Vermillion Creek (Reach 2) Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
March 19-20, 2025

UPPER TERMINUS:	historic USGS Vermillion Creek at Ink Springs gage at UTM North: 4519020.56 UTM East: 185433.71
LOWER TERMINUS:	Vermillion Ditch headgate at UTM North: 4518063.06 UTM East: 177768.90
WATER DIVISION/DISTRICT:	6/56
COUNTY:	Moffat
WATERSHED:	Vermilion
CWCB ID:	23/6/A-004
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	10.12 miles
FLOW RECOMMENDATION:	1.4 cfs (08/01 - 04/30) 2.4 cfs (05/01 - 07/31)

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 (NLL) water rights. 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/2025-isf-recommendations.

RECOMMENDED ISF REACH

BLM recommended that the CWCB appropriate an ISF water right on a reach of Vermillion Creek at the ISF Workshop in February of 2022. Vermillion Creek is located within Moffat County and is approximately 72 miles northwest from the City of Craig, CO (See Vicinity Map). The stream originates in Wyoming and flows south and west into Colorado until it reaches the confluence with the Green River in Browns Park.

The proposed ISF reach extends from the historic Vermillion Creek at Ink Springs Ranch gage (USGS 09235450) downstream to the Vermillion Ditch headgate for a total of 10.12 miles. Seventy-six percent of the land on the proposed reach is owned by BLM, 6% is owned by the state of Colorado, and 18% is privately owned (See Land Ownership Map). BLM is interested in protecting this stream to preserve the natural environment as part of the Little Snake Resource Management Plan which identifies management of streams supporting native fish species as a priority for BLM. The plan specifies that BLM will work to improve aquatic conditions in these streams and will also work to prevent surface disturbances close to them. In addition, the plan specifies that BLM will work with the CWCB to appropriate ISF water rights to protect these fisheries. Vermillion Creek also represents a major riparian habitat resource in an extremely arid area. BLM's plan specifies that BLM will take actions to stabilize and improve riparian habitat. Appropriation of an ISF water right would assist BLM in meeting its aquatic and riparian management objectives.

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 Vermillion Creek was sent to the mailing list in November 2024, March 2024, March 2023, and March 2022. Staff sent letters to identified landowners adjacent to Vermillion Creek based on information from the county assessor's website. A public notice about this recommendation was also published in the Craig Press on December 11, 2024.

Staff presented information about the ISF program and this recommendation to the Moffat County Land Use Board on September 9, 2024. In addition, staff spoke with Destan Gerhard, the current Water Commissioner for Districts 54, 55, and 56, and Sarah Myers, the former Water Commisioner, on November 5, 2024 to discuss water rights and water availablity on Vermillion 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.

This reach flows through a canyon that ranges from ¼ to ½ mile in width. The stream has low gradient and small to medium substrate size. Riffles are limited and a high percentage of the habitat is comprised of runs. The riparian community includes cottonwood, willow, Russian olive and Phragmites. Cattle usage of the creek is evident, but the banks and riparian area appear to be stable. Water temperatures and conductivity are well within the ranges tolerated by native fishes. Fishery surveys indicate a self-sustaining population of sculpin, speckled dace, and mountain suckers (Table 1). CPW lists mountain sucker as a state species of greatest concern and a species of special concern (CPW, 2015).

Table 1. List of species identified in Vermillion Creek.

Species Name	Scientific Name	Status
sculpin	*Cottus bairdii*	None
mountain sucker	*Catostomus platyrhynchus*	State - Species of Greatest Conservation Need State - Species of Special Concern
speckled dace	*Rhinichthys osculus*	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

BLM staff used the R2Cross method to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (CWCB, 2022; CWCB, 2024). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, a survey of channel geometry and features at a cross-section, and a 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; Ferguson, 2021). 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). BLM 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 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

BLM collected R2Cross data at three transects for this proposed ISF reach (Table 2 and Site Map). Results obtained at more than one cross-section are averaged to determine the R2Cross flow rate for the stream reach. The R2Cross model results in a winter flow of 1.40 cfs and a summer flow of 2.35 cfs. R2Cross field data and model results can be found in the appendix to this report.

Table 2. Summary of R2Cross cross-section measurements and results for Vermillion Creek.

Date, XS #	Top Width (feet)	Streamflow (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
06/14/2018, 1	14.00	0.96	1.53	2.66
06/14/2018, 2	15.06	0.82	1.91	2.21
04/01/2021, 1	9.28	2.76	0.75	2.19
			1.40	2.35

ISF Recommendation

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

2.4 cfs is recommended from May 1 to July 31. This period covers spawning activities by native fishes. The recommended flow rate is driven by the average velocity criteria. Protecting average velocity for spawning habitat is important because many portions of this reach have very low velocities. Without suitable velocity, the limited riffles may be unsuitable for spawning.

1.40 cfs is recommended from August 1 to April 30, the base flow period. This recommendation is driven by the average depth criteria. BLM believes that maintaining this

flow rate will prevent stress on the fish population during high temperature periods during late summer and should keep pools sufficiently free of ice to allow overwintering of fish.

WATER AVAILABILITY

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for determining 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 contributing basin of the proposed ISF on Vermillion Creek is 931 square miles, with an average elevation of 7,083 feet and average annual precipitation of 12.2 inches. This large drainage basin starts in Wyoming and includes largely lower elevation terrain that likely melts out earlier than basins with high elevation snowpacks. It also appears to be influenced by rainstorms in late winter and summer that can result in large changes in streamflow on a periodic basis. Hydrology is altered by water uses within the basin.

Water Rights Assessment

Three active water rights were identified in the proposed reach as summarize by Table 3.

Table 3. Active water rights located within the proposed reach on Vermillion Creek.

Structure Name	WDID	Amount	Appropriation Date
Middle Buffham Ditch	5600527	1.0	1943
Vermillion Creek #2	560050	0.04	1930
Moffat CO Pump Div #318*	5601302	2.0 cfs	1971

*for road maintenance

There are a substantial number of water rights within the Vermillion Creek basin tributary to the proposed reach (Table 4). Staff summarized Colorado water rights listed as active and absolute and all Wyoming water rights except those listed as abandoned, cancelled, or expired. Wyoming water rights listed as incomplete, partially adjudicated, or without clear status were included to avoid underestimating the actual amounts.

Table 4. Summary of active water rights in the Vermillion Creek basin in Colorado and Wyoming.

Structure Type, Amount	Colorado	Wyoming	Total
Ditch, cfs	59.8	30.9	90.7
Springs, cfs	2.4	2.3	4.7
Storage, acre-feet	670.5	880.8	1,551.3

Data Collection and Analysis

Representative Gage Analysis

The USGS operated a streamflow gage on Vermillion Creek approximately 4.8 miles upstream from the proposed lower terminus (USGS 09235490 Vermillion Creek below Douglas Draw near Lodore, CO). This short-term gage operated from 9/1/1994 to 12/31/1995. This gage record was compared to a nearby climate station to evaluate how the historical record compares to a longer record. The Western Region Climate Center maintains a Remote Automatic Weather Stations (RAWS) climate gage approximately 1.4 miles southwest from the lower terminus of the proposed reach (Lodore Canyon NWS ID 50104). This climate station includes precipitation data since 1989. Over the last 30 years of record (1993-2023), 1994 had the 3rd highest annual total precipitation while 1995 was at the 25th percentile. Although the stream gage record is short, most of the data is from a year with low annual precipitation. Due to the short period of record, staff calculated mean-monthly streamflow based on the Vermillion Creek below Douglas Creek gage.

Staff reviewed all water court transactions within Colorado that may have altered streamflow since the period of gage operation. This assessment evaluated new water rights, additional or supplemental water rights, and water rights that were made absolute after 1993. Although some water rights were adjudicated after the gage period, the majority of these were already in use prior to 1993. Approximately 40.0 acre-feet for new reservoirs were decreed after 1993, one of which had a 3 cfs water right. Less than 0.1 cfs of spring and 0.13 cfs of well rights were also adjudicated after 1993; staff did not review these in detail to determine the actual date of beneficial use. In summary, some additional water rights have come into use after the

Vermillion gage period of record, but the majority of water rights were already in use. A similar assessment was not conducted for water rights in Wyoming due to limited data availability.

Diversion Records

The Vermillion Ditch is located at the downstream terminus for this proposed reach. This ditch is used for irrigation and storage (WDID 5601180, 10 cfs, appropriated in 1974). This structure has placed three calls in 2009, 2010, and 2011, so at times the basin is under administration. Although diversion records are not a perfect proxy for streamflow, they can provide additional information about potential water availability and timing (See Complete Hydrograph). The median daily diversions from Vermillion Ditch from 1988 to 2020 are generally above the proposed ISF flow rate of 2.4 cfs from May through June and the upper confidence interval for median daily diversions is above 2.4 cfs through July. Median daily diversions or the upper confidence interval for median daily diversions continue to be above the lower proposed ISF flow rate of 1.4 cfs through September ending by mid-October.

Site Visit Data

CWCB staff made four streamflow measurements on the proposed reach of Vermillion Creek as summarized in Table 3. For context, annual precipitation in 2023 was above the 75th percentile, while 2024 was below median based on the last 30 years of data at the Lodore Canyon climate station (Western Regional Climate Center RAWS, Lodore Canyon NWS ID 50104).

Table 3. Summary of streamflow measurements for Vermillion Creek (Middle).

Visit Date	Flow (cfs)	Collector
11/09/2023	4.18	CWCB
03/26/2024	22.44	CWCB
05/15/2024	4.95	CWCB
06/27/2024	0.32	CWCB

Water Availability Summary

The hydrograph shows mean-monthly streamflow at the Vermillion Creek near Douglas Gulch gage, the median daily diversions for Vermillion Ditch, the upper confidence interval for the median daily diversion for Vermillion Ditch, and the proposed ISF rate. The proposed ISF flow rate is below the mean-monthly streamflow or the median or upper confidence interval for median diversions at all times. Staff concludes that water is available for appropriation on Vermillion Creek.

MATERIAL INJURY

If decreed, the proposed ISF on Vermillion Creek would be a new junior water right. This ISF water right can exist without material injury to other senior 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

Common Acronyms and Abbreviations

Term	Definition
af	acre feet
BLM	Bureau of Land Management
cfs	cubic feet per second
CWCB	Colorado Water Conservation Board
CPW	Colorado Parks and Wildlife
DWR	Division of Water Resources
HCCA	High Country Conservation Advocates
ISF	Instream Flow
NLL	Natural Lake Level
USGS	United States Geological Survey
USFS	United States Forest Service
XS	Cross section

Citations

Colorado Parks and Wildlife, 2015, State Wildlife Action Plan: A strategy for conserving wildlife in Colorado. https://cpw.widencollective.com/assets/share/asset/nbenjdfemj

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

Colorado Water Conservation Board, 2024, R2Cross field manual. Retrieve from URL: https://dnrweblink.state.co.us/cwcbsearch/0/edoc/224685/R2Cross%20Field%20Manual%202024.pdf

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.

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

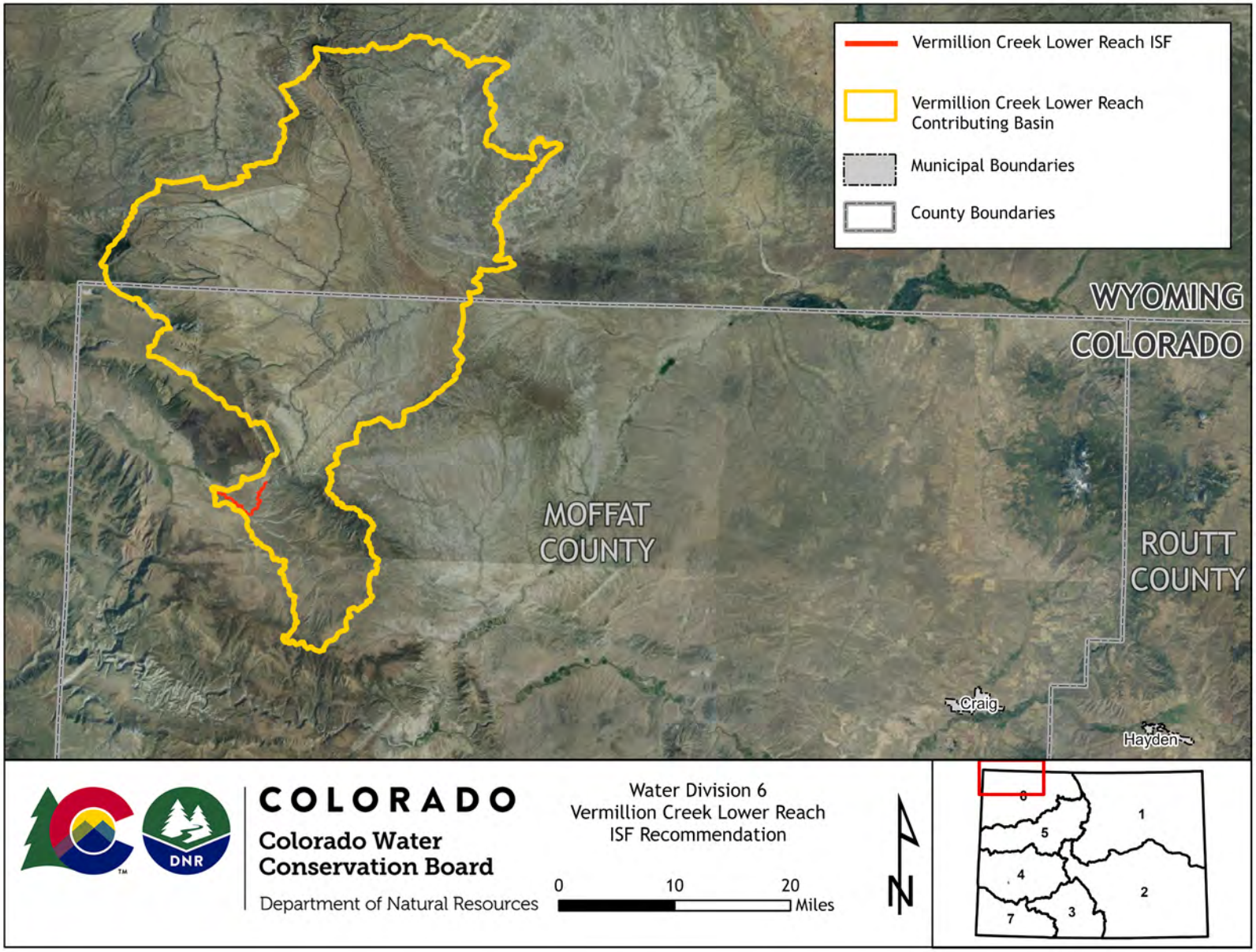
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the state of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

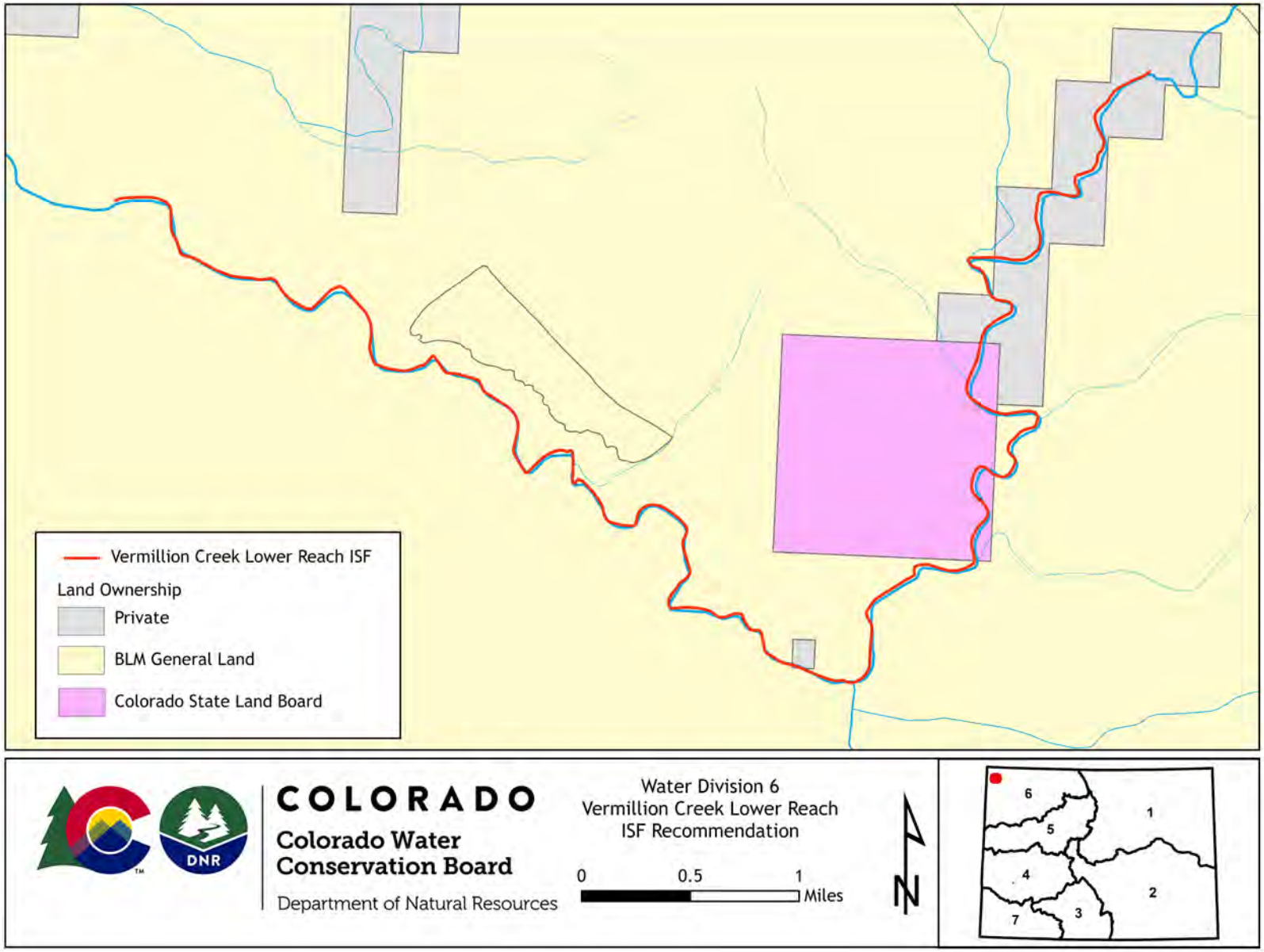
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

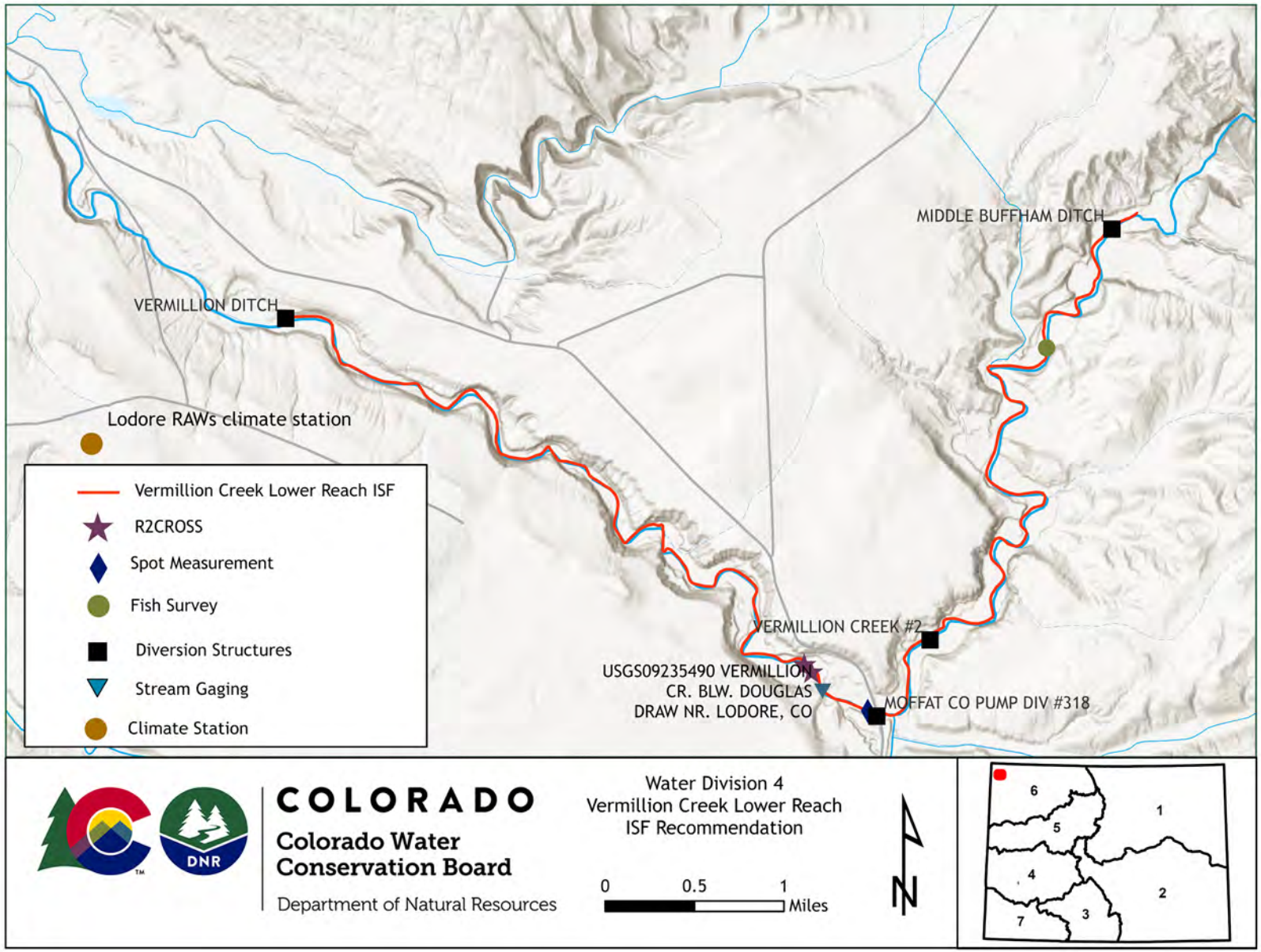
VICINITY MAP



LAND OWNERSHIP MAP



SITE MAP


MIDDLE BUFFHAM DITCH
VERMILLION DITCH
Lodore RAWs climate station
Vermillion Creek Lower Reach ISF
R2CROSS
Spot Measurement
Fish Survey
Diversion Structures
Stream Gaging
Climate Station
VERMILLION CREEK #2
USGS09235490 VERMILLION CR. BLW. DOUGLAS DRAW NR. LODORE, CO
MOFFAT CO PUMP DIV #318
COLORADO
Colorado Water Conservation Board
Department of Natural Resources
Water Division 4
Vermillion Creek Lower Reach
ISF Recommendation
0
0.5
1
Miles
N
6
1
5
4
2
7
3

COMPLETE HYDROGRAPH