Herman Gulch Executive Summary

CWCB STAFF INSTREAM FLOW INCREASE RECOMMENDATION
January 24-25, 2023

UPPER TERMINUS:	headwaters in the vicinity of: UTM North: 4396896.47 UTM East: 422251.32
LOWER TERMINUS:	confluence Clear Creek at: UTM North: 4394857.42 UTM East: 426667.37
WATER DIVISION:	1
WATER DISTRICT:	7
COUNTY:	Clear Creek
WATERSHED:	Clear
CWCB ID:	21/1/A-003
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	3.64 miles
EXISTING INSTREAM FLOW:	84CW0650, 2 CFS (1/1 -12/31)
FLOW INCREASE RECOMMENDATION:	0.4 cfs (04/01 - 04/30) 4 cfs (05/01 - 07/31) 0.7 cfs (08/01 - 08/31)

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 Herman Gulch. Herman Gulch is located within Clear Creek County and is approximately 6.4 miles west from the town of Silver Plume (See Vicinity Map). The stream originates on the east side of Pettingell Peak at approximately 12,200 feet elevation and flows east and south, along the popular Herman Gulch trail, until it reaches the confluence with Clear Creek. The existing ISF water right on Herman Gulch was appropriated in 1984 for two cfs year-round. This ISF water right extends from the headwaters to the confluence with Clear Creek.

The proposed ISF reach extends from the headwaters downstream to the confluence with Clear Creek for a total of 3.64 miles. The entire proposed reach is located on United States Forest Service (USFS) land in the Arapaho National Forest (See Land Ownership Map). CPW is interested in an additional ISF water right to protect this stream because it contains a population of Greenback Cutthroat Trout, which is listed as a threatened species by both the state and federal government. CPW introduced Greenback Cutthroat Trout to Herman Gulch to establish a new conservation population as part of the Greenback Cuthroat Trout recovery plan (US Fish and Wildlife Service, 1998). In 2022, CPW found evidence of natural reproduction of Greenback Cutthroat Trout in Herman Gulch, making it only the second known self-sustaining population in the state.

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 Herman Gulch was sent to the mailing list in March 2020, March 2021, September 2021, March 2022, and November 2022. A public notice about this recommendation was also published in the Clear Creek Courant on December 22, 2022.

Staff presented information about the ISF program and this recommendation to the Clear Creek County Board of County Commissioners on October 20, 2020. In addition, staff communicated

with Water Commisioner Jason Smith via email in late December 2022 regarding existing water rights and water uses on Herman Gulch.

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.

Herman Gulch starts at the continental divide near Pettingell Peak. It is a first order and snowmelt driven stream with snowpack reserves generally lasting into the late summer. The top of the reach flows at a high gradient through high alpine scree fields and high alpine wetlands above treeline. It transitions to a lower gradient for a large section of the reach with stands of evergreen forest and wet meadows. The lower reach transitions again into a steep and densely evergreen forested section before flowing under Interstate 70 and into Clear Creek.

The channel is mainly single thread with substrate that ranges from medium-sized cobble to larger boulders. There are long runs, undercut banks, pocket pools, steep coarse-substrate riffles, and boulder cascades. Large woody debris and boulders form deep pools and scour pools. There is a significant amount of log jams formed by the aftermath of a large avalanche cycle in 2019.

CPW completed a reintroduction process for genetically pure Greenback Cutthroat Trout in Herman Gulch from 2016 to 2019. The Greenback Cutthroat Trout was designated Colorado's state fish in 1994. This subspecies of cutthroat trout is listed as a threatened species by both the state and federal government. A 2019 CPW fish survey found that the fishery was exclusively Greenback Cutthroat Trout and in 2022 CPW fish biologists found evidence that the population are successfully reproducing and naturally sustaining their population. The macroinvertebrate community is diverse and thriving. In the field, staff have identified mayfly caddisfly, stonefly, damselfly, blackfly, and flatworm. Taxa in the mayfly, stonefly, and caddisfly orders are considered evidence of good water quality (Hilsenhoff, 1987).

Table 1. List of species identified in Herman Gulch.

Species Name	Scientific Name	Status
Greenback Cutthroat Trout	*Oncorhynchus clarkii stomias*	Federal - Threatened Species State - Threatened Species State - Species of Greatest Conservation Need
aquatic fly larve	*Diptera*	None
black fly	*Simuliidae*	None
caddisfly	*Trichoptera*	None
damselfly	*Zygoptera*	None
dragonfly	*Anisoptera*	None
flathead mayfly	*Heptageniidae*	None
flatworm	*Turbellaria*	None
mayfly	*Ephemeroptera*	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 macro-invertebrates (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 summer flow of 6.0 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 Herman Gulch.

Date, XS #	Top Width (feet)	Streamflow (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
09/23/2020, 1	12.19	0.93	N/A	6.84
10/11/2021, 3	13.39	1.24	N/A	5.57
07/18/2022, 4	14.81	4.94	N/A	5.58
			N/A	6.00

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

An increase of 0.4 cfs is recommended from April 1 through April 30 to bring the total ISF protection to 2.4 cfs. This maintains adequate depth and wetted perimeter as fish transition from overwintering habitat to more metabolic activity as flows rise before the beginning of spring runoff.

An increase of 4.0 cfs is recommended from May 1 through July 31 to bring the total ISF protection to 6.0 cfs. This maintains adequate depth, velocity, and wetted perimeter during the summer period when fish are most active. This higher flow rate will also help remove fine sediment to maintain clean interstitial space in gravels for spawning and egg incubation.

An increase of 0.7 cfs is recommended from August 1 through August 31 to bring the total ISF protection to 2.7 cfs. This maintains adequate dpeth and wetted perimeter that allows fish to move to more stable habitat as flows begin to recede. It also may assist with higher water temperatures in late 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.

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.). 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 Herman Gulch is 3.16 square miles, with an average elevation of 11,891 feet and average annual precipitation of 32.15 inches (See the Hydrologic Features Map). There are three small springs and a well that total less than 0.07 cfs in decreed water rights. Due to small number of water uses, hydrology in this drainage basin represents essentially natural flow conditions.

Data Collection and Analysis

Gage Data and CWCB Measurements

There is not a current or historic streamflow gage on Herman Gulch. Several nearby gages were evaluated, but none appeared to be representative of Herman Gulch due to differences in drainage basin characteristics. CWCB staff visited Herman Gulch and assisted CPW in making R2Cross measurements on the proposed reach. Staff did not make any additional streamflow measurements.

CSUFlow18

The CSUFlow18 method provides the best available estimate of streamflow for Herman Gulch. The mean-monthly streamflow estimated using CSUFlow18 was not adjusted to account for the existing water rights which are for negligible amounts.

Water Availability Summary
The hydrograph (See Complete Hydrograph) shows CSUFlow18 results for mean-monthly streamflow. Staff has concluded that water is available for appropriation.

MATERIAL INJURY
As a new junior water right, the proposed ISF on Herman Gulch 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

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.

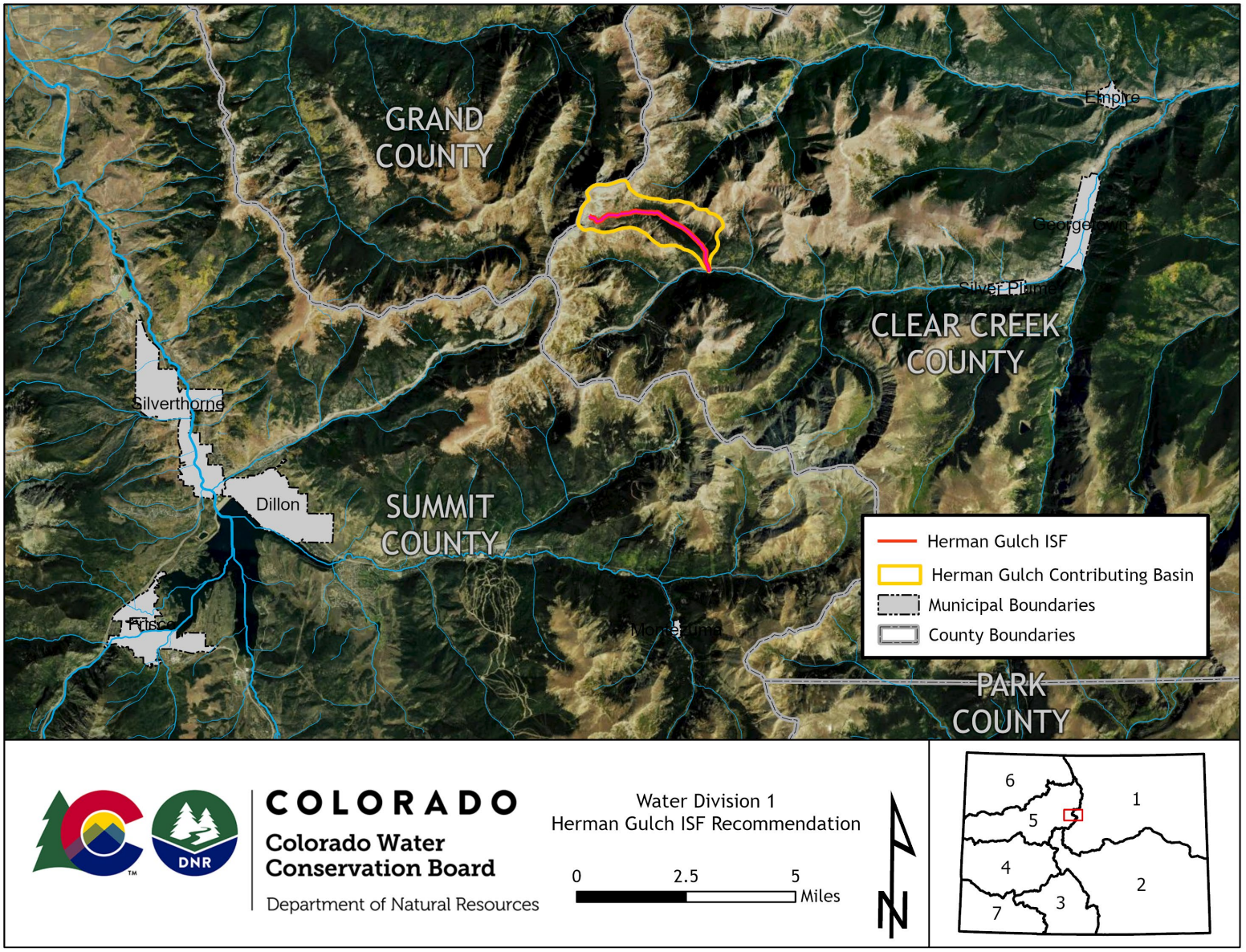
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

U.S. Fish and Wildlife Service, 1998, Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.
https://cpw.state.co.us/Documents/Research/Aquatic/CutthroatTrout/GBNRecoveryPlan.pdf

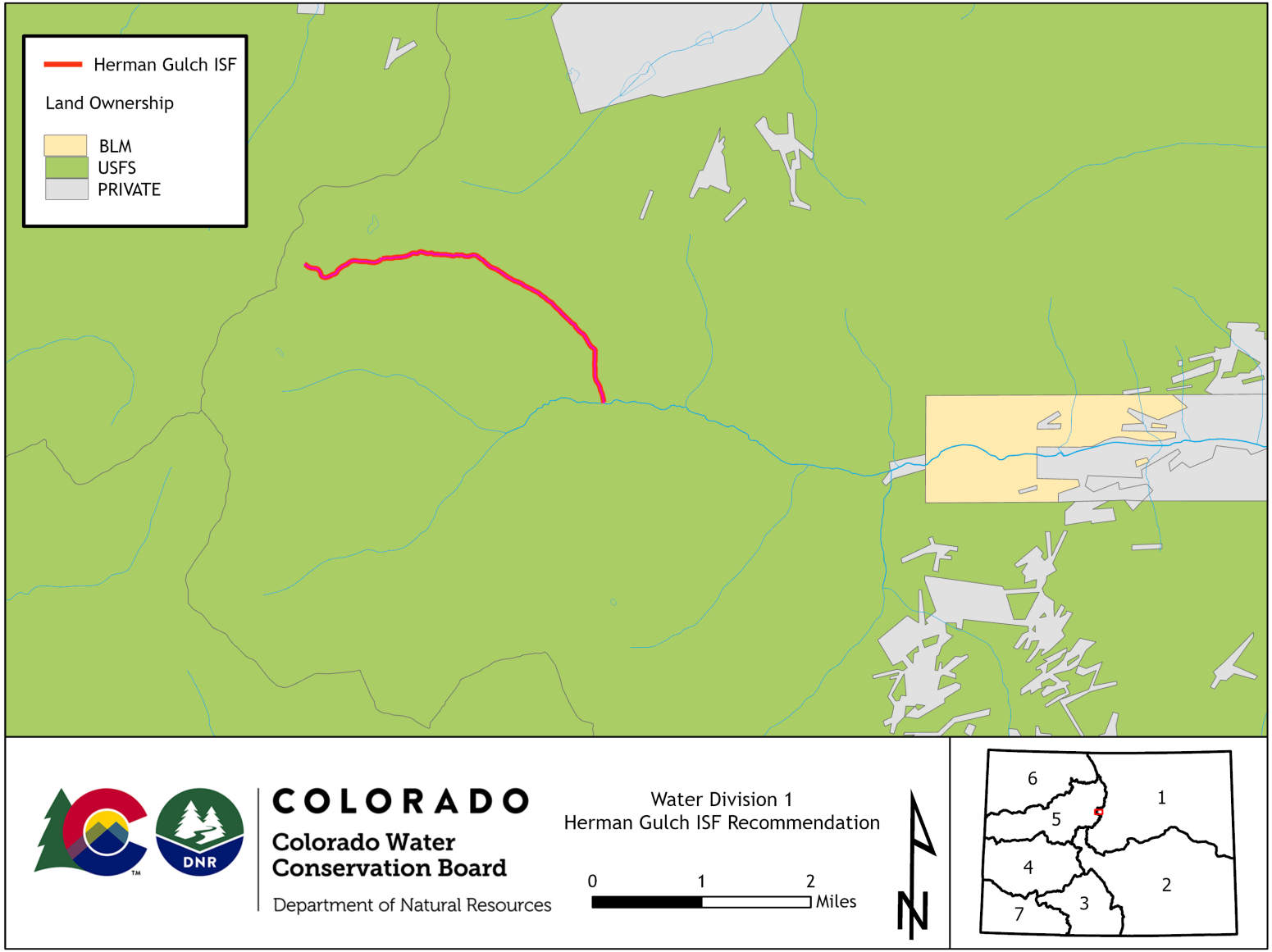
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

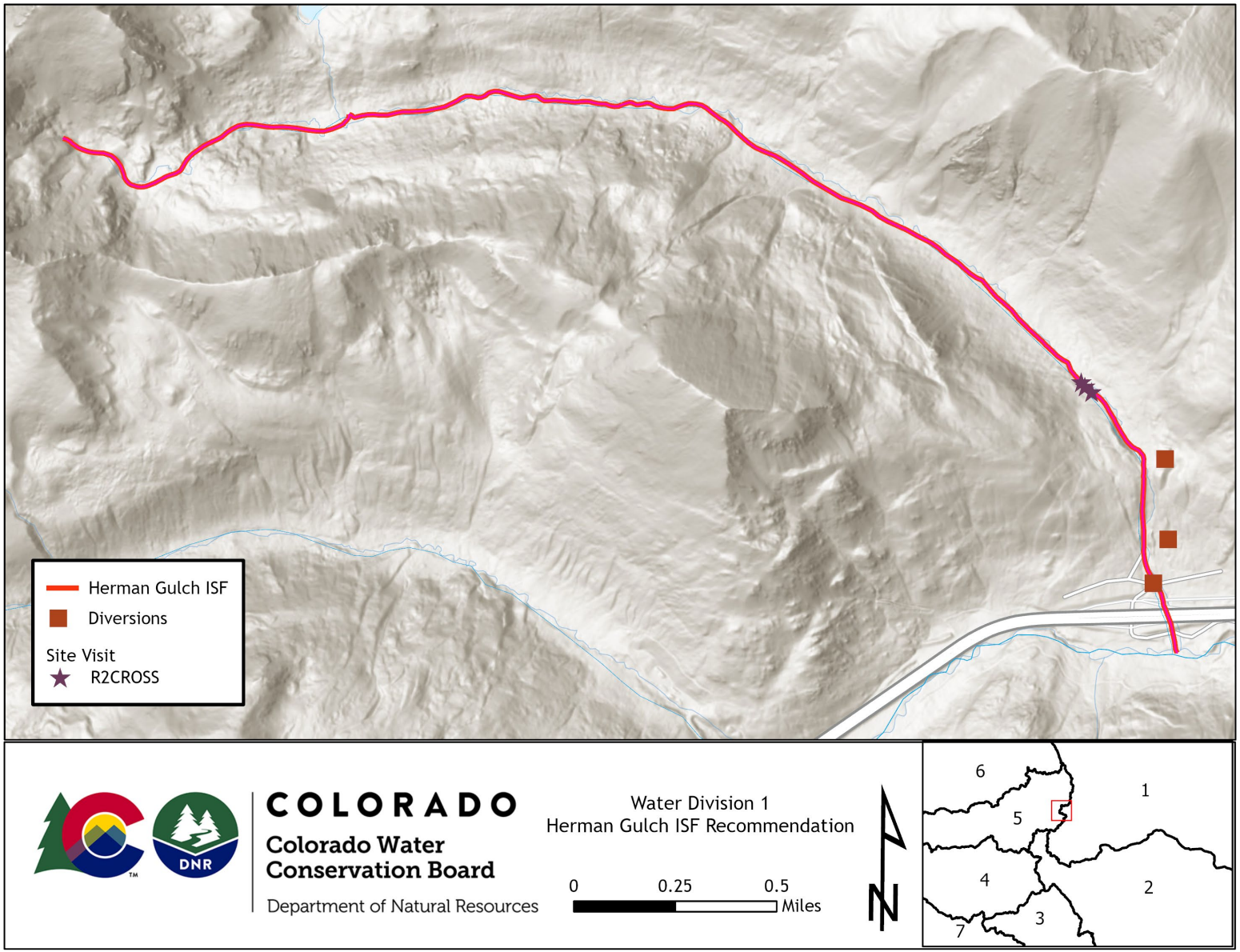
VICINITY MAP



LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH