COLORADO
Colorado Water Conservation Board
Department of Natural Resources

North Fork White River (Upper)

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	outlet of Trappers Lake UTM North: 4429787.37 UTM East: 309550.88
LOWER TERMINUS:	confluence with Skinny Fish Creek UTM North: 4431907.38 UTM East: 308777.90
WATER DIVISION:	6
WATER DISTRICT:	43
COUNTY:	Garfield
WATERSHED:	Upper White
CWCB ID:	18/6/A-008
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	1.52 miles
FLOW RECOMMENDATION:	2.0 cfs (11/01 - 03/31) 3.5 cfs (04/01 - 10/31)

North Fork White River (Upper)

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 the North Fork White River because it has a natural environment that can be preserved to a reasonable degree. The North Fork White River is located within Garfield County and originates from Wall Lake in the Flat Tops Wilderness Area at an elevation of approximately 11,000 ft. The river flows west 33 miles to the confluence with the South Fork White River at an elevation of approximately 7,000 ft (See Vicinity Map). The proposed reach extends from the outlet of Trappers Lake downstream to the confluence with Skinny Fish Creek. The U.S. Forest Service (USFS) manages one hundred percent of the land on the 1.52 mile proposed reach (See Land Ownership Map).

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.

The North Fork White River upstream of Ripple Creek, is a moderate gradient, third order stream. The riparian area is a mix of open meadows and spruce and fir forest with abundant aspens covering the valley sides. Large wood and boulders contribute to channel complexity and create fish habitat throughout the upper North Fork White River. Numerous large tributaries throughout the upper reaches of the stream provide well-connected and diverse habitat types for fish. Past CPW fishery surveys indicate the presence of Colorado River cutthroat trout (CRCT), mountain whitefish, rainbow trout, and brook trout. CRCT is a Tier 1 priority species in the 2015 State Wildlife Action Plan, which has the highest conservation priority in the state. CRCT is classified as a state Species of Special Concern and is considered a Sensitive Species by the Bureau of Land Management (BLM) and USFS. While CRCT is the main species of concern in this basin, other native species, namely mountain whitefish, would benefit from the conservation efforts for the CRCT. In addition to the native species present in the North Fork White River, this reach supports a diverse sport fishery of brook and rainbow trout.

A key component of habitat protection is flow protection. Flow reduction can impact habitat availability and quality, can cause water quality and temperature issues, and can reduce overall population and habitat connectivity. The hydrology of the North Fork White River will likely continue to provide a high annual peak flow for spring spawning species (since minimal water uses presently occur in the basins above the proposed ISF reach), but protection of base flows is an important component of ISF protection. Overwintering adult habitat for CRCT is often a limiting factor for these fish populations. This reach of the North Fork White River provides good habitat for various life stages of fish.

Table 1. List of species identified in the North Fork White River.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern Federal – Sensitive Species
mountain whitefish	*Prosopium williamsoni*	None
brook trout	*Salvelinus fontinalis*	None
rainbow trout	*Oncorhynchus mykiss*	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. However, the R2Cross model also contains the Thorne and Zevenbergen subroutine, which uses field measured bed material grain size to estimate velocity. This method is not constrained by the accuracy range of the Manning's n subroutine.

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 2.00 cfs, which meets 2 of 3 criteria, and a summer flow of 3.50 cfs, which meets 3 of 3 criteria.

Table 2. Summary of R2Cross transect measurements and results for the North Fork White River.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW	07/10/2018 #1	5.60	N/A	2.50[1]	4.20[1]
CPW	07/10/2018 #2	5.60	N/A	1.50[1]	2.80[1]
			Mean	2.00	3.50

1 = Thorne and Zevenberg subroutine was used due to Manning's n results that were outside of the accuracy range. The measured D84 was 0.66 feet

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

2.0 cfs from November 1 through March 31 meets 2 of 3 instream flow criteria and will provide sufficient protection of aquatic habitat during base flows for overwintering.

3.5 cfs from April 1 through October 31 meets 3 of 3 instream flow criteria and will provide sufficient protection of aquatic habitat during snowmelt runoff and during critical periods for fish spawning, rearing, and development.

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 the North Fork White River is 21.4 square miles, with an average elevation of 10,725 ft and average annual precipitation of 44.24 inches. The North Fork White River has one diversion, Trappers Lake Ditch (WDID 4300972, 2.3 cfs), that feeds the Trappers Lake Retaining Pond located adjacent to the river (See the Hydrologic Features Map). Due to this surface water diversion, hydrology in this drainage basin does not represent natural flow.

Available Data

There is not a current streamflow gage on this reach of the North Fork White River. There are two historic gages in the vicinity of the proposed ISF reach. The North Fork White River above Ripple C, NR Trappers Lake CO (USGS 09302420) was located approximately 4.5 miles downstream from the proposed lower terminus. This gage was not used in this analysis due to the large difference in drainage basin size. The North Fork White River Below Trappers Lake, CO (USGS 093002400) is located near the upper terminus of the reach. The North Fork White River Below Trappers Lake, CO (below Trappers Lake gage) has a continuous period of record from 10-1-1956 to 09-30-1965. The gage has a drainage area of 20.2 square miles, with an average annual precipitation of 44.7 inches.

CWCB staff made one site visit during the R2Cross measurements with CPW on the subject reach of the North Fork White River. No other spot measurements were made on this reach.

Data Analysis

Due to the short period of record available at the below Trappers Lake gage, staff took additional steps to evaluate the record. Staff examined other gages in the region in an attempt to find a gage that could be used to extend the record through regression analysis. However, none of the gages evaluated produced a reasonable regression coefficient to be suitable for regression extension. Staff also examined streamflow gages in the region to evaluate the average annual streamflow in the area. The North Fork White River at Buford, CO (USGS 09303000) is located approximately 20.3 miles

southwest from the below Trappers Lake gage and has a continuous period of record from 1951-2002. The total average annual streamflow at the North Fork White River at Buford gage while it operated was 227,419 AF. During the 10 years of operation of the below Trappers Lake gage, 4 years were above average and 6 years of below average streamflow. This likely indicates that below Trappers Lake gage records represent near average conditions.

The North Fork White River gage was used as is, without accounting for the effects of the Trapper's Lake Ditch diversion which is located between the gage and the proposed lower terminus. The decreed diversion rate is small relative to the amount of water available and accounting for this diversion would not change the water availability determination. In addition, the water commissioner indicated that the diversion is rarely used (personal communication, Shanna Lewis, 11/08/2018) and the diversion records and the gage records do not overlap. The North Fork White River gage was scaled using the area-precipitation method to scale the gage data to the lower terminus on North Fork White River. The scaled median streamflow was calculated. The 95% confidence intervals were not calculated due to the short period of record at the North Fork White River gage.

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show median streamflow estimated at the lower terminus of North Fork White River. The proposed ISF is below the median streamflow estimate at all times. Staff concludes that water is available for appropriation on this reach of the North Fork White River.

Material Injury
Because the proposed ISF on this reach of the North Fork White River 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.

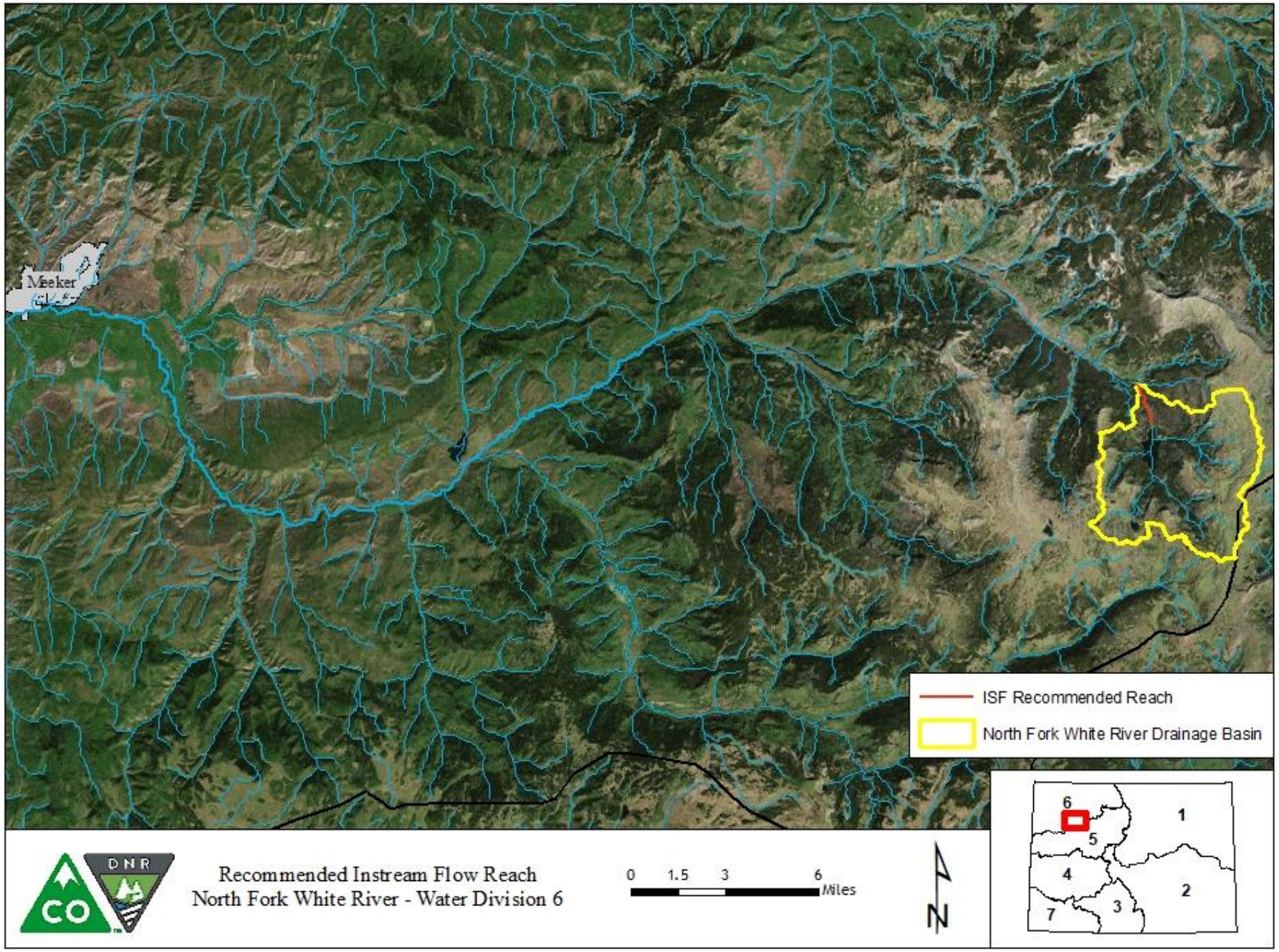
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

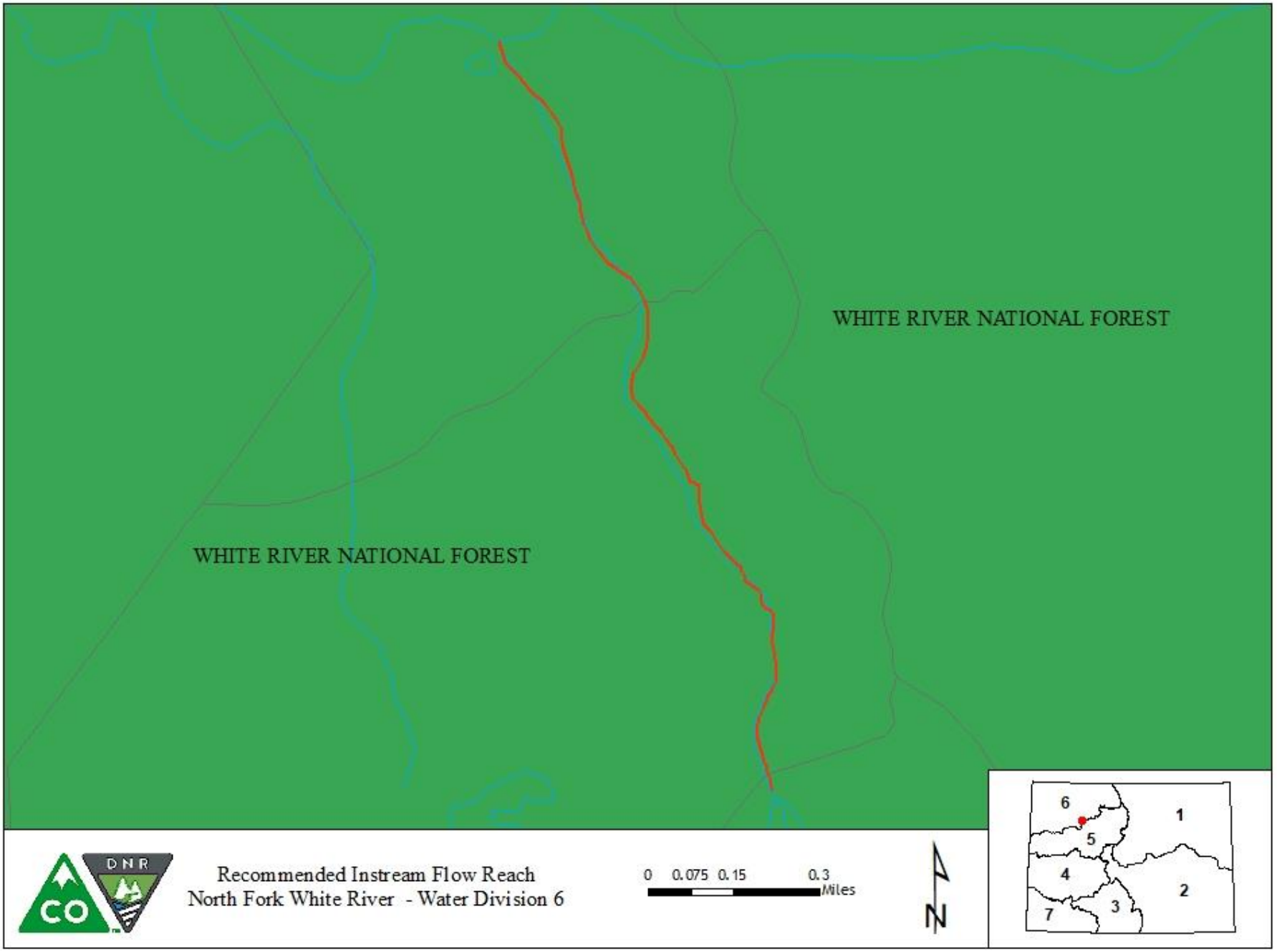
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

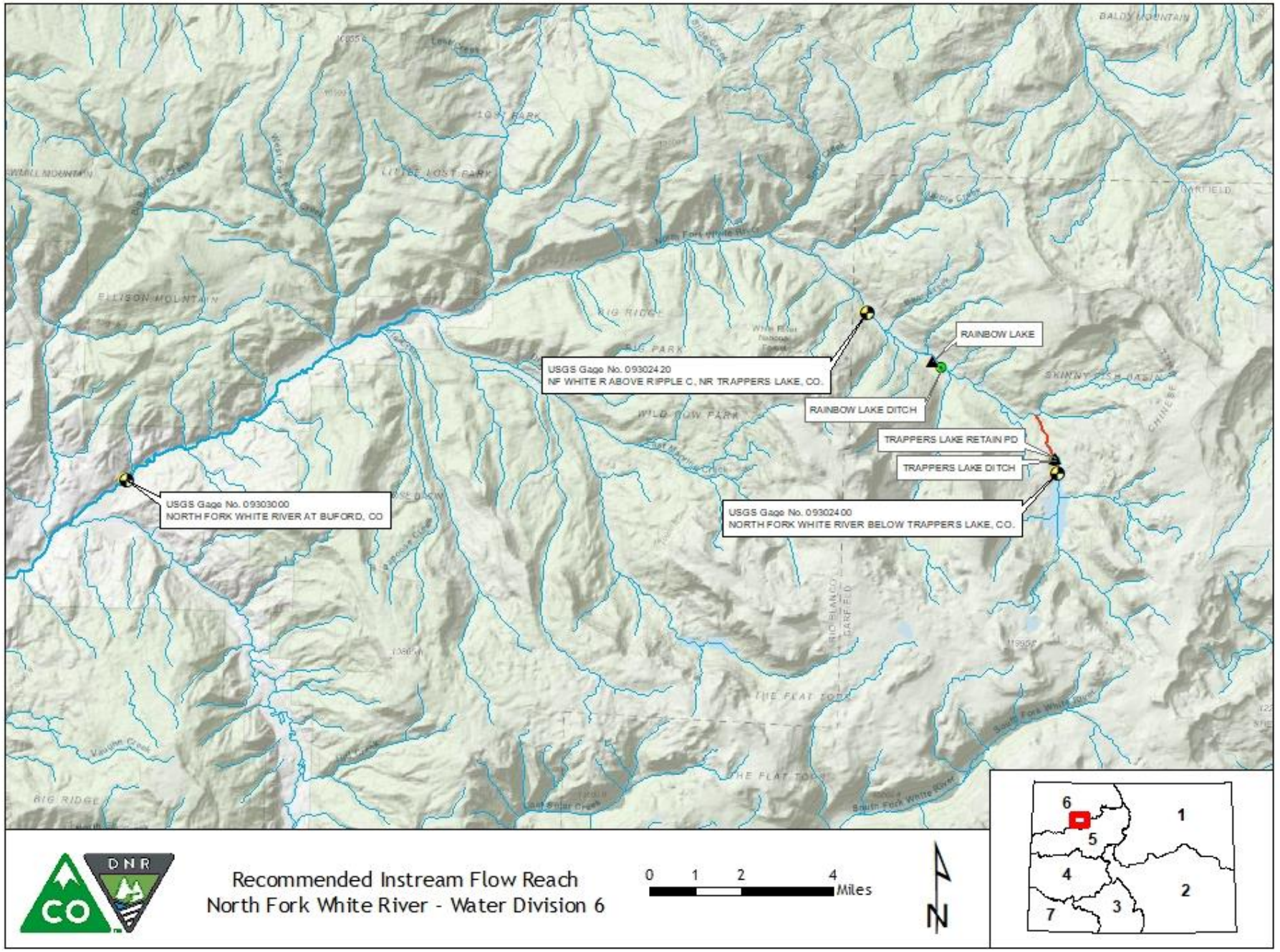
VICINITY MAP



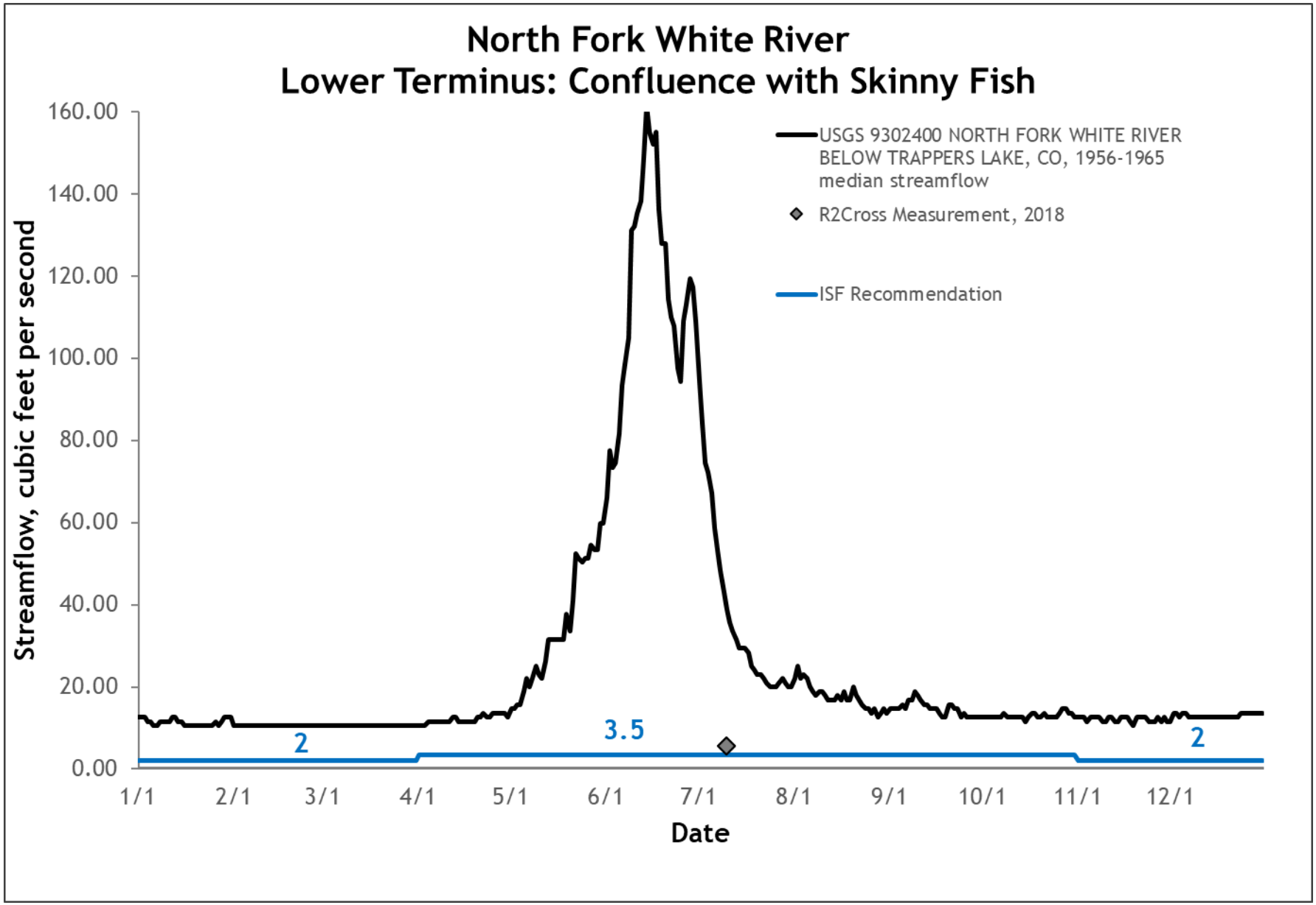
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH