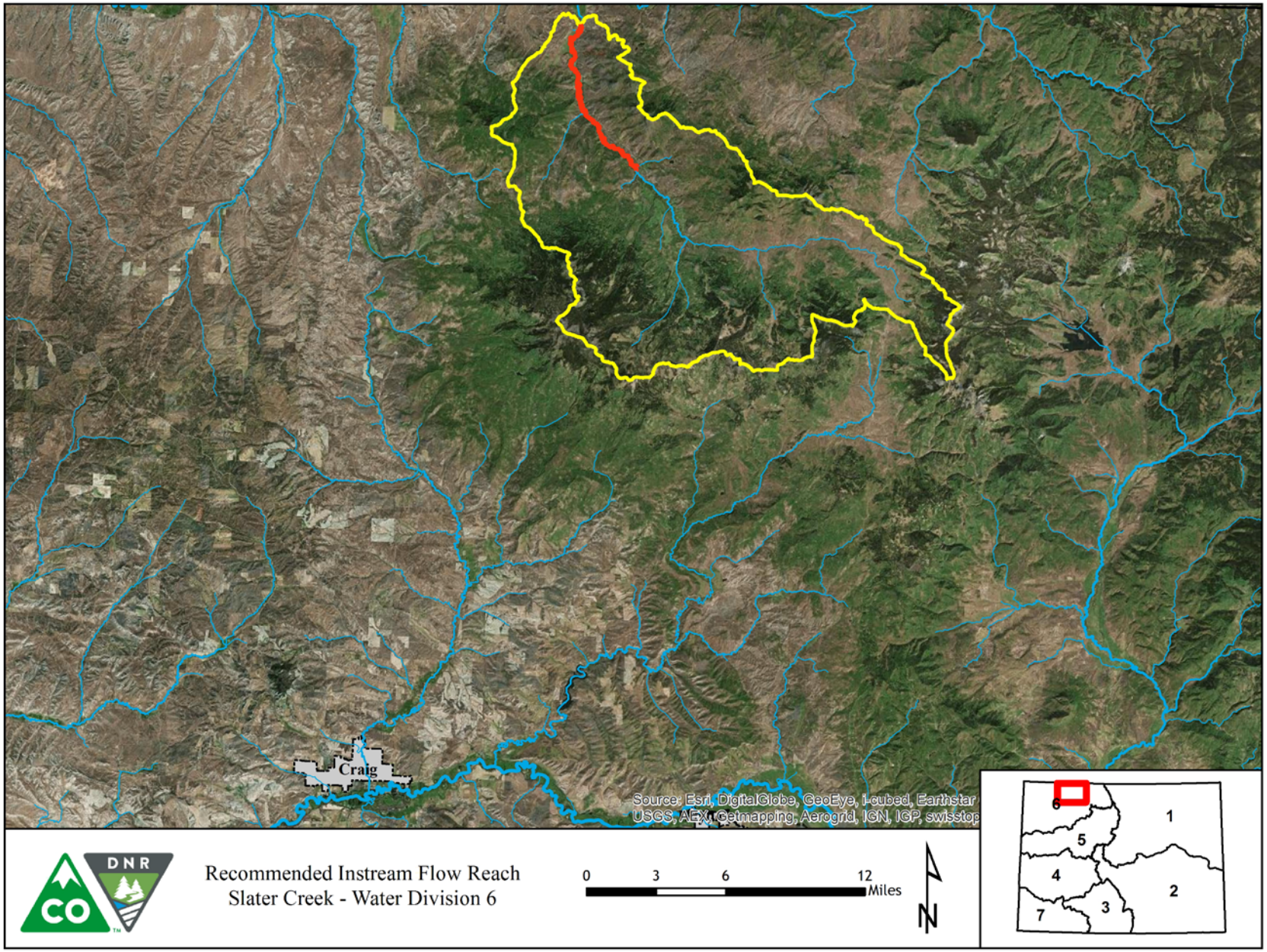
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

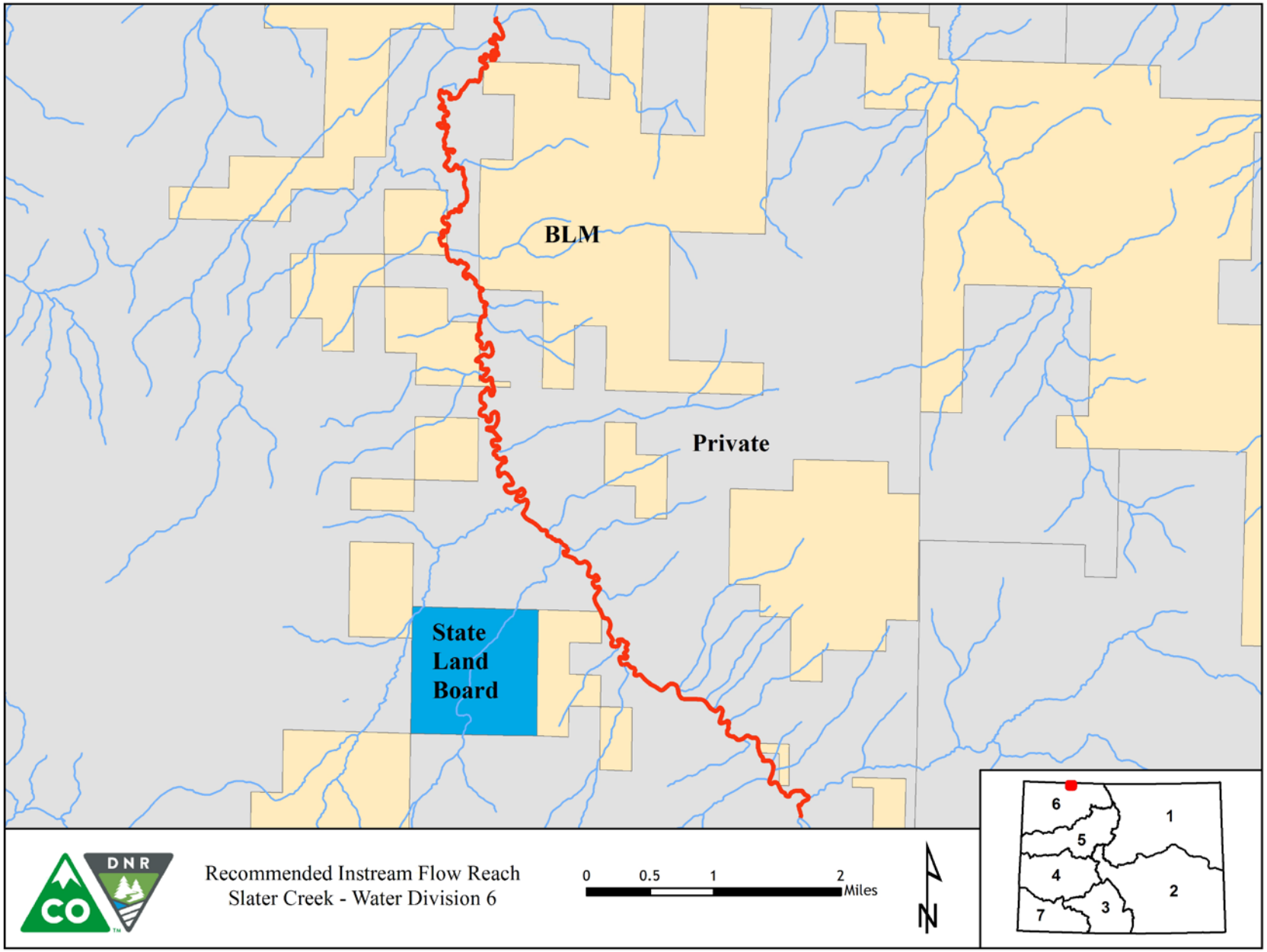
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

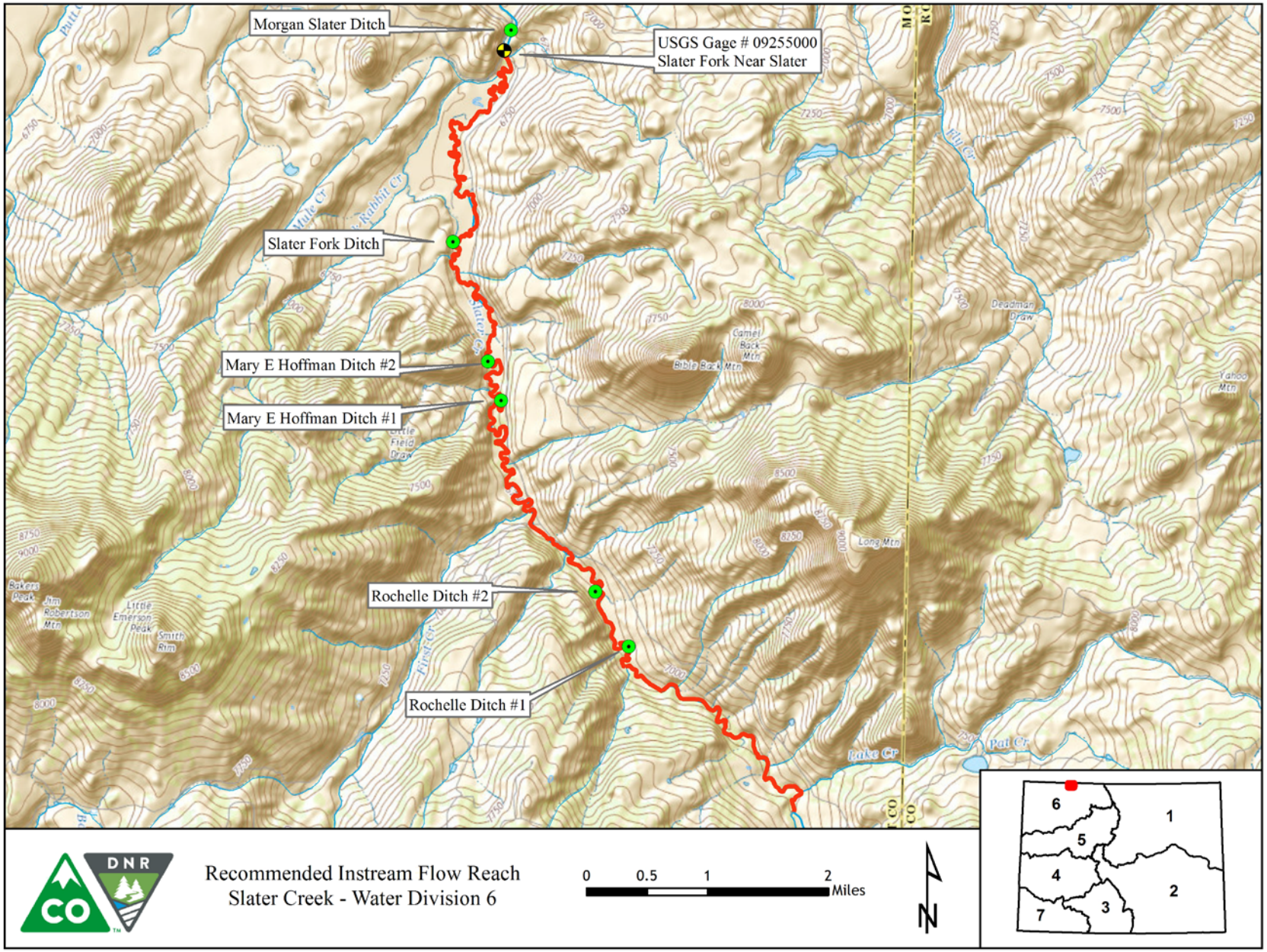
VICINITY MAP



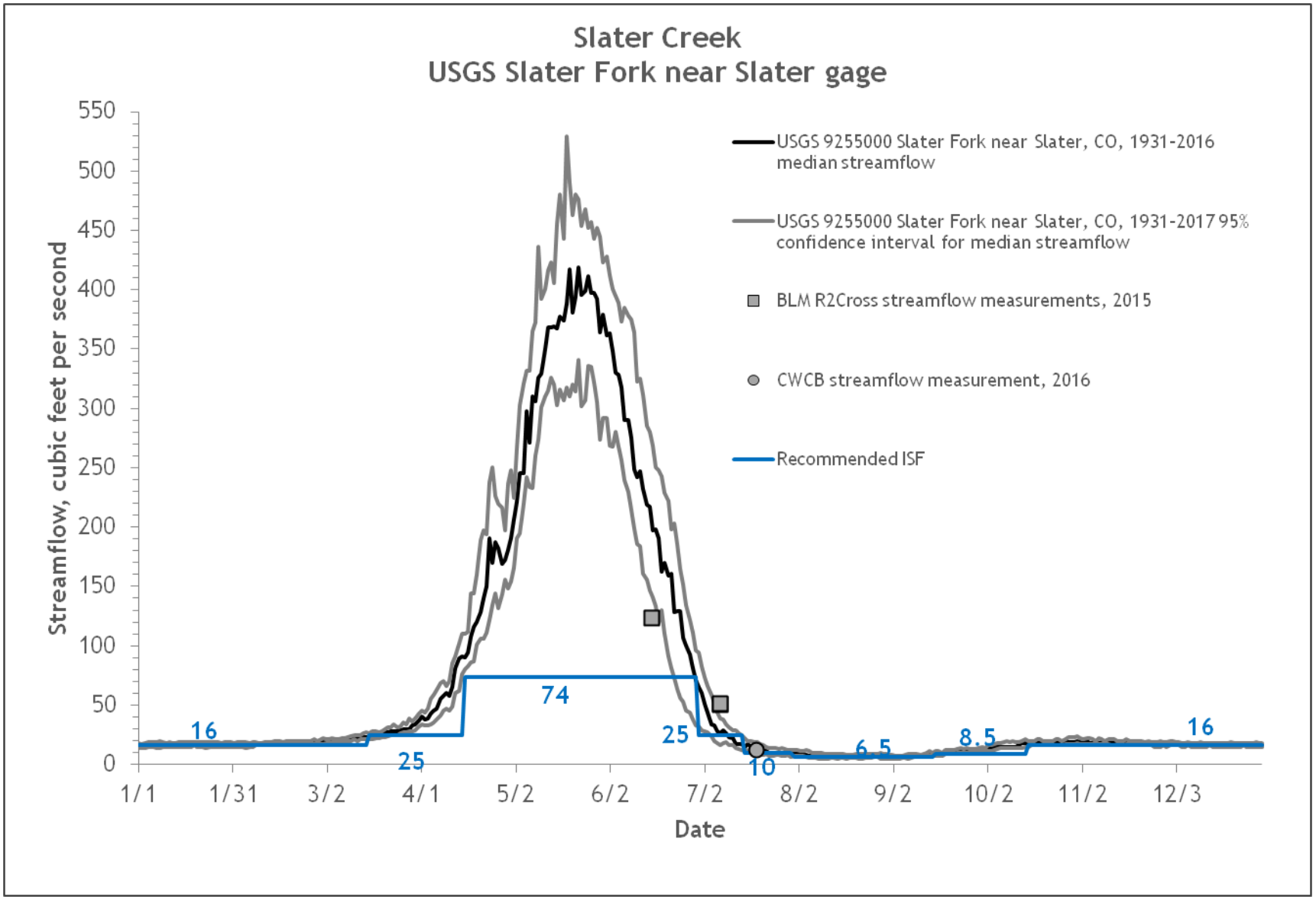
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH