COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Gold Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	headwaters in the vicinity of UTM North: 4284386.51 UTM East: 363395.53
LOWER TERMINUS:	Tarkington Ditch headgate UTM North: 4270404.77 UTM East: 359675.26
WATER DIVISION:	4
WATER DISTRICT:	28
COUNTY:	Gunnison
WATERSHED:	Tomichi
EXISTING ISF:	80W0135, 7.0 cfs (01/01 - 12/31)
CWCB ID:	19/4/A-005
RECOMMENDER:	High Country Conservation Advocates (HCCA)
LENGTH:	10.32 miles
FLOW RECOMMENDATION:	4.0 cfs (04/15 - 07/10)

Gold 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.

HCCA recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Gold Creek. Gold Creek is located within Gunnison County and originates at an elevation of approximately 11,600 ft near the eastern boundary of the Fossil Ridge Wilderness Area. The stream flows south 11 miles to the confluence with Quartz Creek at an elevation of approximately 8,560 ft (See Vicinity Map). The proposed reach extends from the headwaters downstream to the Tarkington Ditch headgate. The U.S. Forest Service manages 67 percent of the land on the 10.32 mile proposed reach and the remaining 33 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 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.

Gold Creek is a cold-water, high gradient stream located in Gunnison County, Colorado. The stream substrate ranges from small gravels to medium boulders. There is a mixture of riffles and small pools that provide excellent habitat for fish and other aquatic life. Sampling conducted by Colorado Parks and Wildlife in 2001 identified a healthy brook trout population. An abundance of fish of differing sizes was observed by HCCA and Alpine Environmental Consultants during field reconnaissance and sampling in 2017. In addition to supporting a healthy aquatic ecosystem, flows in Gold Creek help support a robust riparian area. The riparian community is primarily pine/spruce forest near the headwaters of the creek. The riparian area along the middle section of the creek is primarily composed of willow and alder. A mixture of willows and irrigated pasture prevails toward the bottom of the creek, near Ohio City and the confluence with Quartz Creek. The riparian zone is in good condition and provides shade and cover for the fish community. There are both active and abandoned beaver ponds at several locations alongside the creek.

Table 1. List of species identified in Gold Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	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.

Quantification Methodology

HCCA 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). HCCA 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 one transect 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 7.00 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 11.00 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 Gold Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
HCCA	10/04/2017	7.37	2.95 - 18.43	7.00	11.00

ISF Recommendation

The HCCA recommended the following flows based on R2Cross modeling analyses, biological expertise, and preliminary water availability analysis. CWCB Staff's water availability analysis determined that water was limited in some cases. The following flows represent the final recommendation which has been modified in collaboration with HCCA due to water availability limitations.

Based on analysis of R2Cross results, an increase of 4.0 cfs to the existing 7.0 cfs is recommended to preserve the natural environment on Gold Creek from April 15 to July 10. The combined total of the two ISF water rights would be 11.0 cfs which satisfies all three of the required hydrologic criteria. This flow duration was modified due to water availability limitations.

No recommendation is being made at this time for the period July 11 to April 14.

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.

Water Availability 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 Gold Creek is 30.2 square miles, with an average elevation of 10,808 ft and average annual precipitation of 24.8 inches (See the Vicinity Map). A number of surface water diversions were identified in the drainage basin tributary to and along the proposed ISF on Gold Creek. These structures divert approximately 25 cfs and include 178.9 AF in reservoir storage.

Available Data

There is not a current or historic daily streamflow gage on Gold Creek. The nearest gage was located on Quartz Creek approximately 1.5 miles downstream from the confluence with Gold Creek (USGS 09281000, Quartz Creek near Ohio City, CO). This historic gage operated from 1937 to 1950 and 1959 to 1970 for a total of 24 years of record. The drainage basin of the Quartz Creek gage is 107 square miles with an average elevation of 10,619 ft and average annual precipitation of 23.4 inches. This results in a proration factor of 0.30 using the area-precipitation method. The area-precipitation method estimates streamflow based on the ratio of the precipitation weighted drainage area at the lower terminus location to that of the gage location. There are approximately 187 cfs in decreed surface water diversions and approximately 210 AF in reservoir storage in the drainage basin of the Quartz Creek gage.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. The Tarkington Ditch (WDID 2800704, 17.921 cfs, appropriation date 1891) is located at the lower terminus of the proposed Gold Creek ISF reach. This structure has diversion records between 1970 and 2017. The Tarkington Ditch routinely leaves some water in Gold Creek to be picked up downstream (personal communication, Bob Hurford, 12/28/2018); therefore, the diversion record may not reflect the total amount of water available in the stream.

CWCB staff made two streamflow measurements on the subject reach of Gold Creek at a location approximately 2.8 miles upstream from the lower terminus, summarized in Table 3. There are a number of intervening water rights located between the measurement location and the proposed lower terminus.

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

Visit Date	Flow (cfs)	Collector
05/24/2018	23.74	CWCB
04/04/2018	3.41	CWCB

Data Analysis
The Quartz Creek gage provides the best available information during spring runoff, which typically starts earlier than the irrigation season. The Quartz Creek gage data was scaled by 0.30 to the lower terminus of Gold Creek. No adjustments were made to account for the diversions that impact the Quartz Creek gage or the proposed ISF reach. Median streamflow and the upper 95% confidence interval for median streamflow were calculated.

During the irrigation season, the Tarkington Ditch provides the best available information about water availability. The Tarkington Ditch starts diversions between early April and late June. This structure rarely diverts the entire decreed flow rate; however, it is unclear whether this is due to limited water or some other reason. The median diversion and 95% confidence intervals for the median diversion for the Tarkington Ditch were calculated based on the available record, 1969 to 2017 (downloaded from HydroBase on 11/2/2018).

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show median streamflow and 95% confidence intervals for the median streamflow calculated from the scaled Quartz Creek gage and the median diversion and upper 95% confidence interval for the median diversion for the Tarkington Ditch. The proposed ISF is below the median streamflow based on the Quartz Creek gage the majority of the time and below the upper 95% confidence interval at all times. The proposed ISF is below the upper 95% confidence interval for the median Tarkington Ditch diversions from 6/1 to 7/10 during the primary irrigation season. Staff concludes that water is available for appropriation on Gold Creek.

Material Injury
Because the proposed ISF on Gold 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.

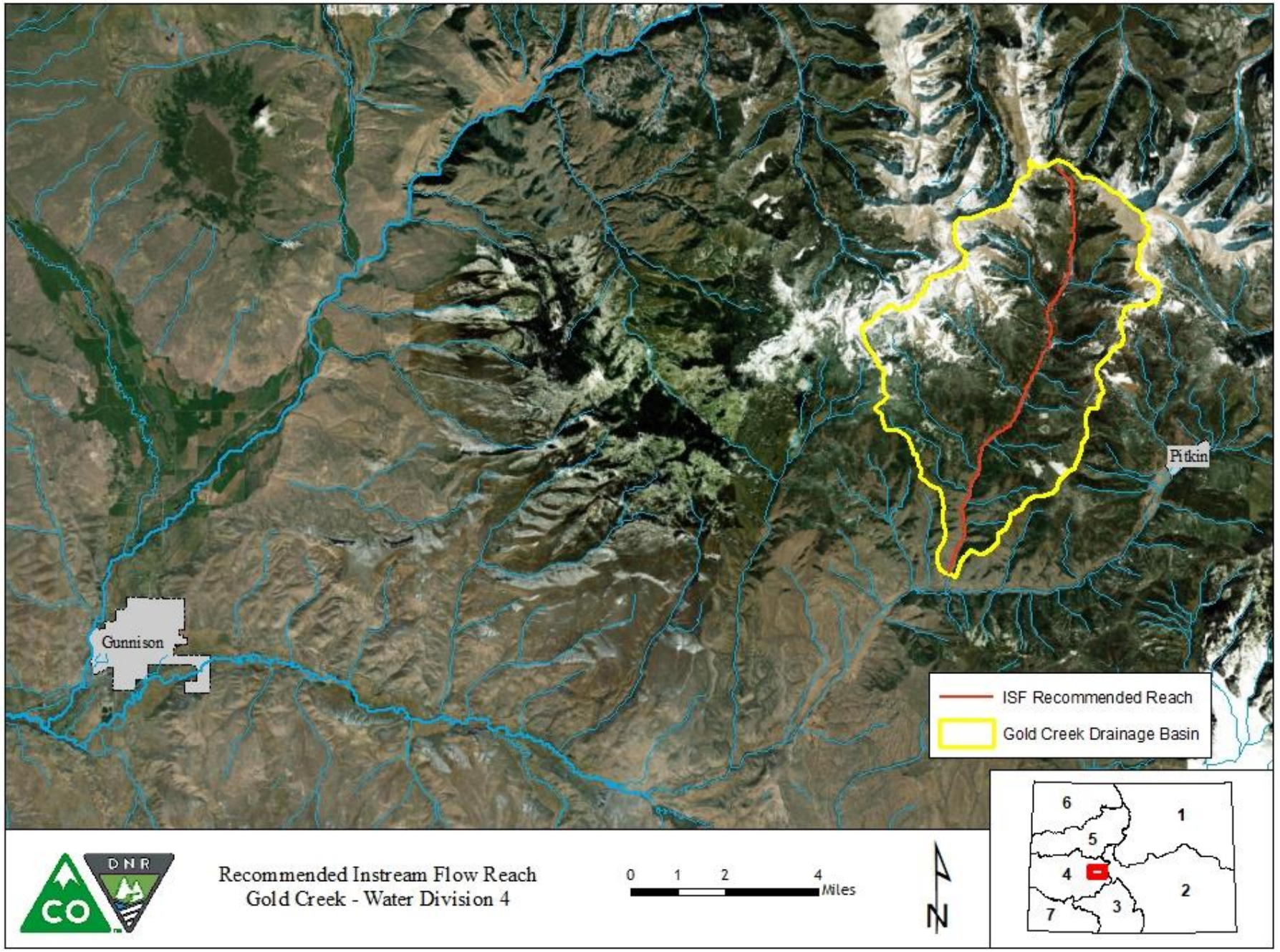
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

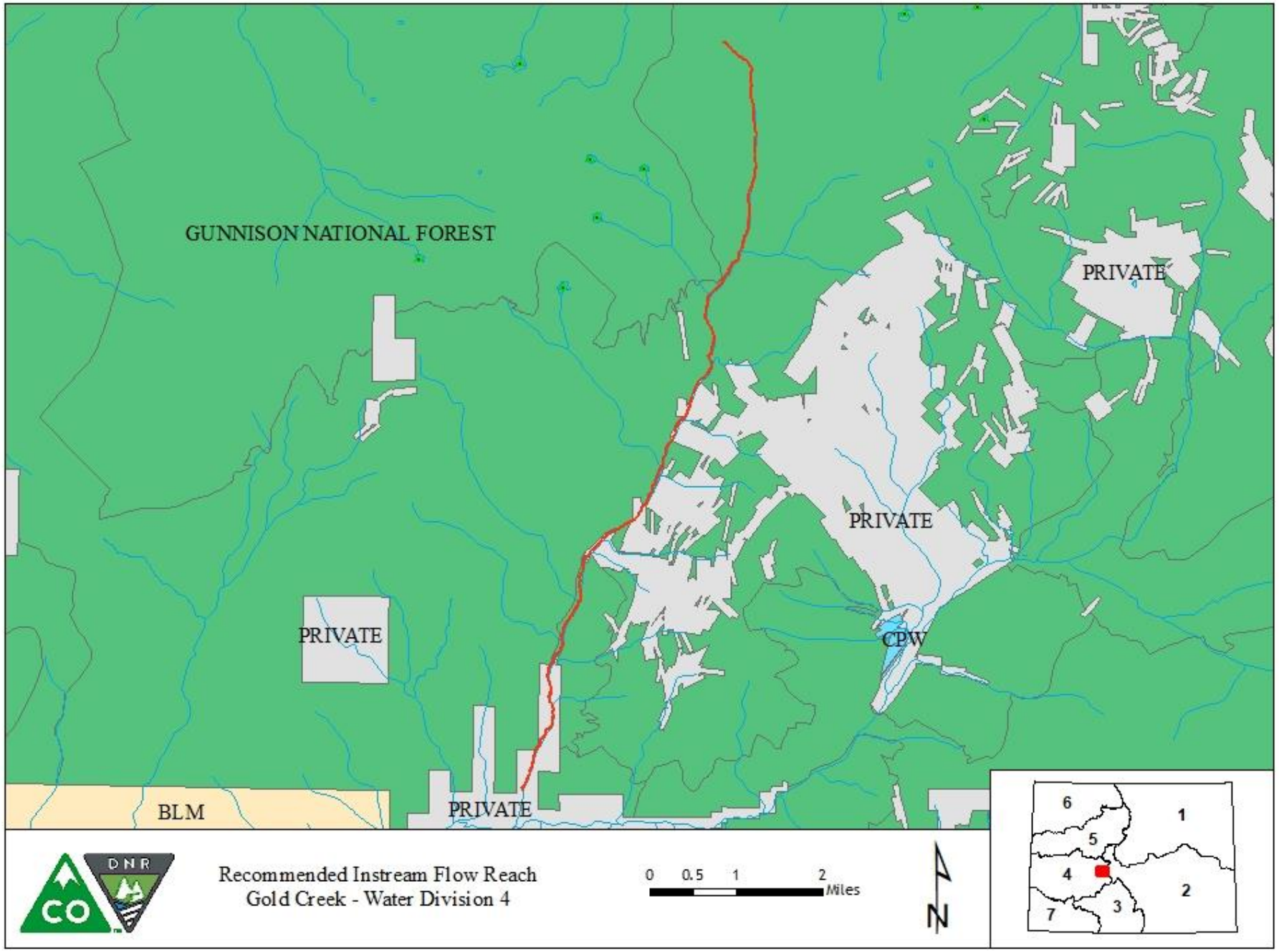
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

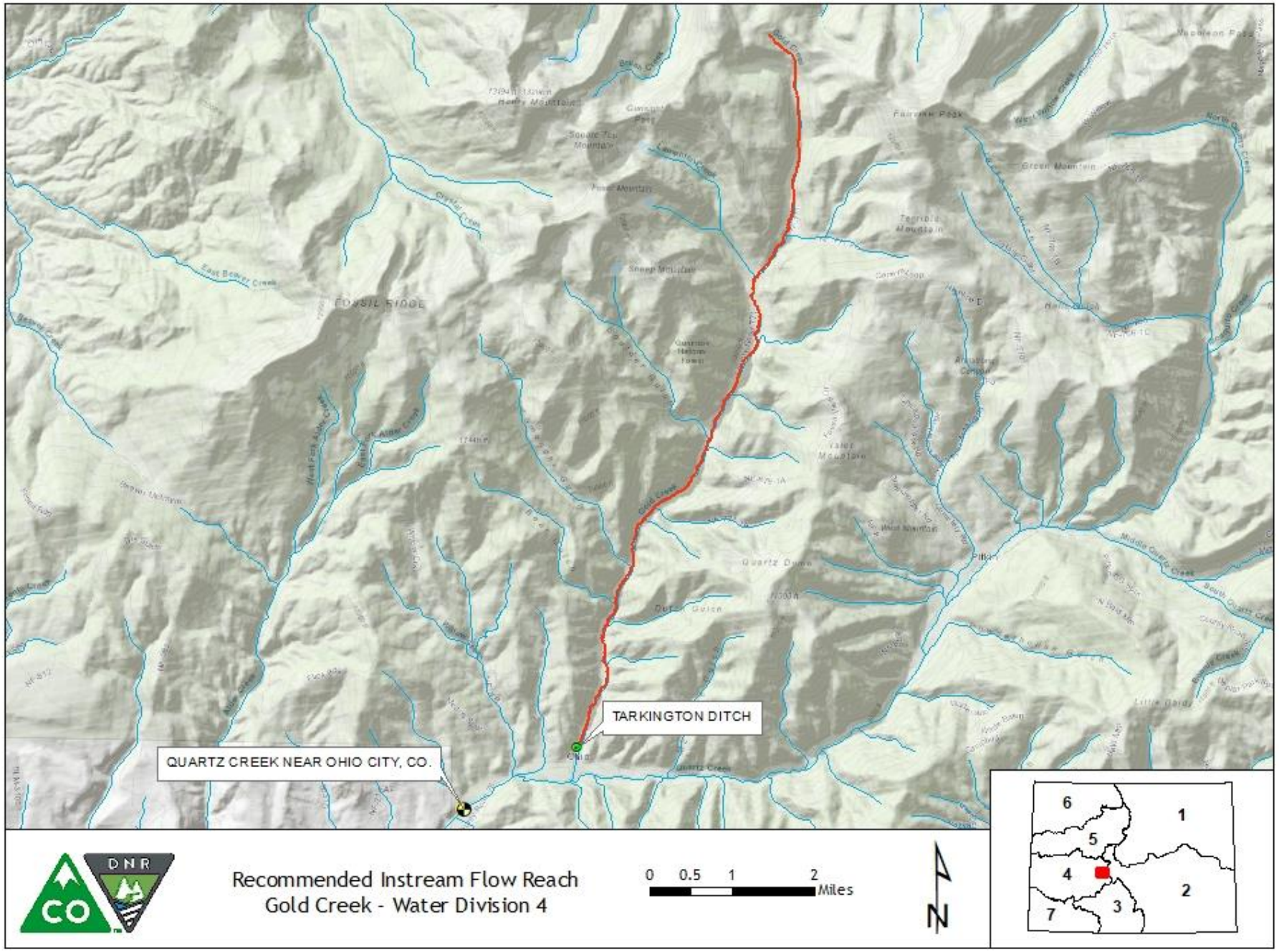
VICINITY MAP



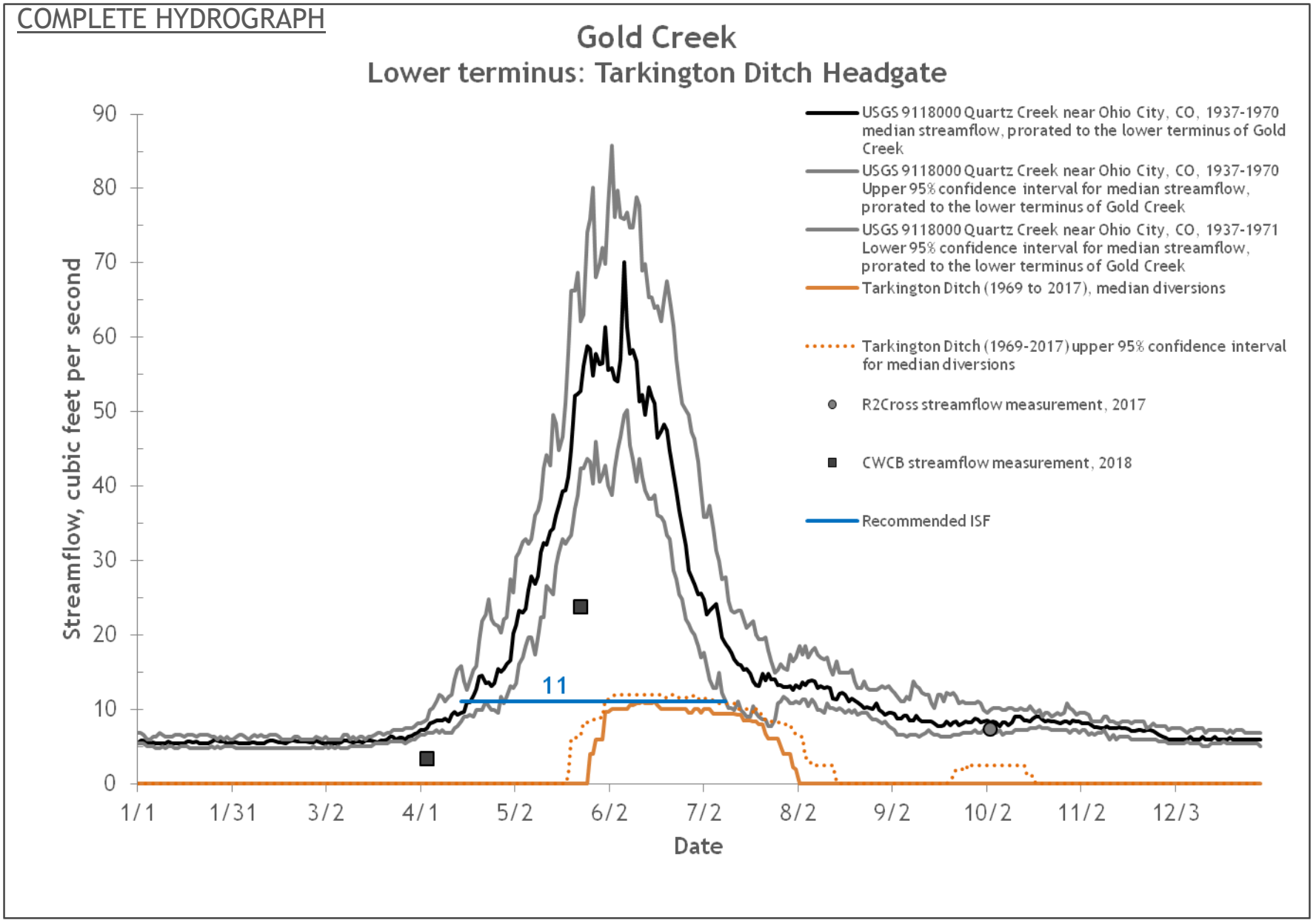
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH