Curecanti Creek (Lower) Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 24-25, 2023

UPPER TERMINUS:	confluence with Commissary Gulch at UTM North: 4272414.37 UTM East: 294045.93
LOWER TERMINUS:	conlfuence wtih Morrow Point Reservoir at UTM North: 4258638.97 UTM East: 289312.65
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	Upper Gunnison
CWCB ID:	21/4/A-014
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	10.1 miles
EXISTING INSTREAM FLOW:	84CW0391, 5 cfs (01/01 – 12/31)
FLOW INCREASE RECOMMENDATION:	3 cfs (03/01 - 03/31) 11.8 cfs (04/01 - 07/15) 4.8 cfs (07/16 - 07/31) 0.4 cfs (08/01 - 09/30) 1.4 cfs (10/01 - 11/30) 0.6 cfs (12/01 - 02/28)

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

BACKGROUND

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 information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

RECOMMENDED ISF REACH

CPW recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Curecanti Creek. Curecanti Creek is located within Gunnison County and is approximately 21 miles east of the town of Montrose (See Vicinity Map). The stream originates near Curecanti Pass and flows south until it reaches the confluence with the Gunnison River upstream of the Black Canyon of the Gunnison. The existing ISF water right on Curecanti Creek was appropriated in 1984 for 5 cfs year-round.

The proposed ISF reach extends from the confluence with Commissary Gulch downstream to the confluence with Morrow Point Reservoir for a total of 10.1 miles. Approximately 59.7% of the land on the proposed reach is owned by the United States Forest Service (USFS) in the Gunnison National Forest, 10.2% is owned by the National Park Service (NPS), and 30.1% is privately owned (See Land Ownership Map). CPW is interested in protecting this stream in order to protect the natural environment.

OUTREACH

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Curecanti Creek was sent to the mailing list in November 2022, March 2022, March 2021 and March 2020. Staff sent letters to identified landowners adjacent to Curecanti Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on Spetember 13, 2022 and November 10, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer on October 11, 2022 and November 29, 2022 regarding water availability on Curecanti Creek.

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 provides the Board with a basis for determining that a natural environment exists.

The headwaters of Curecanti Creek gather on the southern slope of Curecanti pass amongst dense alpine forest. The channel then weaves down through a wide sagebrush and conifer valley dotted with lightly grazed meadows and active beaver complexes in the upper reach. Downstream of Colorado State Highway 92, Curecanti Creek descends sharply into a deep canyon of steep metamorphic rock walls. At the mouth of Curecanti Creek stands a towering spire, called the Curecanti Needle.

Curecanti Creek is a snowmelt driven stream and has a high gradient in this lower reach. The streambed substrate is made-up of large boulders. The boulders make up cascade drop features, large pools, back waters, and course riffles. Shade and cover are also abundant throughout the reach due to the canyon walls and pockets of alder, willow, and blue spruce. Significant woody debris and leafy detritus provide habitat and food for the macroinvertebrate and fish communities.

CPW has identified populations of Brook Trout, Colorado River Cutthroat Trout, and Rainbow Trout in this reach of Curecanti Creek (Table 1). Colorado River Cutthroat Trout are classified as a species of greatest conservation need and a species of special concern in Colorado. Black fly larvae, caddisfly, mayfly, and stonefly were identified in the field. Taxa in caddisfly, mayfly, and stonefly orders are considered evidence of good water quality (Hilsenhoff, 1987). Marmots, snakes, and frogs where also observed by staff in the area.

Table 1. List of species identified in Curecanti Creek.

Species Name	Scientific Name	Status
Colorado River Cutthroat Trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Greatest Conservation Need State - Species of Special Concern
Brook Trout	*Salvelinus fontinalis*	None
Rainbow Trout	*Oncorhynchus mykiss*	None
black fly	*Simuliidae*	None
caddisfly	*Trichoptera*	None
mayfly	*Ehpemeroptera*	None
stonefly	*Plecoptera*	None

ISF QUANTIFICATION

CWCB staff relies on 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
CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022) Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: 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 macroinvertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. 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 Collection and Analysis
CPW collected R2Cross data 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 5.6 cfs and a summer flow of 16.8 cfs. R2Cross field data and model results can be found in the appendix to this report.

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

Date, XS #	Top Width (feet)	Streamflow (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
10/06/2020, 1	35.80	2.77	5.04	19.95
08/10/2021, 2	36.40	2.26	6.39	13.46
08/10/2021, 3	38.80	2.26	5.44	16.84
			5.6	16.8

ISF Recommendation and Increase Justification
CPW and National Park Service (NPS) observed that the single decreed instream flow rate of 5 cfs did not protect seasonal fluctuations in flow. R2Cross data supports additional protection of flow during the summer months to meet three of three hydraulic criteria. Data collected in

2020 and 2021 demonstrated the need for seasonal increases. CPW recommends the following increased flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

An increase of 3.0 cfs is recommended for March 1 through March 31, to bring the total ISF protection to 8.0 cfs; this early spring flow initiation rate is reduced due to water availability. This rate maintains adequate depth and wetted perimeter across riffles, which will support fish they begin to move, transitioning from overwintering habitat to more metabolic activity as temperatures rise before the beginning of spring runoff.

A summer flow increase of 11.8 cfs is recommended for April 1 through July 15, to bring the total ISF protection to 16.8 cfs; this flow rate provides complete minimum protection of three of three criteria during the summer months. This rate maintains adequate average depth of 0.4 feet, velocity, and wetted perimeter during the spring and early summer periods. This flow rate supports fish passage and ideal conditions macroinvertebrate production, fish feeding, and spawning

An increase of 4.8 cfs is recommended for July 16 through July 31 to bring the total ISF protection to 9.8 cfs; this flow rate is reduced due to water availability limitations. This rate maintains fish habitat with adequate depth and wetted perimeter and allows fish movement as flows recede and temperatures may be high in late July.

An increase of 0.4 cfs is recommended from August 1 to September 30, to bring total ISF protection to 5.4 cfs; this flow rate is reduced due to water availability limitations but will still provide suitable habitat availability by maintaining depth and wetted perimeter in most riffles.

A fall increase of 1.4 cfs is recommended for October 1 through November 30, to bring the total ISF protection to 6.4 cfs; this flow rate is reduced due to water availability limitations and does not meet the two of three criteria for baseflow protections. This rate maintains available habitat and allows fish movement during the fall transition to overwintering conditions.

An increase of 0.6 cfs is recommended for baseflow conditions from December 1 through February 28, to bring total ISF protections to 5.6 cfs. This rate is protective by maintaining adequate habitat to support fish during the overwintering period by maintaining adequate depth and wetted perimeter in riffles, as well as habitat availability in glides and pools.

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 streamflow 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) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are 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 from gage records; 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 Curecanti Creek is 39.30 square miles, with an average elevation of 9,544 feet and average annual precipitation of 21.98 inches (See the Hydrologic Features Map). Curecanti Creek is a snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff. Curecanti Creek originates as a medium to high-gradient, heavily forested headwater steam and transitions over the reach to a lower gradient, gaining stream near its confluence with Morrow Point Reservoir.

Water Rights Assessment

There are twenty-four decreed water rights within the contributing basin of Curecanti Creek; for the purposes of this assessment, staff is not including existing or recommended ISF rights. Of these, four water rights were cancelled by the water court, according to Hydrobase documentation. Of the remaining 20 decreed water rights, three are diverting ditch rights from both main channel and tributaries, four are reservoir storage rights and thirteen are spring rights (Table 3). The Head and Ferrier Ditch (WDID 5900944) is the only main-channel diverting ditch, is decreed for 10.5 cfs of transbasin diversions, and is located near the headwaters of Curecanti Creek. As per the Final Revised Abandoned List in Division 4 and email communication with Bob Hurford (11/29/2022), 4.45 cfs of the senior right and the entire 2.5 cfs junior right are on the finalized abandonment list, leaving 3.55 cfs remaining in this right. Limited diversion records show the ditch operates from June through September.

Table 3. Summary of decreed water rights in the Curecanti Creek Contributing Basin

Structure Type	#	Flow (cfs)	Volume (acre-foot)
Ditch	3	17.75[1]	
Reservoir	4		20.3
Spring	13	0.453	

[1] Includes 6.95 cfs of flow listed for abandonment

Data Analysis

Representative Gage Analysis

There is a historic gage on Curecanti Creek within this proposed reach, Curecanti Creek near Sapinero, CO (USGS9125000). The gage collected daily streamflow records for a period of record (POR) of 27 years (1945 to 1972) and is located approximately 2.5 miles above the creek's confluence with Morrow Point Reservoir. The contributing basin of the gage is 35 square miles with an average precipitation of 22.77 inches, slightly more than the entire basin, which could be because the higher average elevation of 9674 feet.

To assess the how the gage POR compared hydrologically to the most recent thirty-year POR, staff evaluated daily precipitation records from NOAA Climate station Gunnison 3 SW (USC00053662). The climate station is located approximately 25 miles east of the gage. Average annual precipitation recorded was 10.55 inches, compared to the last 30-year average precipitation of 8.95 inches. Six years of gage record were recorded during conditions that were drier than the most recent 30-year average. Overall, the gage record reflects normal hydrologic conditions with three notably wet years that significantly increase the gage POR's average precipitation values (1957, 1959 and 1969).

Of the water rights decreed within the contributing basin of Curecanti Creek, all ditches and reservoirs were appropriated prior to the stream gage POR. No thorough records on use are available from the Division Engineer or on Hydrobase; diversion and storage are assumed to be reflected in the gage records for all but the Irving Ditch (WDID 5900961). Irving Ditch is decreed for 3.75 cfs and diverts from a tributary that joins Curecanti Creek below gage. According to Bob Hurford, this "ditch runs fast in the spring and then there is not much water supply after the runoff" (email communication, 11/29/2022**).** Three the spring rights were appropriated during or prior to the gage and POR; the remaining 10 were all appropriated in total for 0.33 cfs between 1999 and 2000. Spring rights are not all consumptive, so water availability was not reduced due to the presence of these rights.

Sufficient data exist to calculate upper and lower 95% confidence intervals for median streamflow and median streamflow based on the gage records. A weighted area-precipitation factor of 108% was applied the gage records to account for the gage's mid-reach location.

CWCB staff made one streamflow measurement on the proposed reach of Curecanti Creek as summarized in Table 4.

Table 4. Summary of streamflow measurements for Curecanti Creek.

Visit Date	Flow (cfs)	Collector
06/24/2022	19.02	CWCB

Water Availability Summary
The hydrograph (See Complete Hydrograph) shows the median streamflow with upper and lower range of the 95% confidence intervals recorded from USGS9125000 gage from 1945 to 1972 and the proposed ISF flow rate. Staff has concluded that water is available for a year-round increase.

MATERIAL INJURY
As a new junior water right, the proposed ISF on Curecanti Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

ADDITIONAL INFORMATION

Citations
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

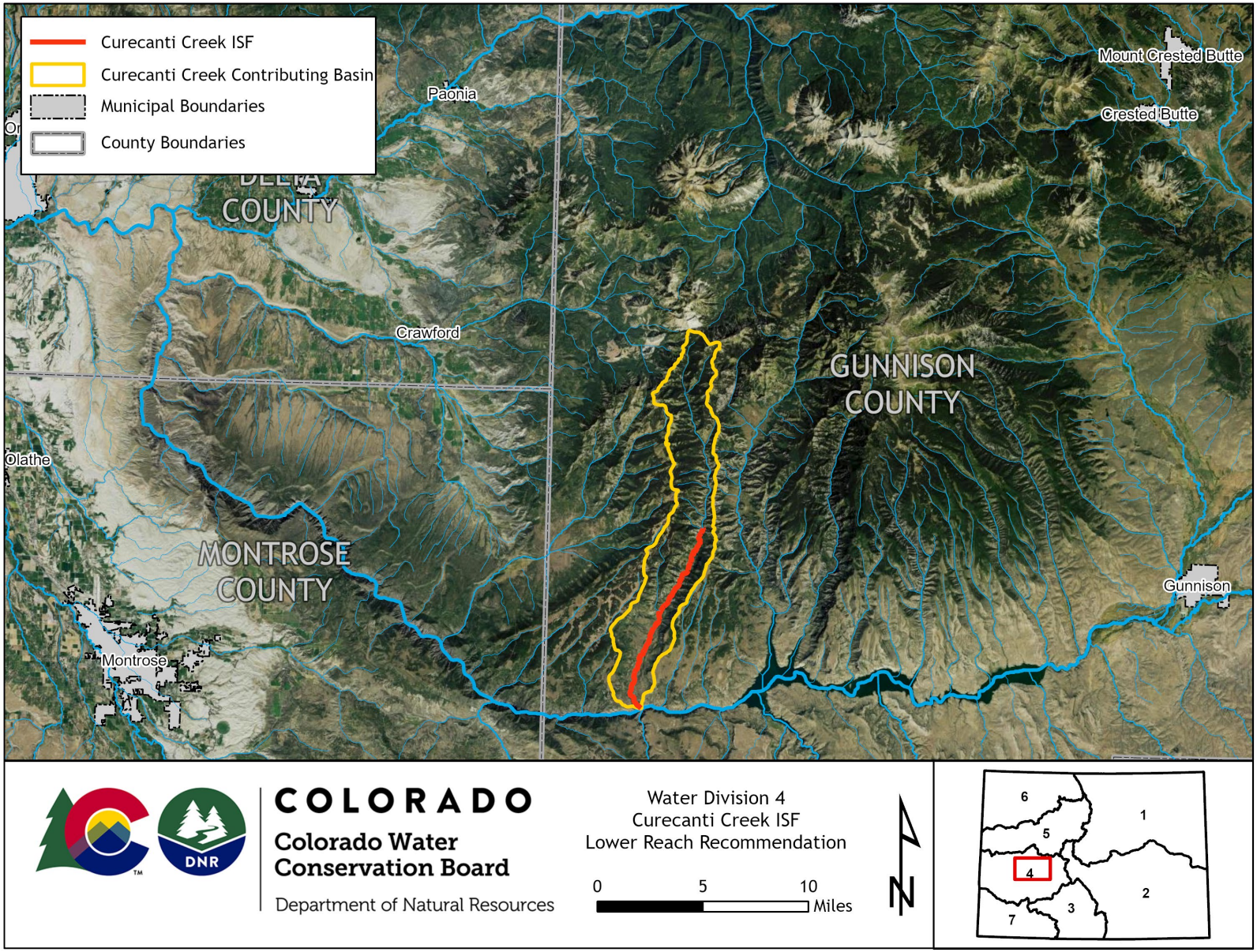
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

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.

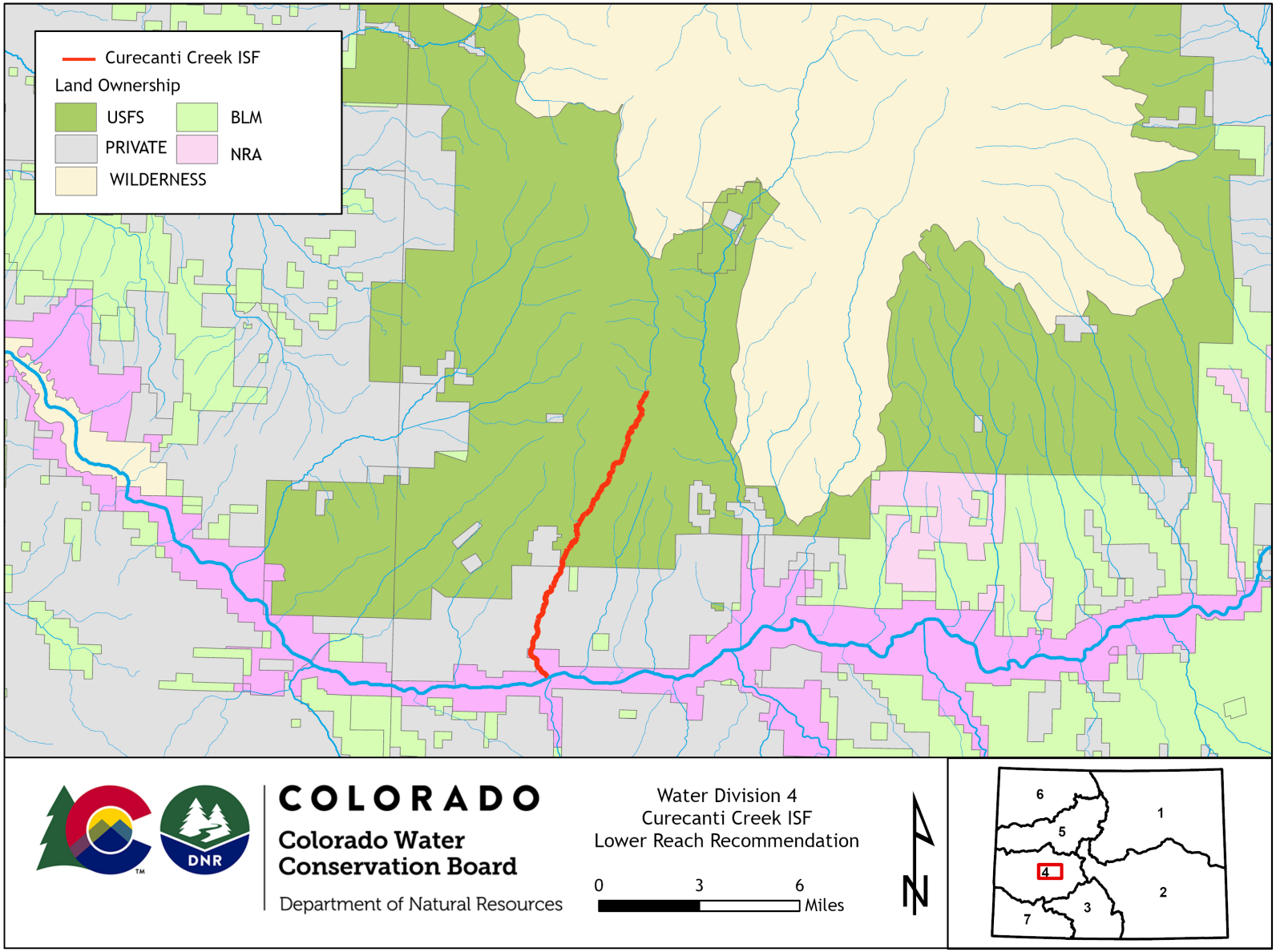
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

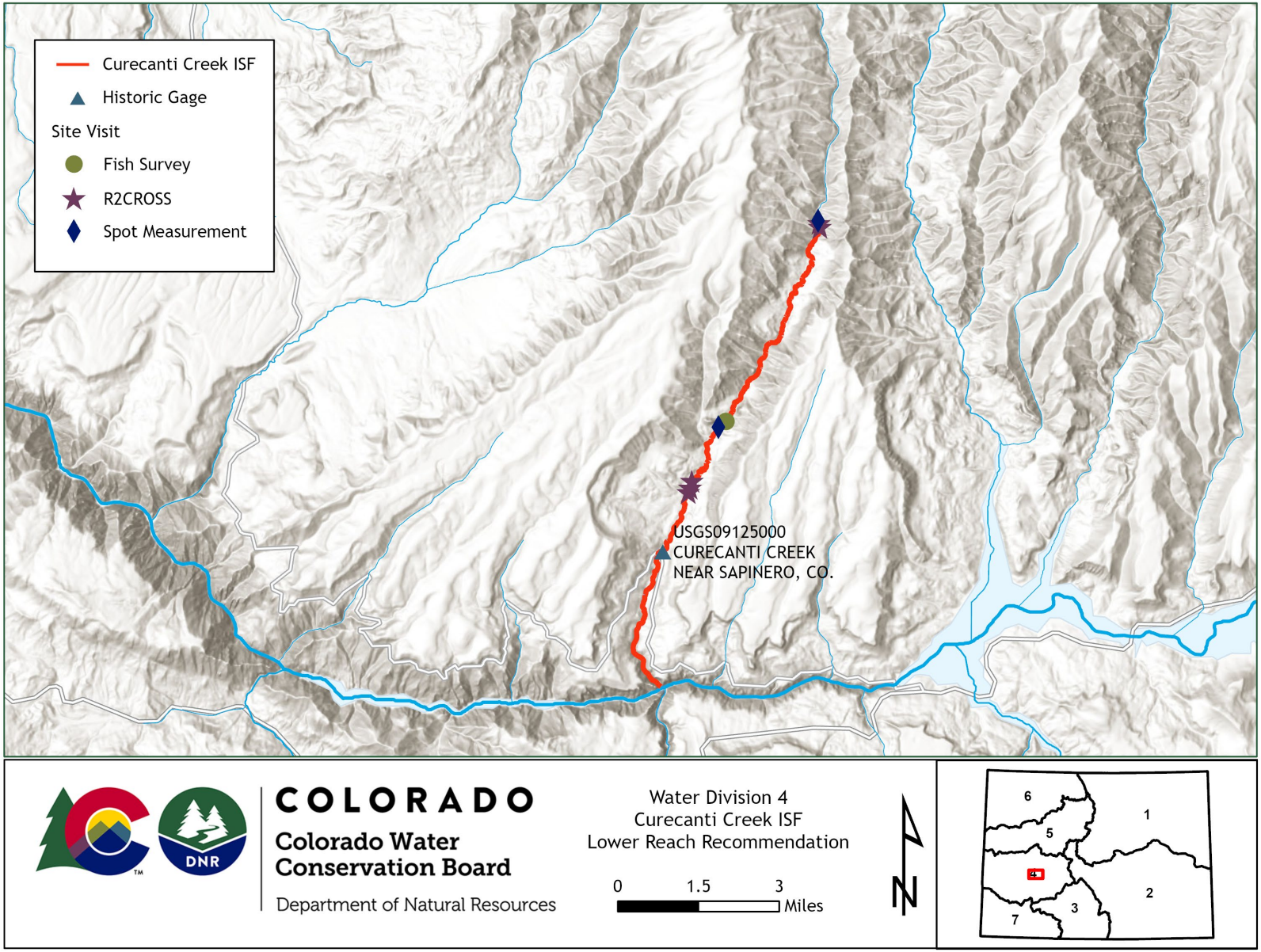
VICINITY MAP



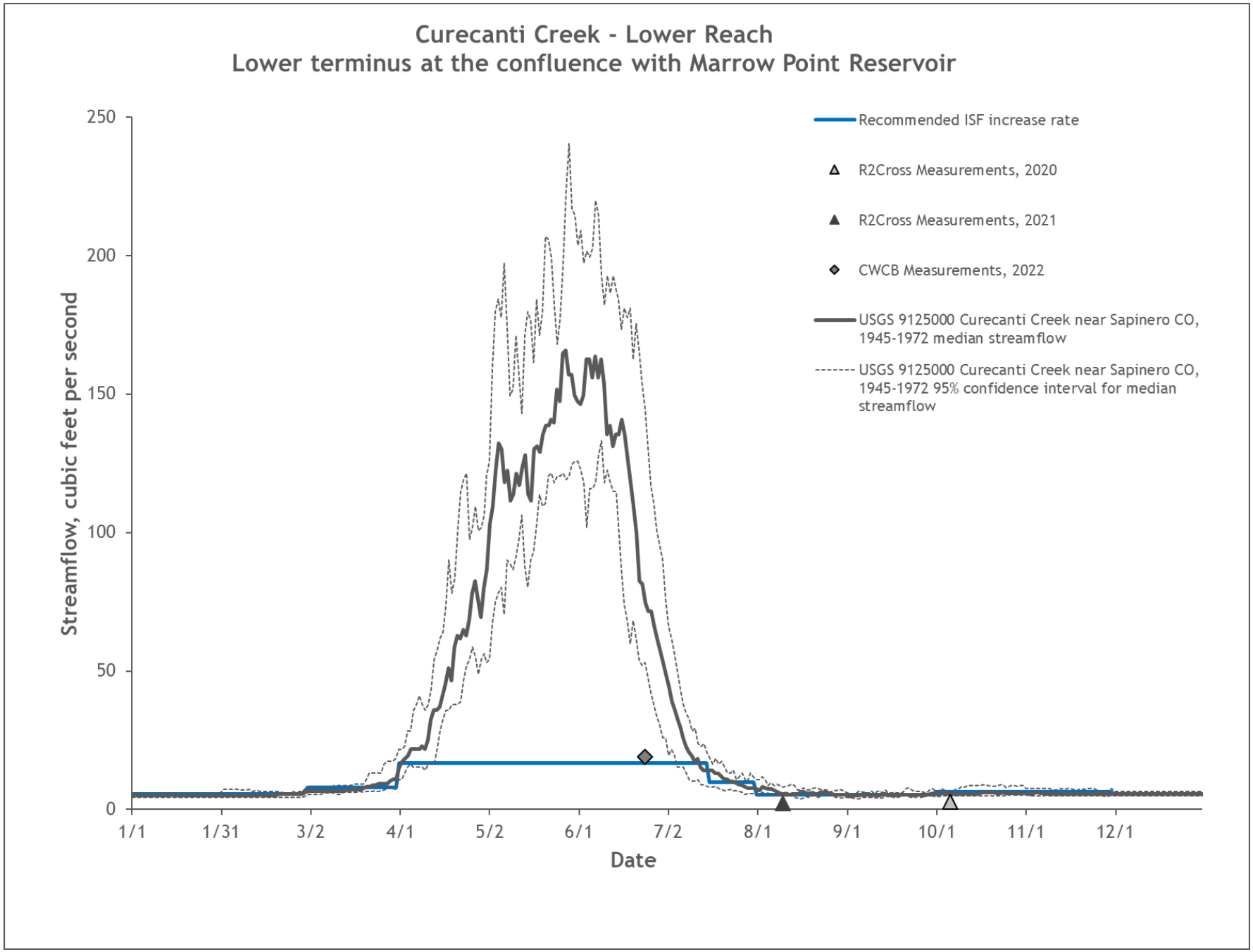
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH