COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 718
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

Jared Polis, Governor

Dan Gibbs, DNR Executive Director

Rebecca Mitchell, CWCB Director

2020 Instream Flow Recommendations

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Iowa Gulch

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	headwaters in the vicinity of UTM North: 4343774.07 UTM East: 398270.52
LOWER TERMINUS:	Iowa Gulch intake UTM North: 4342373.29 UTM East: 394280.86
WATER DIVISION:	2
WATER DISTRICT:	11
COUNTY:	Lake
WATERSHED:	Arkansas Headwaters
CWCB ID:	20/2/A-002
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	3.61 miles
FLOW RECOMMENDATION:	1.7 cfs (05/01 - 09/15) 1 cfs (09/16 - 04/30)

Iowa Gulch

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.

The BLM recommended that the CWCB appropriate an ISF water right on a reach of Iowa Gulch because it has a natural environment that can be preserved to a reasonable degree. Iowa Gulch is located within Lake County (See Vicinity Map), and originates at an elevation of approximately 13,150 feet in the Mosquito Range, flowing west 10.4 miles to the confluence with the Arkansas River at an elevation of 9,350 feet. The proposed reach extends from the headwaters downstream to the Iowa Gulch intake. The BLM manages 68 percent of the land on the 3.61 mile proposed reach and the remaining 32 percent is privately owned (See Land Ownership Map).

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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.

Iowa Gulch is a steep, cold water, high elevation stream flowing through broad, subalpine meadows. The stream substrate is primarily boulders and cobbles forming large pools separated by riffles. The stream has good floodplain connectivity with the surrounding willow communities, and several sections have numerous side channels that support healthy wetland communities throughout the valley floor. Located near the Leadville Mining District, Iowa Gulch is impacted by historic mining activities that have leached metals into the stream and eliminated fish populations within the recommended segment. However, recent reclamation activities have mitigated impacts to the watershed from abandoned mines and improved water quality to a point that BLM biologists believe it could now support a fish population. Macroinvertebrate samples collected in support of this recommendation were used to evaluate biological condition using the Colorado Benthic Macroinvertebrate Multimetric Index (MMI). The

Iowa Gulch MMI score was 59.9, which is above the attainment threshold of 48 for Biotype 2 (mountains), indicating that the stream can support aquatic life and is not in an impaired condition as compared to reference streams of a similar biotype.

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

BLM 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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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). BLM 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 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 Analysis

R2Cross data was collected at 2 transects for this proposed ISF reach by the BLM (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 1.31 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 1.69 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Iowa Gulch.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
09/18/2018, 1	11.41	1.58	0.63 - 3.95	1.57	1.58
09/18/2018, 2	9.22	1.65	0.66 - 4.13	1.05	1.80
	Mean			1.31	1.69

ISF Recommendation

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

1.7 cubic feet per second is recommended from May 1 to September 15. This recommendation is driven by the average depth criteria. Given the small amount of riffle habitat in this reach, it is important to provide depths that are suitable for aquatic macroinvertebrate production, and ultimately for spawning trout when they are reintroduced to the stream.

1.0 cubic feet per second is recommended from September 16 to April 30. This recommendation is driven by limited water availability. This flow rate should prevent complete icing of the numerous pools in this reach, allowing insects and reintroduced fish populations to overwinter.

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 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) 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 Iowa Gulch is 4.98 square miles, with an average elevation of 12,258 feet and average annual precipitation of 32.36 inches (See the Hydrologic Features Map). There are no surface water diversions in the drainage basin tributary to the proposed ISF reach. Therefore, hydrology in this drainage basin represents natural flow conditions.

Available Data

There is not a current or historic streamflow gage on Iowa Gulch. CWCB staff installed a temporary streamgage on Iowa Gulch 1.7 miles upstream from the lower terminus. Private property downstream and wetlands in the valley limited suitable gaging locations and prevented staff from installing the gage near the proposed lower terminus. This location has a 2.2 square mile drainage basin, 12,661 feet average basin elevation, and 36.04 inches of average basin annual precipitation. The CWCB streamgage was installed on 7/8/2019 and is still operating. The pressure transducer recorded water depth every 15 minutes, which was converted to streamflow using a rating curve developed by staff. The 15 minute interval data collected by CWCB staff was used to calculate daily average streamflow values. There are no diversions above the proposed lower terminus that may affect the CWCB streamgage measurements.

CWCB staff made three streamflow measurements on the proposed reach of Iowa Gulch as summarized in Table 3.

Table 3. Summary of streamflow measurement visits and results for Iowa Gulch.

Visit Date	Flow (cfs)	Collector
07/18/2019	13.28	CWCB
08/13/2019	5.06	CWCB
10/09/2019	0.79	CWCB

Data Analysis

Staff used the daily streamflow data from the CWCB streamgage on Iowa Gulch and did not scale the data to the proposed lower terminus, which is located downstream from the measurement location. This likely underestimates the amount of flow in the stream due to the difference in drainage basin size. Median streamflow and 95% confidence interval for median streamflow were not calculated due to the short period of record.

Because of the short period of record of the CWCB streamgage, staff examined precipitation and streamflow in the basin to assess how 2019 gage data compare to typical conditions. Leadville Lake County AP NOAA climate station (USW0093009) is located 5 miles west of the proposed lower terminus and has recorded daily precipitation from 1948 to present. Staff examined the average monthly precipitation and compared it to the 2019 monthly precipitation totals. The station reported having above average precipitation in March, April, and May, but significantly below average precipitation in July, August, and September.

To further examine hydrology this year, staff computed the median daily streamflow at the EF Arkansas R at US Highway 24 (USGS 7079300) gage and compared it to 2019 flows. The EF Arkansas gage is located approximately 5 miles northwest of the proposed lower terminus. The gage has a drainage basin of 49.8 square miles, an average elevation of 11,477 feet, and 25.52 inches of average basin annual precipitation. The gage is somewhat affected by diversions, but provides a good representation of hydrology because it is not affected by reservoir releases. In 2019, flows at the gage in mid-May were significantly below the median due to a late runoff period. In June through mid-August, flows were significantly above the median, at times more than 250 cfs above the median. In late summer of 2019, flows returned to near median due to the dry summer months.

The analysis of hydrologic indicators showed that although 2019 saw very high and delayed runoff flows, conditions on the stream returned to normal in the fall due to a dry summer. Therefore, this likely means that streamflow recorded by the CWCB streamgage is higher than average in the July, but returns to approximately normal conditions in August (See Figure 1).

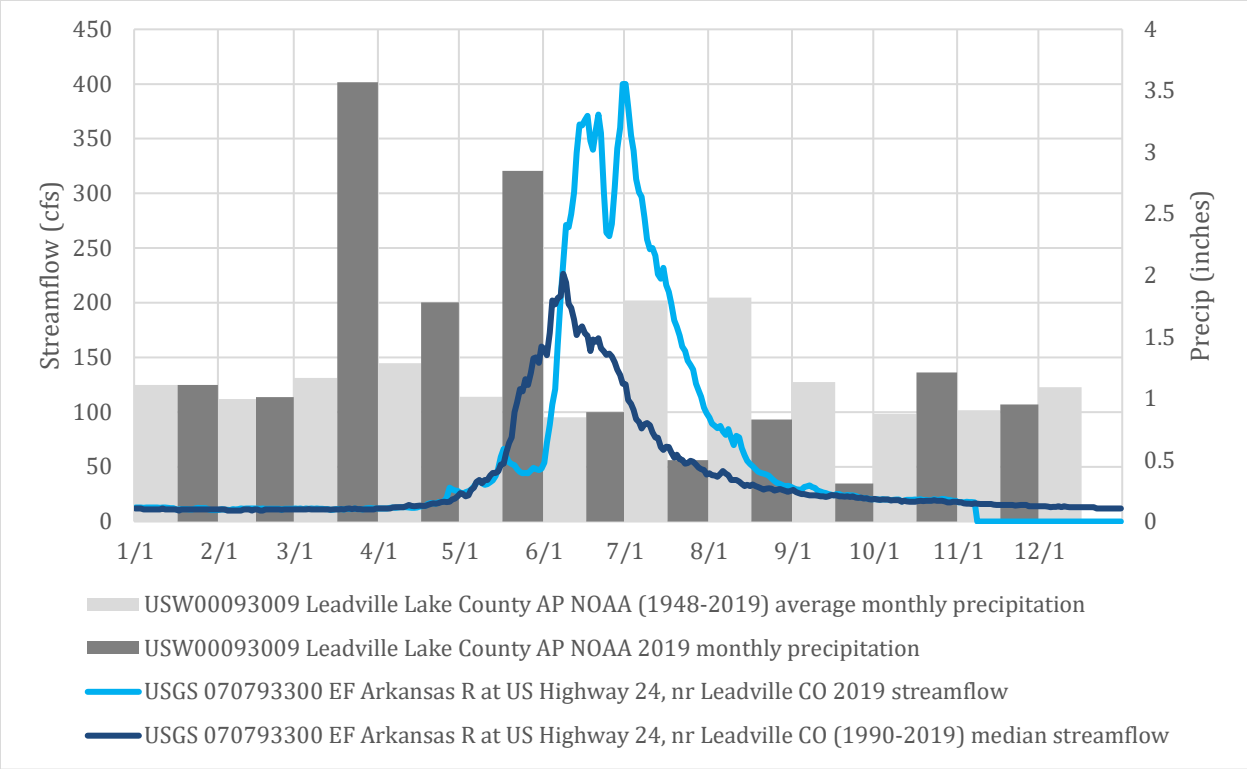


Figure 1. Comparison of average monthly and 2019 precipitation at nearby climate station and median and 2019 streamflow at a nearby streamgage. Streamflow data available through 11/7/2019 and precipitation data only available through 12/13/2019 at time of download.

StreamStats estimates median monthly flow and is not affected by single year conditions, which could be much higher or lower than typical years depending on a number of factors. Although the CWCB streamgage provides an indication that the appropriation was available this year, StreamStats gives an indication of whether the recommendation is available over a longer period. Additionally, it provides information about flow conditions in the spring and winter when no CWCB streamgage data is available.

Water Availability Summary

The hydrograph (See Complete Hydrograph) shows StreamStats results for mean-monthly streamflow and the streamflow recorded at the CWCB streamgage. Due to the lack of diversions in the basin, StreamStats provides a good indication of mean monthly flows at the lower terminus. The CWCB streamgage is likely an underestimation of the streamflow at the lower terminus due to the gage's location and a significantly smaller drainage basin. From staff's analysis of precipitation and nearby streamgages, while streamflow recorded at the CWCB streamgage was also likely far above average during the summer months, it provides a good estimate of seasonality and flow amounts typical of a normal autumn.

Due to the location of the CWCB streamgage, the short period of record, and the unusual conditions during the period of record, a combination of StreamStats and the CWCB streamgage record was used in this analysis. StreamStats indicates that runoff begins in May. This was used

to define the beginning of the summer recommendation. Both StreamStats and the CWCB streamgage indicate that the summer flow rate is available until mid-September. StreamStats shows that the winter flow rate is available. Staff has concluded that water is available for appropriation.

Material Injury

Because the proposed ISF on Iowa Gulch 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. (2019), 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.

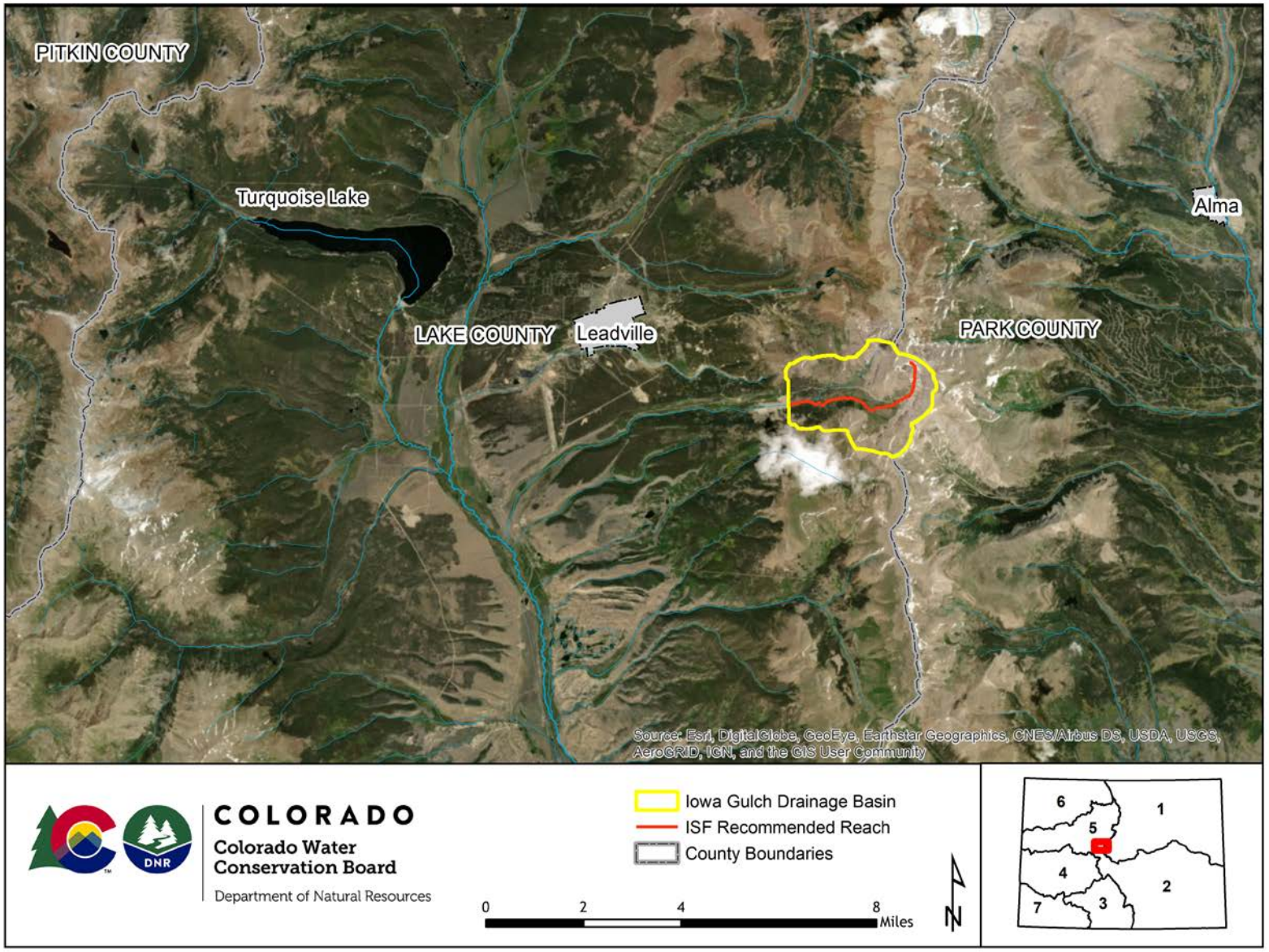
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

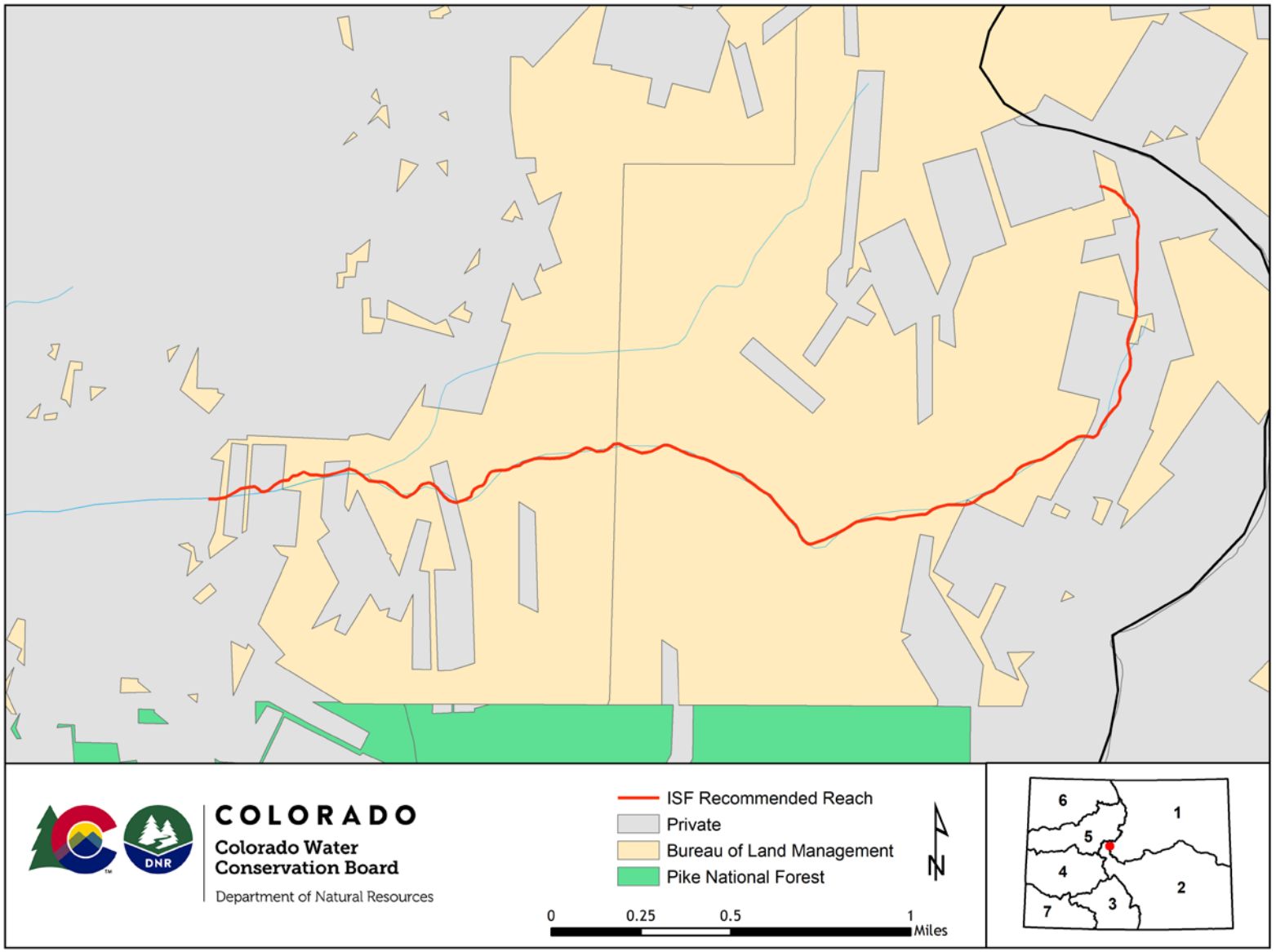
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

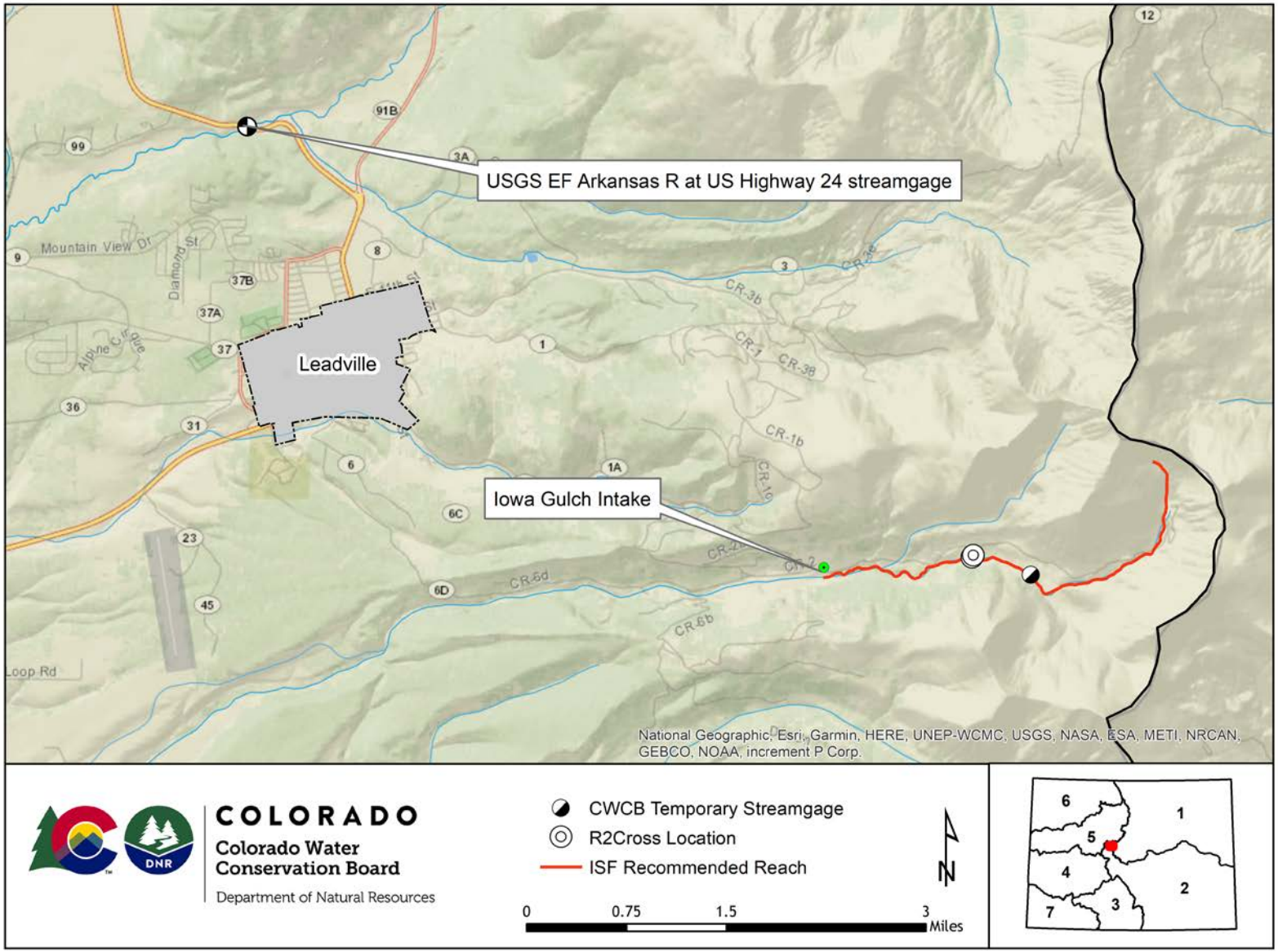
VICINITY MAP



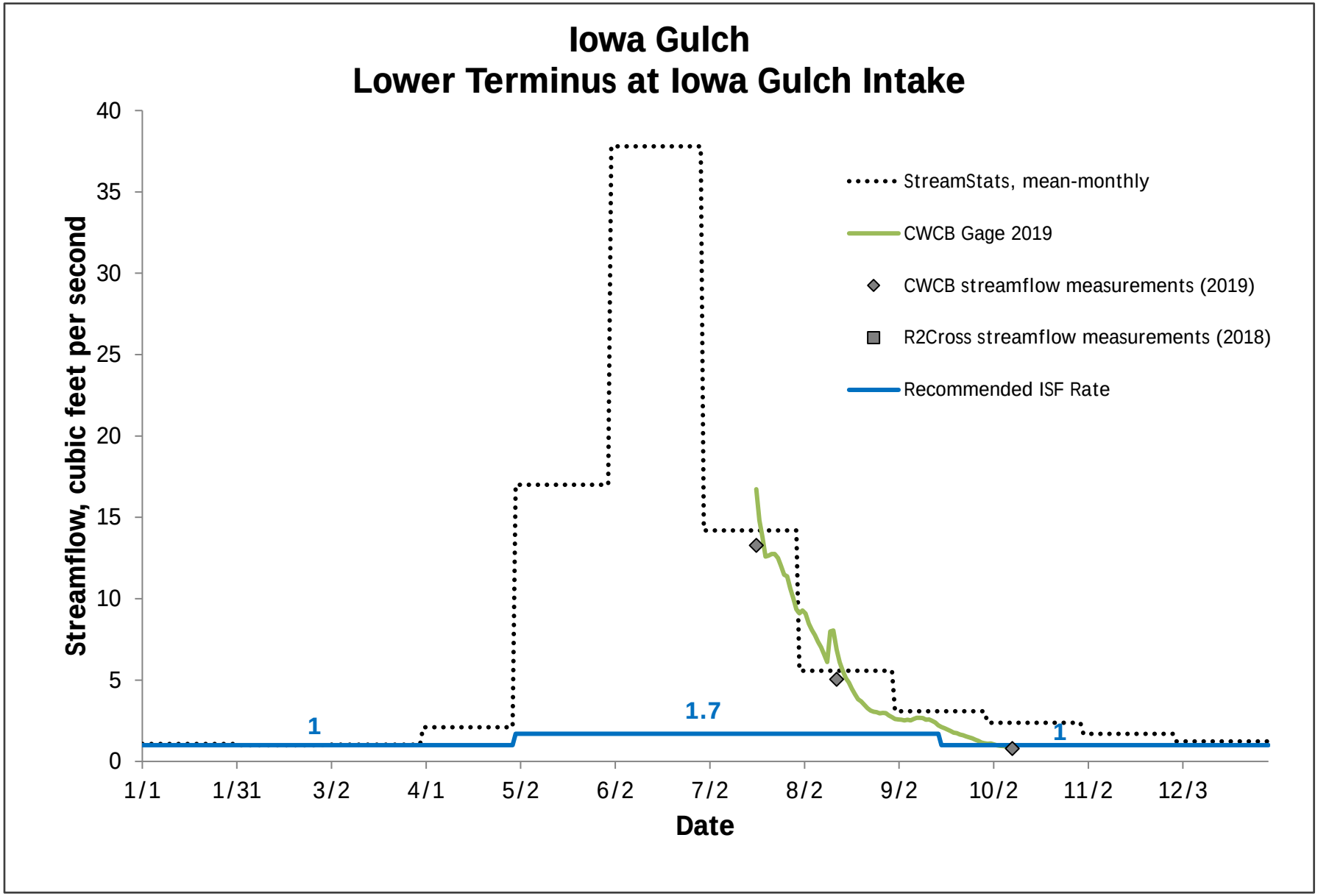
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



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Cement Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	headwaters in the vicinity of UTM North: 4314893.95 UTM East: 346437.58
LOWER TERMINUS:	confluence with the East River UTM North: 4296619.14 UTM East: 336739.49
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	East-Taylor
EXISTING ISF:	80CW0103, 10 cfs (01/01 – 12/31)
CWCB ID:	20/4/A-002
RECOMMENDER:	High Country Conservation Advocates (HCCA)
LENGTH:	17.35 miles
FLOW RECOMMENDATION:	3 cfs (04/15 - 07/10)

Cement 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 Cement Creek. Cement Creek is located within Gunnison County (See Vicinity Map), and originates at an elevation of approximately 11,900 feet in the Gunnison National Forest. The creek flows southwest 17.4 miles to the confluence with the East River at an elevation of approximately 8,500 ft. The proposed reach extends from the headwaters of Cement Creek downstream to the confluence with the East River. The U.S. Forest Service manages 81 percent of the land on the 17.35 mile proposed reach and the remaining 19% is privately owned (See Land Ownership Map).

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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.

Cement Creek is a cold water snowmelt-driven stream. The stream substrate ranges from small gravels to large boulders. The Cement Creek riparian area is diverse, consisting of mixed conifers, alders and willows, high alpine meadows, beaver complexes, and an area of irrigated hay meadow. The riparian zone is in good condition in upper Cement Creek and provides shade and cover for the fish community.

Cement Creek supports a diverse fishery due to a mixture of riffles and small pools that provide high quality habitat for all life stages of fish and other aquatic life. Stream sampling conducted by Colorado Parks and Wildlife (CPW) between 1973 and 2012 documented Colorado River cutthroat trout, brook trout, brown trout, and rainbow trout.

Table 1. List of species identified in Cement Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern Federal – Sensitive Species
brook trout	*Salvelinus fontinalis*	None
brown trout	*Salmo trutta*	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.

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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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 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 Analysis

HCCA collected R2Cross data at two transects for this proposed ISF reach (Table 2). The R2Cross model results in a summer flow of 13.11 cfs, which meets 3 of 3 criteria and is within the

accuracy range of the R2Cross model. There is no proposed change to the existing winter ISF rate. R2Cross field data and model results can be found in the appendices.

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

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
9/26/2018, 1	32.25	4.23	1.69 - 10.58	N/A	Out of range
10/05/2018, 2	37.17	13.05	5.22 - 32.63	N/A	13.11
	Mean				13.11

ISF Recommendation

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

Based on analysis of R2cross results, an increase of 3 cfs to the existing ISF of 10 cfs is recommended during the snowmelt runoff period and early summer, from April 15 to July 10. The combined total of 13.0 cfs for the two ISF water rights satisfies all three of the required hydrologic criteria. This recommendation is driven by the average depth criteria.

HCCA supports this increase to the existing summer instream flow rate to protect the groundwater flows necessary to support the Cement Creek fen and riparian area. An increase to the existing instream flow will also maintain the quality of the aquatic habitat during the summer, a critical time for fish growth, survival, and reproduction. The proposed increase will raise the average water depth by 0.04 feet from 0.33 to 0.37 feet. The percent wetted perimeter will also increase. Together, these conditions will increase habitat connectivity including access to pools and other areas that provide critical refuge to fish during the summer months.

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 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) 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 Cement Creek is 35.7 square miles, with an average elevation of 10,691 feet and average annual precipitation of 31.4 inches (See the Hydrologic Features Map). There is a total of 55 cfs of active decreed surface rights and about 3 acre-feet of decreed storage rights. Due to the number and volume of surface water diversions, streamflow is altered from natural conditions.

Available Data

There is no current gage located on the proposed ISF reach. A historic gage, Cement Creek near Crested Butte, CO (USGS 9112000), was located approximately 2.5 miles upstream from the proposed lower terminus. The historic gage operated from 1910 – 1913 and 1940 – 1951. The drainage basin of the Cement Creek gage was 32.9 square miles, with an average elevation of 10,808 feet and average precipitation of 32.0 inches.

The historic Cement Creek gage has several diversions upstream and downstream from it. In some cases, diversion records can be used to provide an indication of water availability in the reach. Several diversions along Cement Creek have over 40 years of diversion records available; however, others do not keep diversion records. There are a number of intervening water rights located between the measurement location and the proposed lower terminus. Table 3 summarizes surface water diversions 0.5 cfs or greater on Cement Creek. Cement Creek Ditch has the highest amount of water (26 cfs) and is the most senior diversion, but according to the Division Engineer, it does not sweep the creek (email communication from Bob Hurford, Division 4 Engineer, 11/5/19).

Table 3. Active surface water diversions on Cement Creek

Structure Name	WDID	Appropriation Date	Decreed Rate (cfs)	Location in respect to historic gage
Yarnell Ditch	5900712	5/30/1951	6.5	Upstream
Jordan Ditch No. 1-4	5901244-5901247	9/1/1954	3	Upstream
Tim & Helen Morgan Ditch	5900727	6/1/1954	2	Upstream
Reese Ditch No 1 & 2	5901266 5901267	6/1/1973	3.5	Upstream
Cement Creek Ditch	5900537	6/1/1886	26	Downstream
Jones Highline Ditch	5900605	6/14/1903 6/1/1894	1.33 4	Downstream
Adams Cement Creek Ditch	5900502	6/1/1917	1.5	Downstream
Obaid Ditch	5901736	7/1/1925	0.5	Downstream
Cement Cr Ranger Sta	5900536	5/1/1908 5/1/1914 4/3/2002	2.38 2.7 0.25	Downstream
Adams Ranch Ditch & Pond	5900730	6/1/1920	1	Downstream

CWCB staff made three streamflow measurements on the proposed reach of Cement Creek as summarized in Table 4.

Table 4. Summary of streamflow measurement visits and results for Cement Creek.

Visit Date	Flow (cfs)	Collector
05/14/2019	52.80	CWCB
08/02/2019	52.92	CWCB
10/18/2019	17.31	CWCB

Data Analysis

Adjustments were made to the historic gage record to reflect surface water diversions that started after the gage data was collected. Because all structures upstream from the gage have appropriation dates of 1951 or later, Staff made the assumption that diversions were not active during the operation of the Cement Creek gage and therefore, these uses were not accounted for in the gage records. Active structures downstream from the Cement Creek gage are also unaccounted for in the historic record due to their location. Records for Cement Creek diversions start after 1975, so a daily comparison cannot be made to the historic gage. Instead, the median daily diversion rate for each of diversion with records was calculated and subtracted from the median daily gage record. For diversions without records (Jordan Ditch No. 1-4, Reese Ditch No. 1 & 2, and Adams Ranch Ditch & Pond), the full decreed amount, a total of 7.5 cfs,

was subtracted from the median daily gage record during irrigation season (May 15 – Oct 31). Subtracting the full decreed amount is likely to result in underestimating the amount of water available particularly during late summer and early fall.

The historic gage data was not adjusted to account for the additional contributing drainage basin below the gage. This was not done due to the small difference in drainage basin size and precipitation that result in a proration factor of 1.06%. Additionally, no adjustments were made for return flows. All diversions, except for the Cement Creek Ditch, irrigate lands next to the creek and return flows from these diversions likely accrue to the creek above the lower terminus. Due to these factors, this analysis will likely result in an underestimation of the amount of water available in the proposed reach.

Water Availability Summary

The hydrograph (See Complete Hydrograph) shows the adjusted Cement Creek gage record. The methods used to estimate the effects from diversion structures not measured in the historical gage data results in some negative streamflow estimates in September. This demonstrates that this analysis method is likely underestimating the amount of water available. Nevertheless, this conservative estimate does show that water is available for an increase April 15 to July 10. Staff concludes that water is available for this appropriation on Cement Creek.

Material Injury

Because the proposed ISF on Cement 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. (2019), 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.

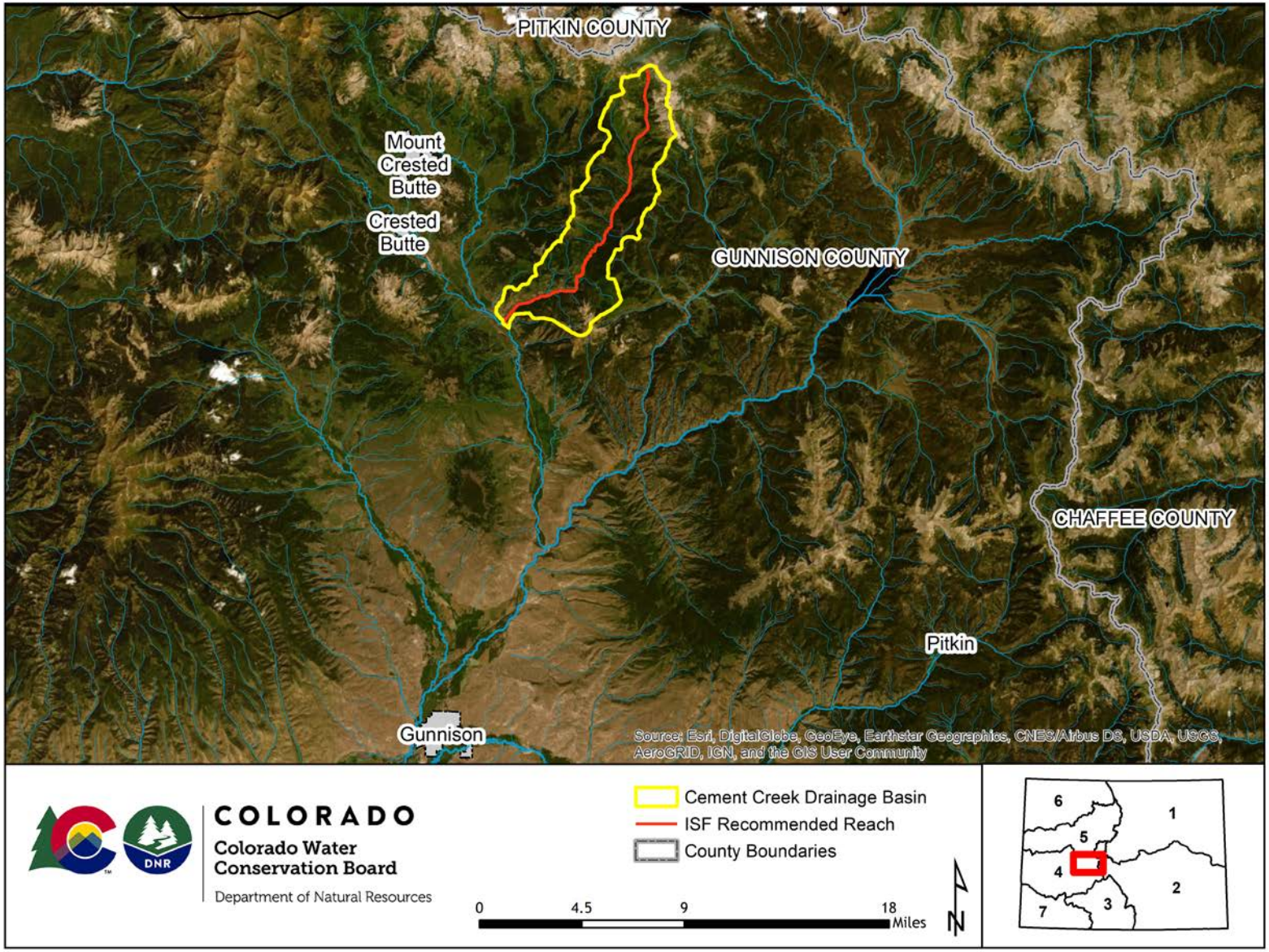
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

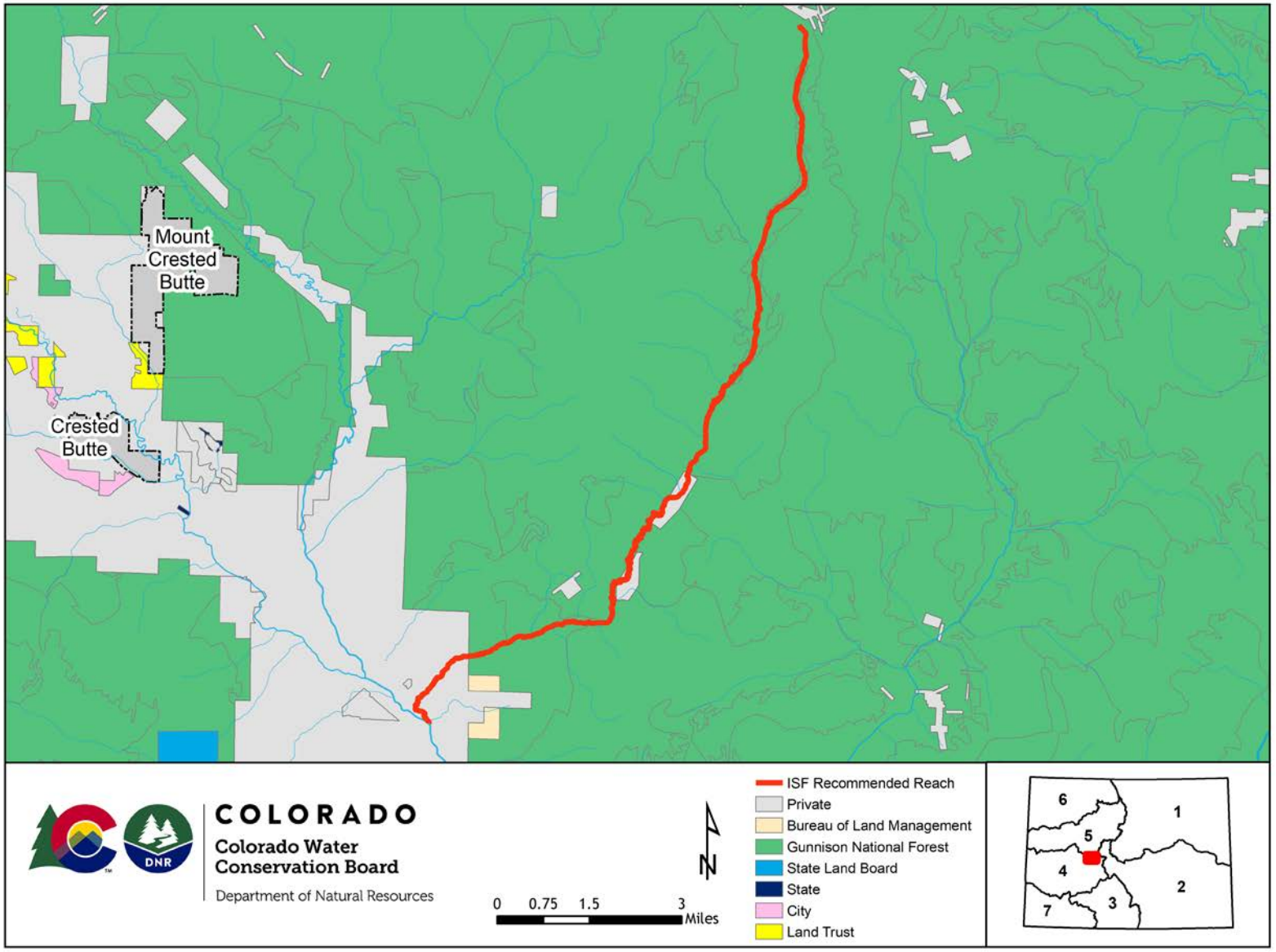
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

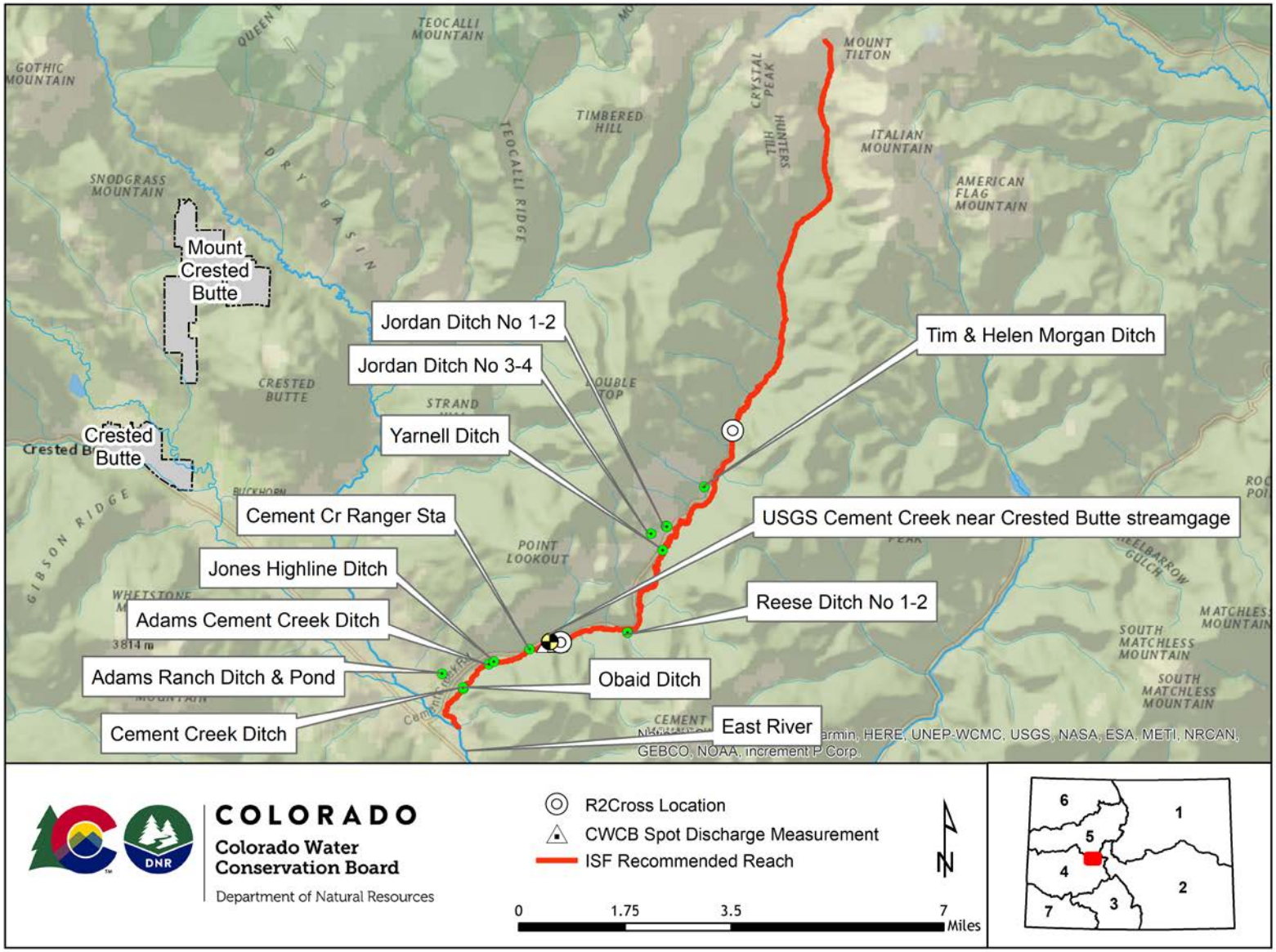
VICINITY MAP



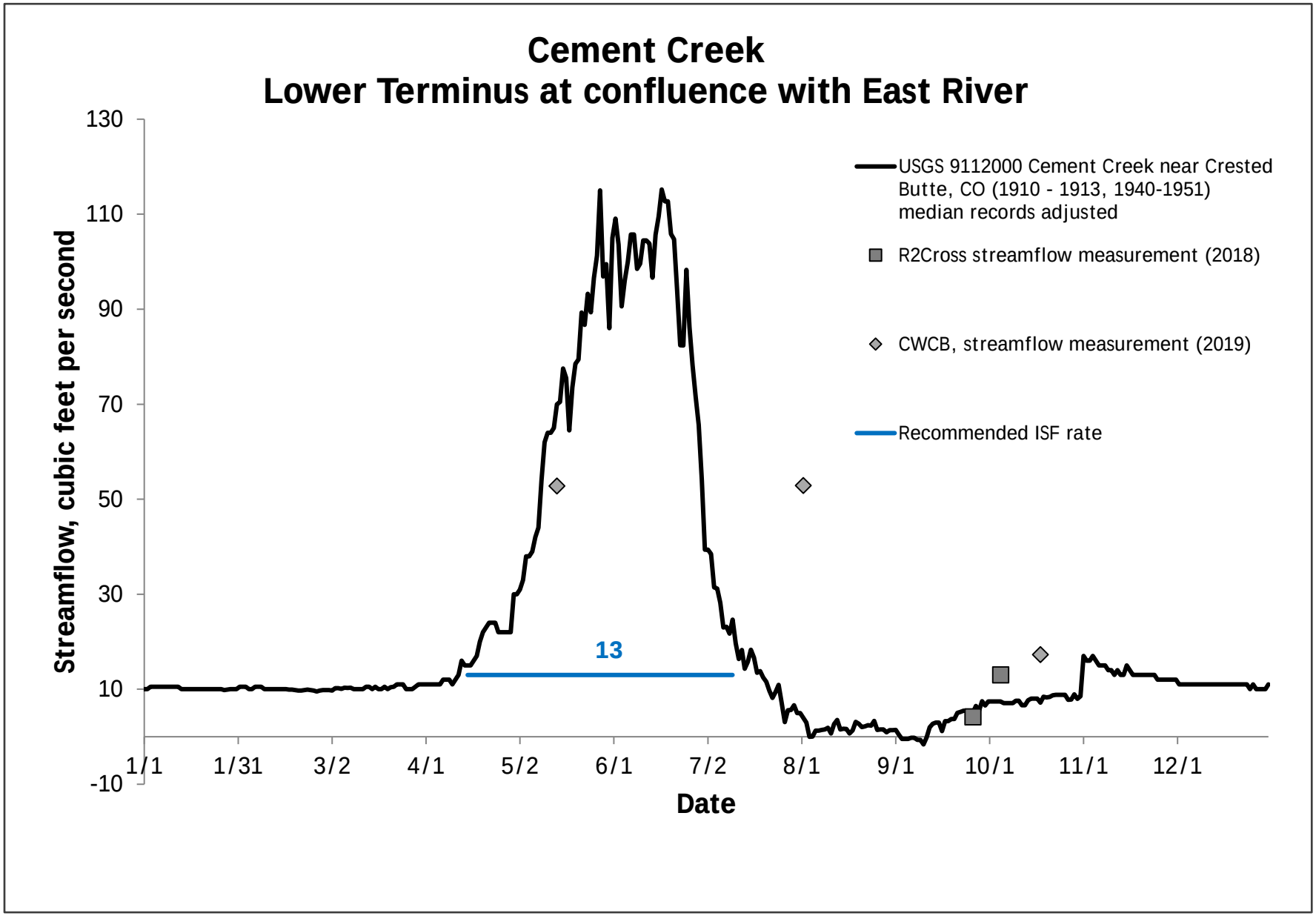
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80203

Kelso Creek

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	headwaters in the vicinity UTM North: 4271192.67 UTM East: 185287.30
LOWER TERMINUS:	confl Bear Gulch UTM North: 4276621.43 UTM East: 197851.54
WATER DIVISION:	4
WATER DISTRICT:	40
COUNTY:	Mesa
WATERSHED:	Lower Gunnison
CWCB ID:	15/4/A-003
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	9.89 miles
FLOW RECOMMENDATION:	0.85 cfs (09/01 - 03/31) 2.4 cfs (04/01 - 08/31)

Kelso 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.

CPW recommended that the CWCB appropriate an ISF water right on a reach of Kelso Creek because it has a natural environment that can be preserved to a reasonable degree. Kelso Creek is located within Mesa County (See Vicinity Map), and originates on the east slope of the Uncompahgre Plateau at an elevation of 9,041 feet. Kelso Creek flows northeast to the confluence with Escalante Creek at an elevation of 6,204 feet. The proposed reach extends from the headwaters downstream to the confluence with Bear Gulch. The Grand Mesa National Forest manages 93 percent of the land on the 9.89 mile proposed reach, three percent is managed by CPW, and four percent is privately owned (See Land Ownership Map).

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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.

Kelso Creek is a relatively low gradient, snow-melt driven stream that supports an important conservation population of Colorado River cutthroat trout. The uplands surrounding Kelso Creek are composed of aspen stands, large open meadows, and interspersed pinyon-juniper woodland. The riparian area supports abundant willows, narrowleaf cottonwoods, and gray alder that stabilize the banks and shade the stream. The stream substrate ranges from sand to cobbles with a mixture of habitat types, including riffles, runs, glides and pools that provide diverse habitat for the fish population. A healthy macroinvertebrate community of mayflies, stoneflies and caddisflies were observed on field visits. The resident trout population in Kelso Creek are a core conservation population of Colorado River cutthroat trout that exhibit greater than 99% genetic purity. This population is self-sustaining and physically isolated from non-native species in Escalante Creek by diversions that serve as migration barriers, which ensures preservation of

their genetic purity in the future. As a result, Kelso Creek is important to CPW for use as a source population for cutthroat trout conservation efforts throughout the Gunnison Basin.

Table 1. List of species identified in Kelso Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern Federal – Sensitive Species

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

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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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.

The R2Cross methodology provides 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 Analysis

R2Cross data was collected at 2 transects for this proposed ISF reach by CPW (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 2.35 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model did not

produce in-range results for a winter flow rate. 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 Kelso Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
06/25/2019, 1	14.60	6.54	2.62 - 16.35	Out of range	2.63
06/25/2019, 2	13.97	4.92	1.97 - 12.30	Out of range[1]	2.07
	Mean				2.35

[1]The flow meeting 2 of 3 hydraulic criteria is out of range. The lowest in range streamflow for the modeling results is 1.97 cfs. Please see the ISF Recommendation section below for more information.

ISF Recommendation

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

Based on 2019 field investigations, the initial biological recommendation is 2.4 cfs in the summer, which maintains an average of 1 ft/s velocity, average depth of at least 0.2 feet, and at least 50 percent wetted perimeter in the stream channel. Numerous field trips over a five year period were unable achieve in-range model results that satisfy two of the three hydraulic criteria used to determine winter flow rates. However, the lowest in-range modeled flow (1.97 cfs) is the closest to meeting the two of three criteria. Using this value results in protecting an average depth that is slightly higher than the typical depth criteria for a stream this size (0.24 feet compared to 0.2 feet). It is CPW's opinion that recommending 2.0 cfs (based on rounding 1.97 to the nearest whole number) for the initial biological winter recommendation is reasonable given a number of factors: the value of the Kelso Creek cutthroat trout population; the proven difficulty to achieve in-range model results on Kelso Creek; and importantly, because water availability constraints limit this flow rate to 0.85 cfs during the baseflow period.

The final recommendation is 2.4 cfs in the summer from April 1 to August 31. This flow rate maintains adequate depth, velocity, and wetted perimeter during the critical time period when the eggs are incubating in the gravel.

The final recommended baseflow rate is 0.85 cfs from September 1 through March 31. This flow recommendation is reduced due to water availability constraints, but should provide adequate flows over the baseflow period to maintain habitat and provide connectivity.

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 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) 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 Kelso Creek is 16.5 square miles, with an average elevation of 8,438 feet, and an average annual precipitation of 22.3 inches. There are no known surface water diversions within the basin tributary to the proposed ISF. There are no known transbasin imports or exports. Hydrology in this drainage basin represents natural flow conditions. See the Hydrologic Features Map for more information.

Available Data

There is not a current or historic streamflow gage on Kelso Creek. The closest gage identified was the historic Escalante Creek near Delta, CO gage (USGS 09151500). The gage was located downstream approximately 16.3 miles northeast from the proposed lower terminus. The gage has a short period of record from 1977 to 1989. The Escalante Creek gage has a 209 square mile drainage basin. The average elevation of the basin is 7,680 feet and the average precipitation is 18.05 inches. There are over 80 cfs in surface water diversions in the basin tributary to the Escalante gage. The three largest diversions are located on Kelso Creek below the proposed lower terminus.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. There are three diversion structures on Kelso Creek below the proposed lower terminus. However, it is CWCB staff's understanding that below the lower terminus, Kelso Creek goes subsurface and re-emerges at different locations depending on the time of year. Because of the complex hydrology below the proposed lower terminus, Staff elected to not use data

from the diversion structures, which may not provide a reliable estimate of water availability in the upstream reaches.

CWCB staff and other entities made a number of streamflow measurements on the proposed reach of Kelso Creek as summarized in Table 3.

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

Visit Date	Flow (cfs)	Collector
07/31/2019	0.42	CWCB
6/22/2015	2.18	USFS
6/22/2015	1.94	USFS
7/30/2014	0.32	USFS, CPW, CWCB
07/30/2014	0.46	CWCB
9/26/2013	0.41	USFS

Data Analysis
The Escalante Creek gage measures flow from a much larger drainage basin that results in a proration factor of 0.097 based on 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. Due to the small proration factor and the large number of water diversions that impact the water measured at the gage, this gage was not used to evaluate water available in the proposed reach.

Due to limited available data and the lack of diversion structures in the basin tributary to the proposed ISF reach, StreamStats was used to assess water availability.

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show StreamStats results for mean-monthly streamflow. The proposed ISF is below the StreamStats estimates at all times. Staff concludes that the proposed ISF flow rates are available for appropriation.

Material Injury
Because the proposed ISF on Kelso 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. (2019), 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.

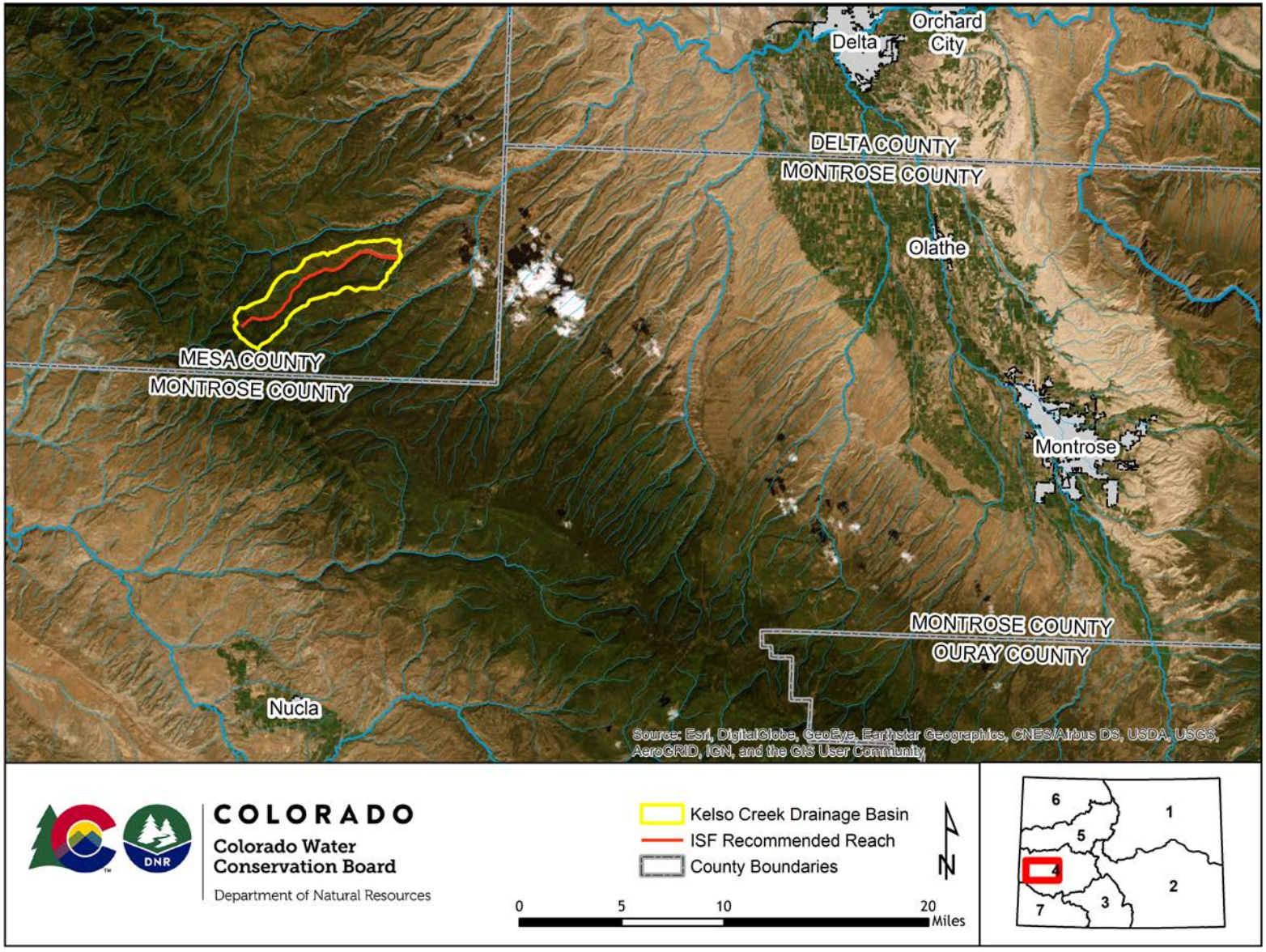
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

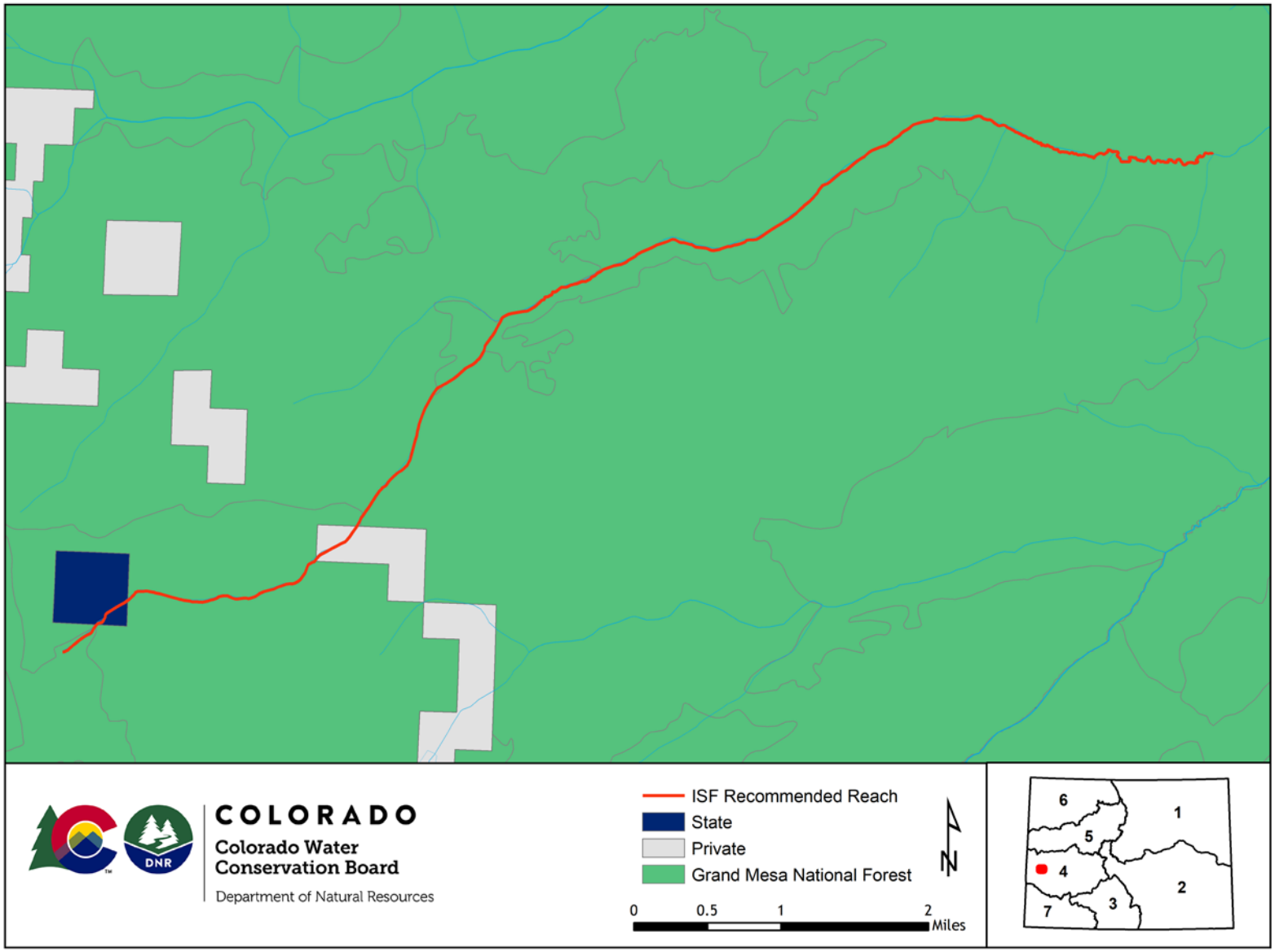
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

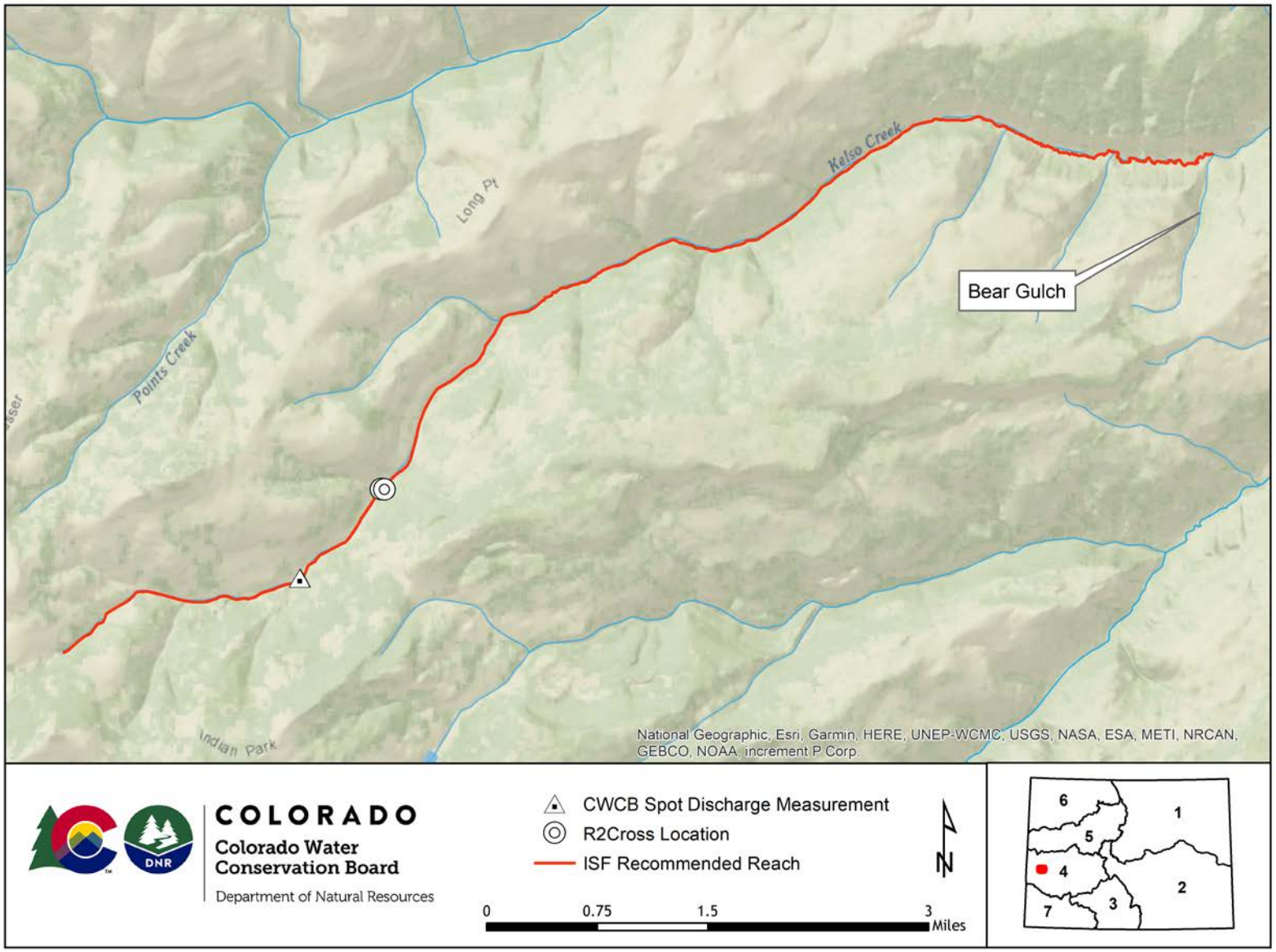
VICINITY MAP



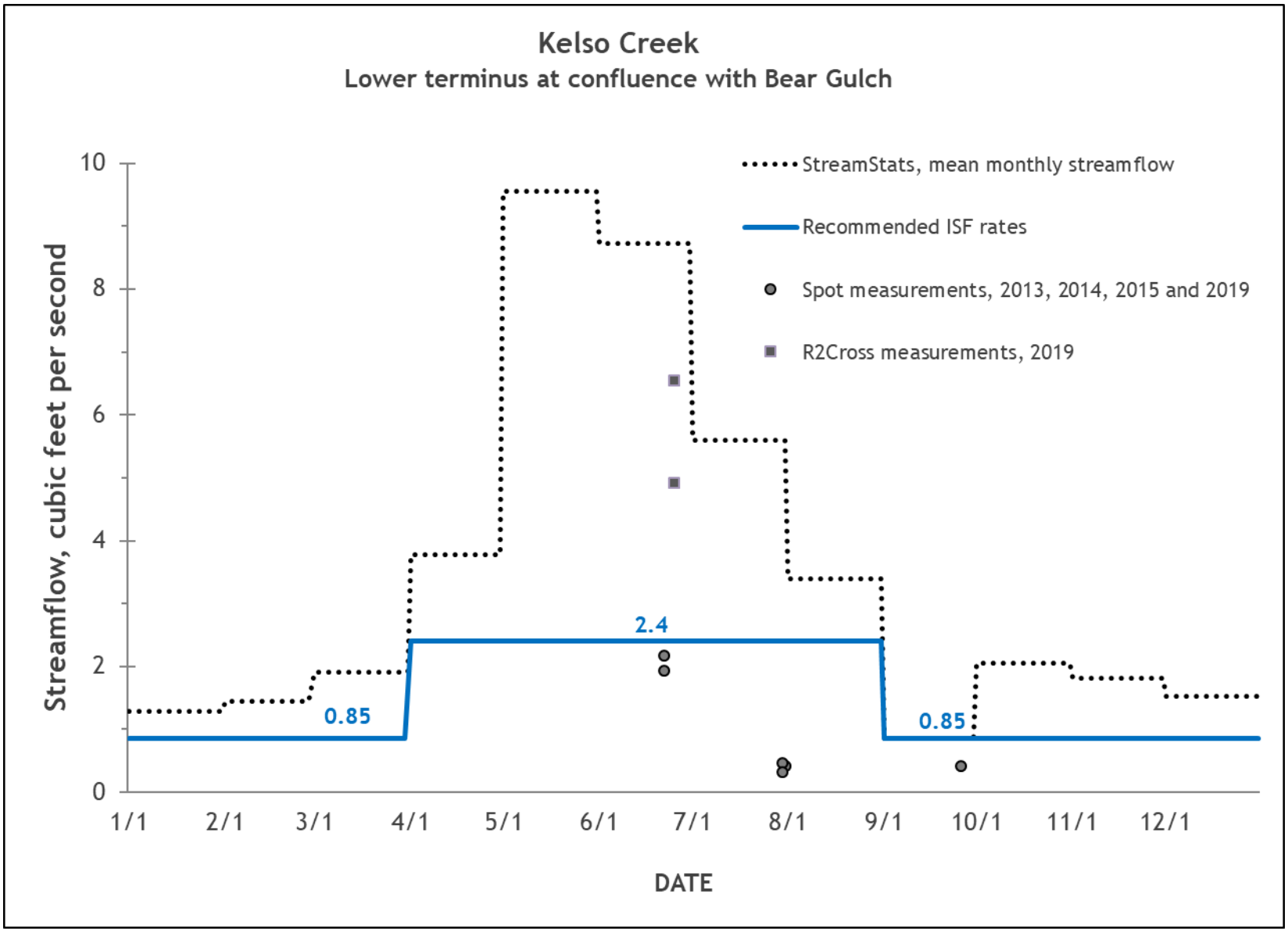
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80203

Spring Creek (Upper)

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	confluence with Rocky Brook Creek UTM North: 4301609.78 UTM East: 351947.60
LOWER TERMINUS:	confluence with Bear Creek UTM North: 4298075.72 UTM East: 349182.58
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	East-Taylor
EXISTING ISF:	84CW0368, 7.5 cfs (01/01 – 12/31)
CWCB ID:	20/4/A-003
RECOMMENDER:	High Country Conservation Advocates (HCCA)
LENGTH:	3.18 miles
FLOW RECOMMENDATION:	6.5 cfs (04/01 - 09/30)

Spring Creek (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.

HCCA recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Spring Creek. Spring Creek is located within Gunnison County (See Vicinity Map), and originates at an elevation of approximately 11,950 feet in the Gunnison National Forest. The creek flows south 17 miles to the confluence with the Taylor River at an elevation of 8,350 feet. The proposed reach extends from confluence with Rocky Brook Creek downstream to the confluence with Bear Creek. The U.S. Forest Service manages 95 percent of the land on the 3.18 mile proposed reach and the remaining 5 percent is privately owned. (See Land Ownership Map).

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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.

This segment of Spring Creek flows through a broad valley with open meadows consisting of sagebrush and potentilla. The riparian plant community is primarily willows with abundant grasses and forbs. The stream has good floodplain connectivity and stable banks throughout, which support good water quality and cold water for trout species. The upper segment is primarily cobble and gravel substrate with riffle-run type habitat. Large pools are scattered throughout the upper reach, providing habitat complexity for fish species. Downstream from Bear Creek at the start of the lower segment, Spring Creek transitions to a steep canyon channel type surrounded by mature coniferous forests.

Fish sampling conducted by Colorado Parks and Wildlife (CPW) has recorded populations of brown and rainbow trout. When conducting field work, the team observed robust macroinvertebrate and fish communities.

Table 1. List of species identified in Spring Creek.

Species Name	Scientific Name	Status
brown trout	*Salmo trutta*	None
rainbow trout	*Oncorhynchus mykiss*	None
Snake River cutthroat trout	*Oncorhynchus clarkii behnkei*	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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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 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 Analysis
R2Cross data was collected at one transect for this proposed ISF reach by HCCA (Table 2). The R2Cross model results in a summer flow of 13.54 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Spring Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
09/28/2018, 1	26.00	6.30	2.52 - 15.75	Out of range	13.54
	Mean				13.54

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

Based on analysis of R2Cross results, an increase of 6.5 cfs to the existing ISF of 7.5 cfs is recommended during the snowmelt runoff period and summer, from April 1 to September 30. The combined total of the two ISF water rights would be 14.0 cfs, which satisfies all three of the required hydrologic criteria. This recommendation is driven by the velocity criteria.

The proposed increase to the existing instream flow will improve the quality of the aquatic habitat during the summer, a critical time for fish growth, survival, and reproduction. On this segment of Spring Creek, the proposed increase will increase the average water depth by approximately 0.21 feet to an average depth of 0.7 feet. The percent wetted perimeter will also increase. Together, these conditions will increase habitat connectivity including access to pools and other areas that provide critical refuge to fish during the summer months.

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 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) 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 Spring Creek is 44.10 square miles, with an average elevation of 10,899 feet and average annual precipitation of 25.64 inches (See the Hydrologic Features Map). Spring Creek Reservoir is located 0.75 miles upstream from the upper terminus, but there are no surface water diversions in this reach. The reservoir has a 2 cfs evaporation diversion right. There are no other surface water diversions in the basin tributary to this proposed reach on Spring Creek. Due to the small number and volume of diversions, streamflow represents natural conditions.

Available Data

There are no current or historic streamgages in the vicinity of the proposed ISF reach or nearby drainages that would be representative of streamflow in this reach. In some cases, diversion records or reservoir release records can be used to provide an indication of water availability in the stream reach; however, no diversion or release records are maintained in the basin.

CWCB staff made two streamflow measurements on the proposed reach of Spring Creek as summarized in Table 3.

Table 3. Summary of streamflow measurement for Spring Creek.

Visit Date	Flow (cfs)	Collector
08/02/2019	49.14	CWCB
10/17/2019	22.83	CWCB

Data Analysis

CWCB staff spoke with the Division 4 Engineer, Bob Hurford, who confirmed that Spring Creek Reservoir is used for recreation and fishing, and kept full at all times of the year. Therefore, Spring Creek Reservoir likely releases flow equal in amount and timing to the reservoir inflow. All other diversions in the basin are small springs or wells. StreamStats provides the best available estimate of streamflow on Spring Creek.

Water Availability Summary
The hydrograph (see Complete Hydrograph) shows StreamStats results for mean-monthly streamflow. Staff has concluded that water is available for an increase.

Material Injury
Because the proposed ISF on Spring 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. (2019), 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.

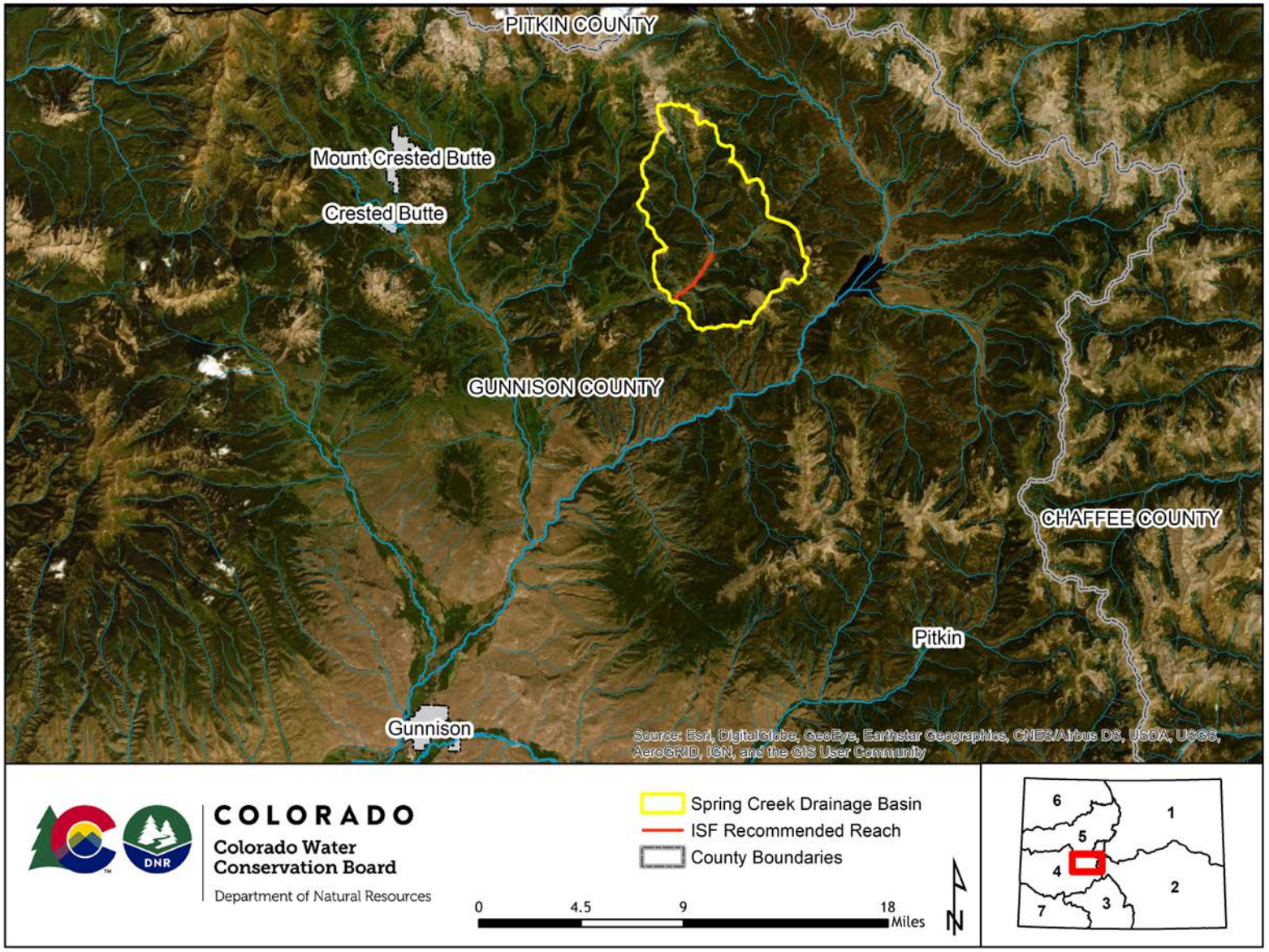
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

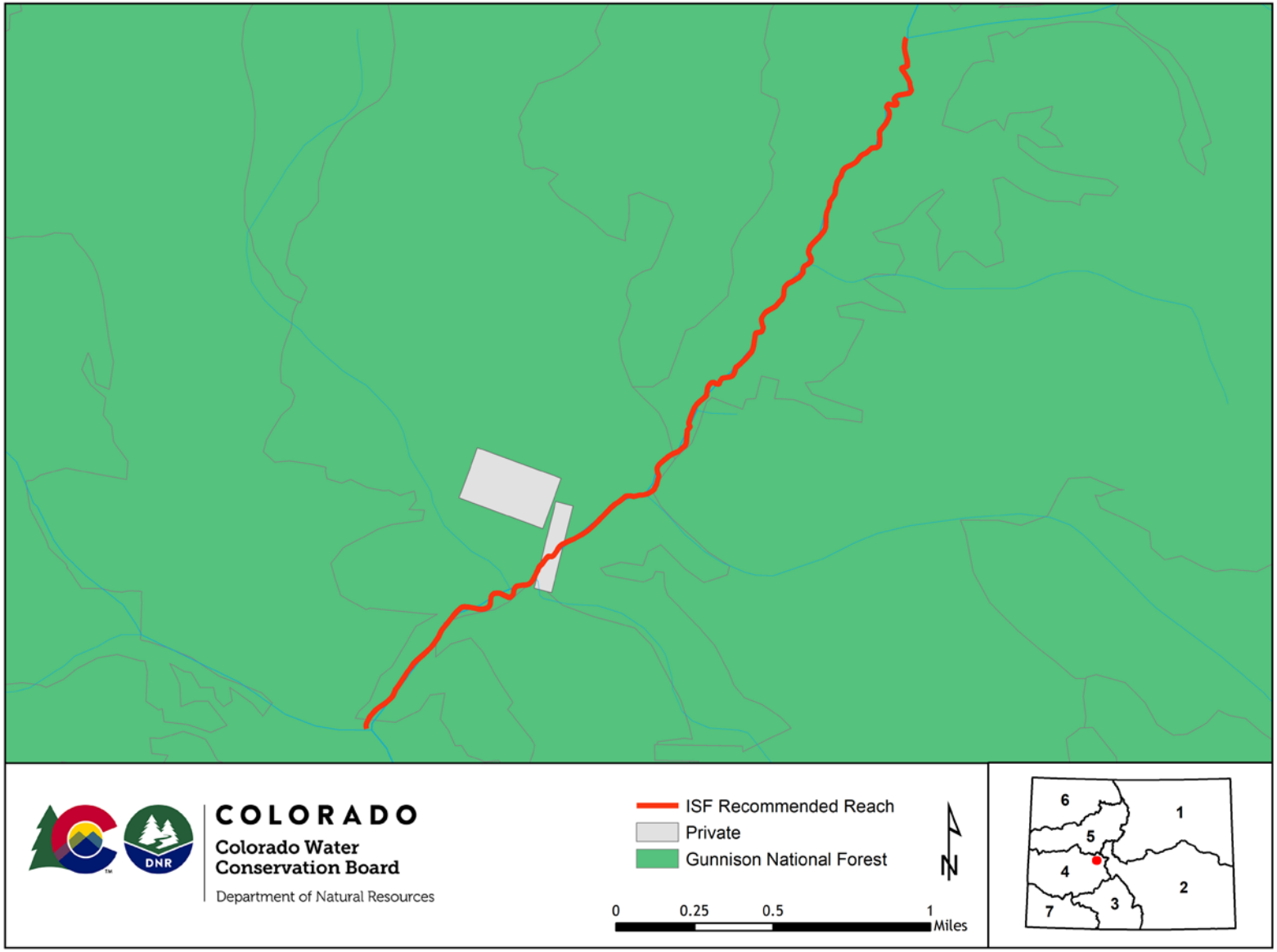
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

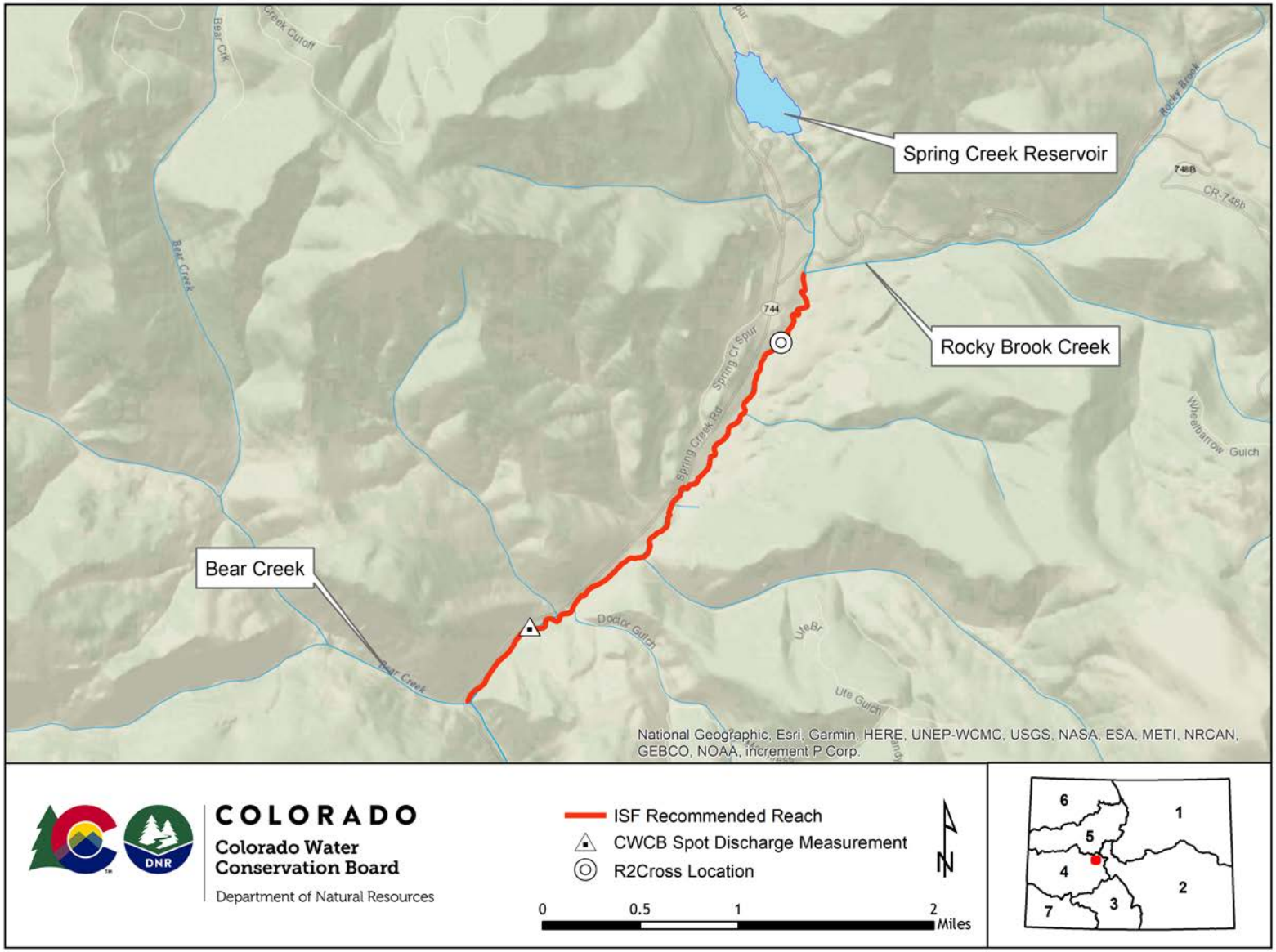
VICINITY MAP



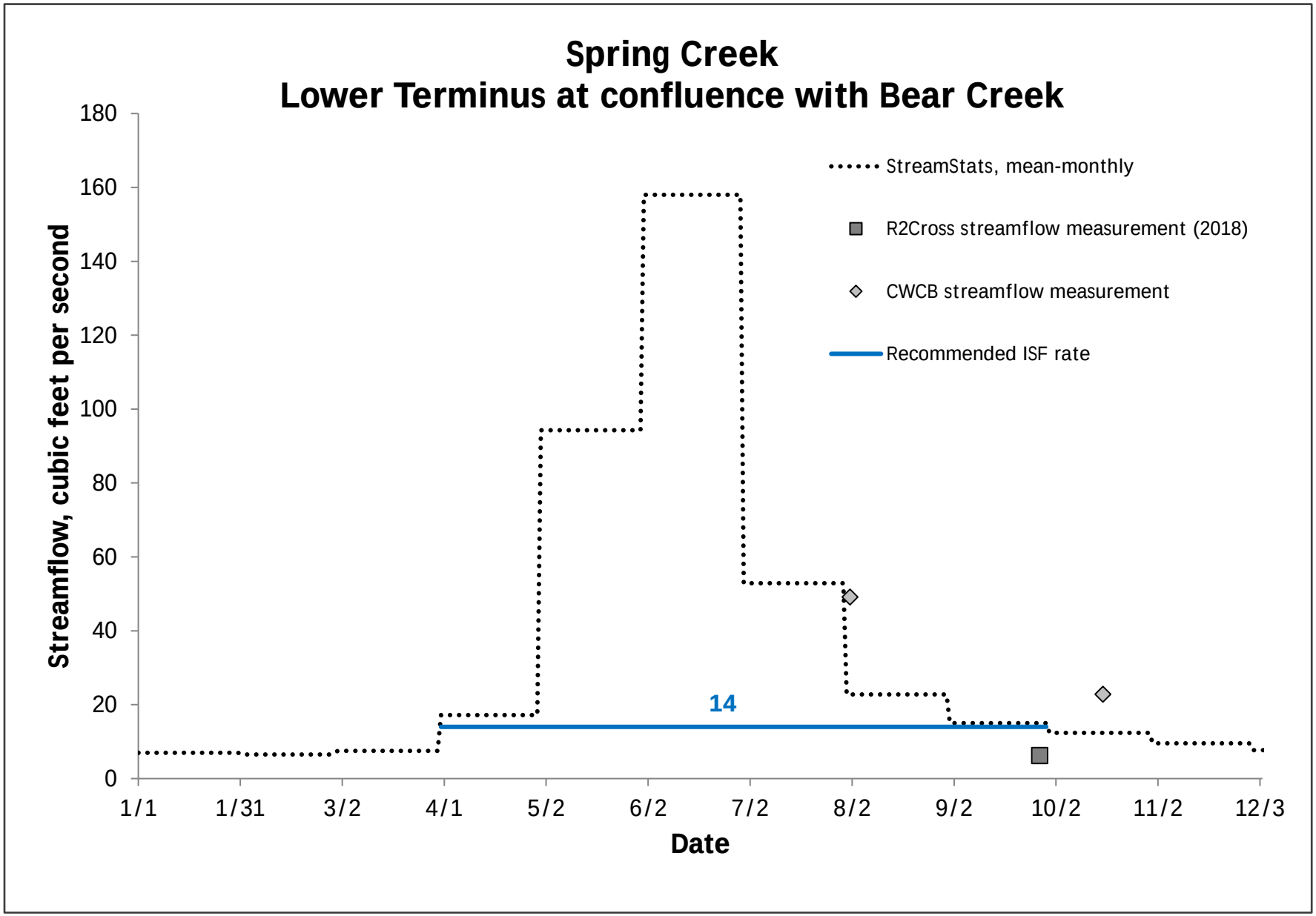
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80203

Spring Creek (Lower)

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	confluence with Bear Creek UTM North: 4298075.72 UTM East: 349182.58
LOWER TERMINUS:	confluence with the Taylor River UTM North: 4287535.69 UTM East: 345706.96
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	East-Taylor
EXISTING ISF:	84CW0368, 7.5 cfs (01/01 – 12/31)
CWCB ID:	20/4/A-004
RECOMMENDER:	High Country Conservation Advocates (HCCA)
LENGTH:	8.17 miles
FLOW RECOMMENDATION:	13.5 cfs (04/01 - 07/31)

Spring Creek (Lower)

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 Spring Creek. Spring Creek is located within Gunnison County (See Vicinity Map), and originates at an elevation of approximately 11,950 feet in the Gunnison National Forest. The creek flows south 17 miles to the confluence with the Taylor River at an elevation of 8,350 feet. The proposed reach extends from the confluence with Bear Creek downstream to the confluence with the Taylor River. The U.S. Forest Service manages 78 percent of the land on the 8.17 mile proposed reach and the remaining 22 percent is privately owned (See Land Ownership Map).

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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.

This segment of Spring Creek flows through a narrow canyon surrounded by a mature pine and spruce forest. There is abundant large wood within the active channel, creating complex habitat for fish species. Numerous side channels and connected wetlands support all life stages of fish. Spring Creek drops steeply in elevation as it flows through the narrow canyon section with a substrate of large boulders and cobbles. Several beaver ponds exist throughout this reach, promoting aquifer recharge and increasing habitat complexity for fish and wildlife species. Spring Creek is largely free from impacts by development, with some homes located near the lower terminus. The stream supports diverse recreation opportunities for camping, fishing, and hiking on public land throughout its length.

Fish sampling conducted by Colorado Parks and Wildlife (CPW) has recorded populations of brown and rainbow trout. When conducting field work, the team observed robust macroinvertebrate and fish communities.

Table 1. List of species identified in Spring Creek.

Species Name	Scientific Name	Status
brown trout	*Salmo trutta*	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.

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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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 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 Analysis
R2Cross data was collected at one transect for this proposed ISF reach by HCCA (Table 2). The R2Cross model results in a summer flow of 20.81 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Spring Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
09/28/2019, 1	41.92	22.07	8.83 - 55.18	14.13	20.81

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

Based on analysis of R2cross results, an increase of 13.5 cfs to the existing ISF of 7.5 cfs is recommended during the snowmelt runoff period and summer, from April 1 to July 31. The combined total of the two ISF water rights would be 21.0 cfs, which satisfies all three of the required hydrologic criteria. This recommendation is driven by the velocity criteria.

The proposed summer increase will increase the average water depth by approximately 0.3 feet to an average depth of 0.54 feet. The average velocity will increase from approximately 0.7 feet per second to 1.0 foot per second. The proposed increase will assure the average velocity criteria is met on Lower Spring Creek. There is no proposed change for the winter instream flow rate due to water availability constraints.

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 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) 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 Spring Creek is 68.70 square miles, with an average elevation of 10,717 feet and average annual precipitation of 25.66 inches (See the Hydrologic Features Map). There is 83 cfs of decreed surface water diversions in the basin. Due to the number and volume of surface water diversions, hydrology in this drainage basin does not represent natural conditions.

Available Data

There is not a current or historic gage located on Spring Creek. Due to limited available data, CWCB staff installed a temporary streamgage on Spring Creek 0.1 miles upstream from the confluence with the Taylor River and below all surface water diversions. The drainage area upstream of this gage is 68.7 square miles with basin elevations ranging from 8,340 feet to 13,300 feet. The mean annual precipitation is 25.7 inches. The CWCB streamgage was installed on 5/13/19 and is still operating. It records water depth every 15 minutes, which is converted to streamflow using a rating curve developed by staff. The 15 minute interval data is used to calculate daily average streamflow values.

The CWCB streamgage has several diversions upstream from it. In some cases, diversion records can be used to provide an indication of water availability in the reach. There are only three surface water diversions decreed for greater than 0.1 cfs in the contributing basin, listed in Table 3. Spring Cr Irg Ditch is the most senior ditch with the most decreed rights and has the ability to sweep the creek, but most often, even in dry years, allows some water to pass the headgate (personal communication with Bob Hurford, Division 4 Engineer, 11/5/19).

Table 3. Active surface water diversion on Spring Creek

Structure Name	WDID	Appropriation Date	Decreed Rate (cfs)
Spring Cr Irg Ditch	5900679	6/1/1891	10.0
		6/15/1882	33.2
		12/1/2007	30.0
Elmer No 2 Ditch	5900714	5/10/1915	1.875
		3/28/1932	2.0
		5/10/1915	2.225
Axtell Ditch	5900513	9/1/1922	1.45

CWCB staff and cooperating entities made seven streamflow measurements on the proposed reach of Spring Creek as summarized in Table 4.

Table 4. Summary of streamflow measurements for Spring Creek.

Visit Date	Flow (cfs)	Collector
05/13/2019	70.39	CWCB
06/14/2019	308.88	CWCB
07/09/2019	112.08	CWCB
07/18/2019	57.75	National Park Service
08/02/2019	31.96	CWCB
09/09/2019	10.94	National Park Service
10/17/2019	5.16	CWCB

Data Analysis

Staff used the daily streamflow data from the CWCB streamgage on Spring Creek as is and did not scale the data to the proposed lower terminus due to the small change in drainage basin size between the gage location and the lower terminus. The CWCB streamgage is also located downstream of all diversions on Spring Creek, so no adjustments to the gage record were necessary to account for surface water diversions. Median streamflow and 95% confidence interval for median streamflow were not calculated due to the short period of record.

Because of the short period of record of the CWCB streamgage, staff examined precipitation and streamflow in the basin to assess how 2019 gage data compare to typical conditions. The Crested Butte climate station (USC00051959) is located approximately 15 miles northwest of the proposed lower terminus. The station has precipitation records dating back to 1909, with nearly 110 years of data. Average monthly precipitation was calculated and compared to the 2019 monthly average. Precipitation at the climate station was much above average January through May of 2019, but for the remainder of 2019 was severely below average. Staff also looked at the USGS 09107000 Taylor River at Taylor Park, CO streamgage, located just upstream of Taylor Park Reservoir, approximately 15 miles northwest of the proposed lower terminus.

Although the Taylor River at Almont gage is closer to the proposed lower terminus, the Taylor Park gage was chosen because it is unaffected by reservoir operations and better represents natural hydrology in the basin. The periods of record for the Taylor Park gage are from 1929 through 1934 and from 1987 to present. Staff calculated the median daily average flow and compared it to the 2019 daily average flow. Flows at the gage were below the median mid-May to the beginning of June due to a late runoff. Flows then were much above the median from June to August, at times flowing more than 600 cfs above the median. Flows, however, returned to the median in August due to lack of precipitation.

This analysis of precipitation and streamflow revealed that above average early year precipitation led to a delayed and high runoff year (Figure 1). However, due to lack of precipitation in the summer and fall, flows returned to around normal in August. Division 4 Engineer Bob Hurford confirmed that late summer flows are likely typical of normal conditions despite the high runoff period (personal communication, 11/5/19). Based on this analysis, the CWCB streamgage data is a good estimate of flow from mid-August through October, but is likely showing far higher than typical streamflow earlier in the year between June and mid-August.

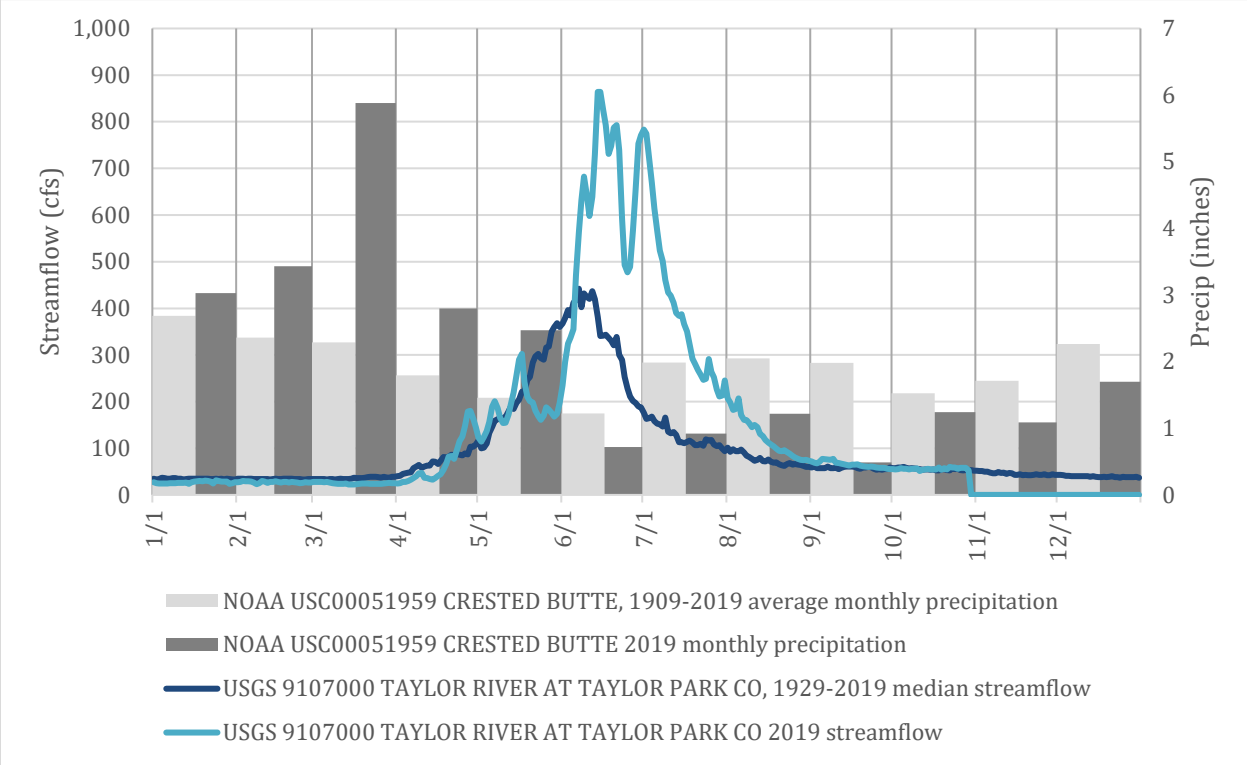


Figure 1. Comparison of average monthly and 2019 precipitation at nearby climate station and median and 2019 streamflow at a nearby streamgage. Streamflow data available through 10/29/2019 and precipitation data only available until 12/13/2019 at time of download.

StreamStats estimates average monthly flow and is not affected by single year conditions, which could be much higher or lower than typical years depending on a number of climate factors of

that year. Although the CWCB streamgage indicates that the appropriation was available this year, StreamStats gives an average monthly flow based on a longer period. Additionally, it provides information about flow conditions in the spring and winter when no CWCB streamgage data is available. However, StreamStats likely overestimates the amount of flow available because it does not account for diversions.

To account for diversions on the creek, adjustments were made to the StreamStats results. The average monthly diversion rate was calculated for Spring Cr Irg Ditch, Elmer No. 2 Ditch, and Axtell Ditch and subtracted from the average monthly flow reported from the StreamStats model.

Water Availability Summary
The hydrograph (See Complete Hydrograph) shows the adjusted StreamStats results for mean-monthly streamflow and the streamflow recorded at the CWCB streamgage. Due to the diversions in the basin, StreamStats was adjusted to account for mean monthly diversion in the basin. From staff's analysis of precipitation and nearby streamgages, streamflow recorded at the CWCB streamgage was likely far above average during the summer months, however the gage provides a good estimate of seasonality and flow amounts typical of a normal autumn.

Due to the short period of record and 2019 conditions at the CWCB streamgage, a combination of adjusted StreamStats and CWCB streamgage data was used in this analysis. The adjusted StreamStats indicates that the proposed increase is available April 1 through July 31. The CWCB streamgage also confirms that flow was available in 2019 during these periods. Staff has concluded that water is available for appropriation.

Material Injury
Because the proposed ISF on Spring 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. (2019), 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.

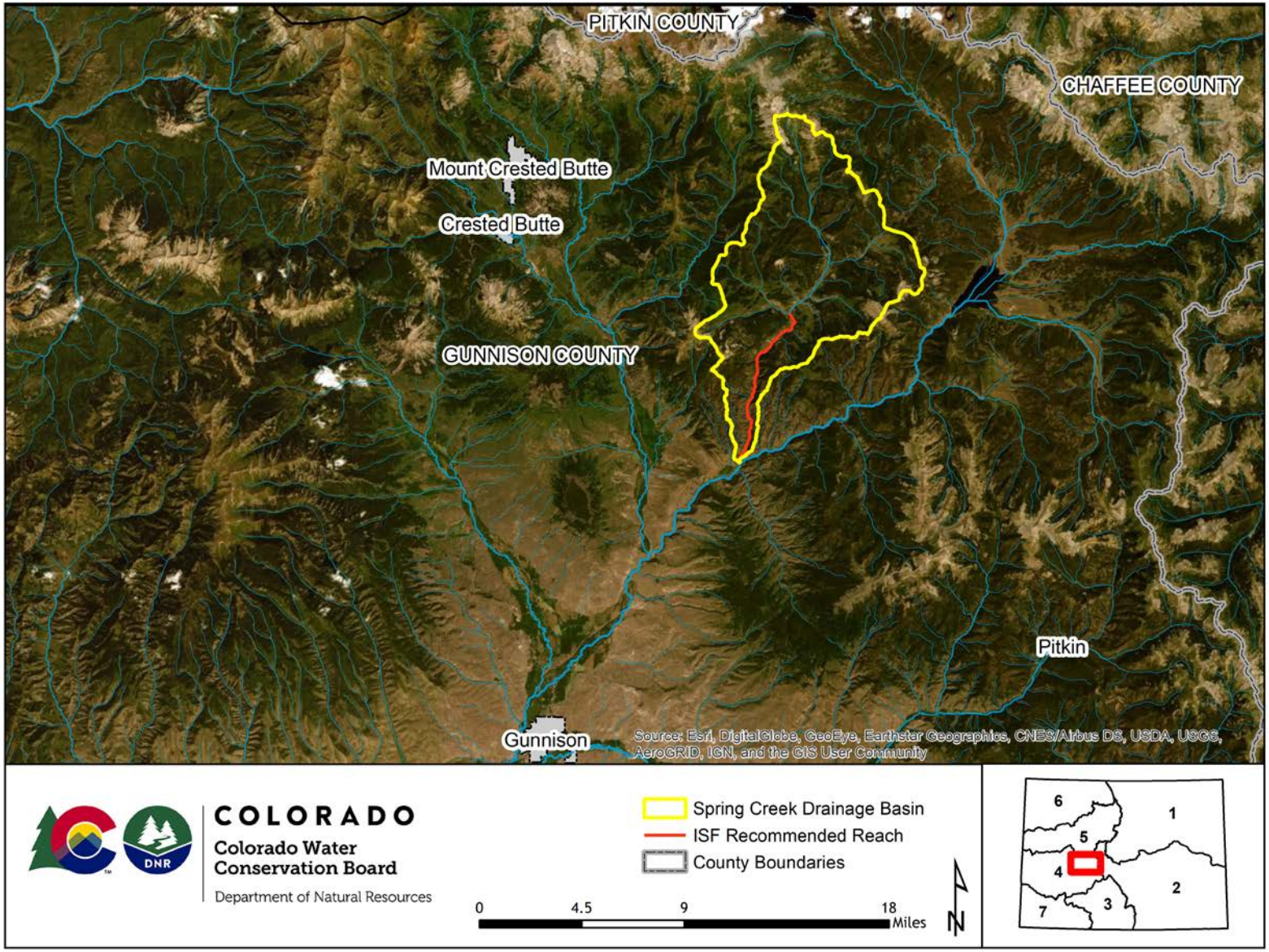
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

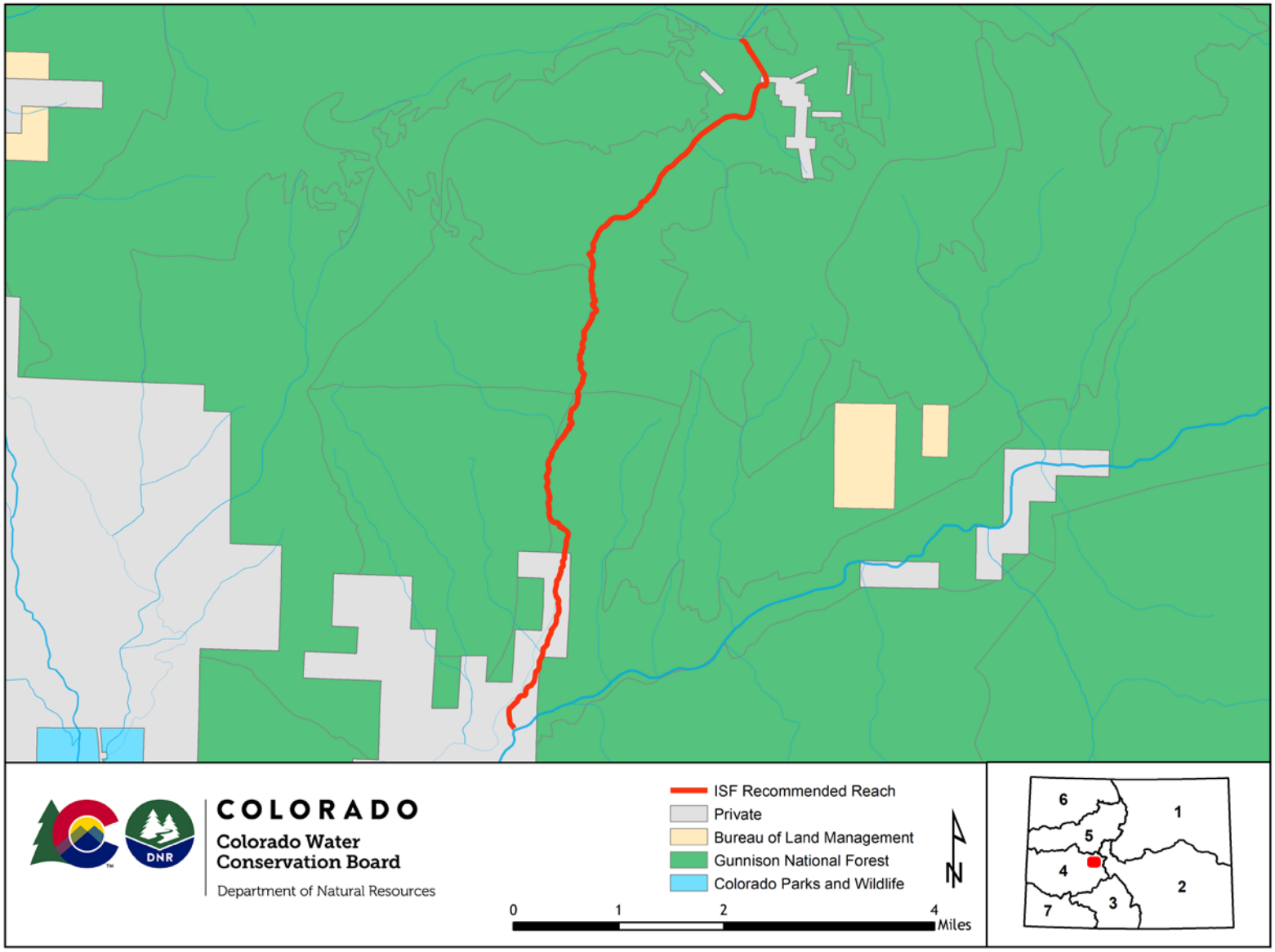
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

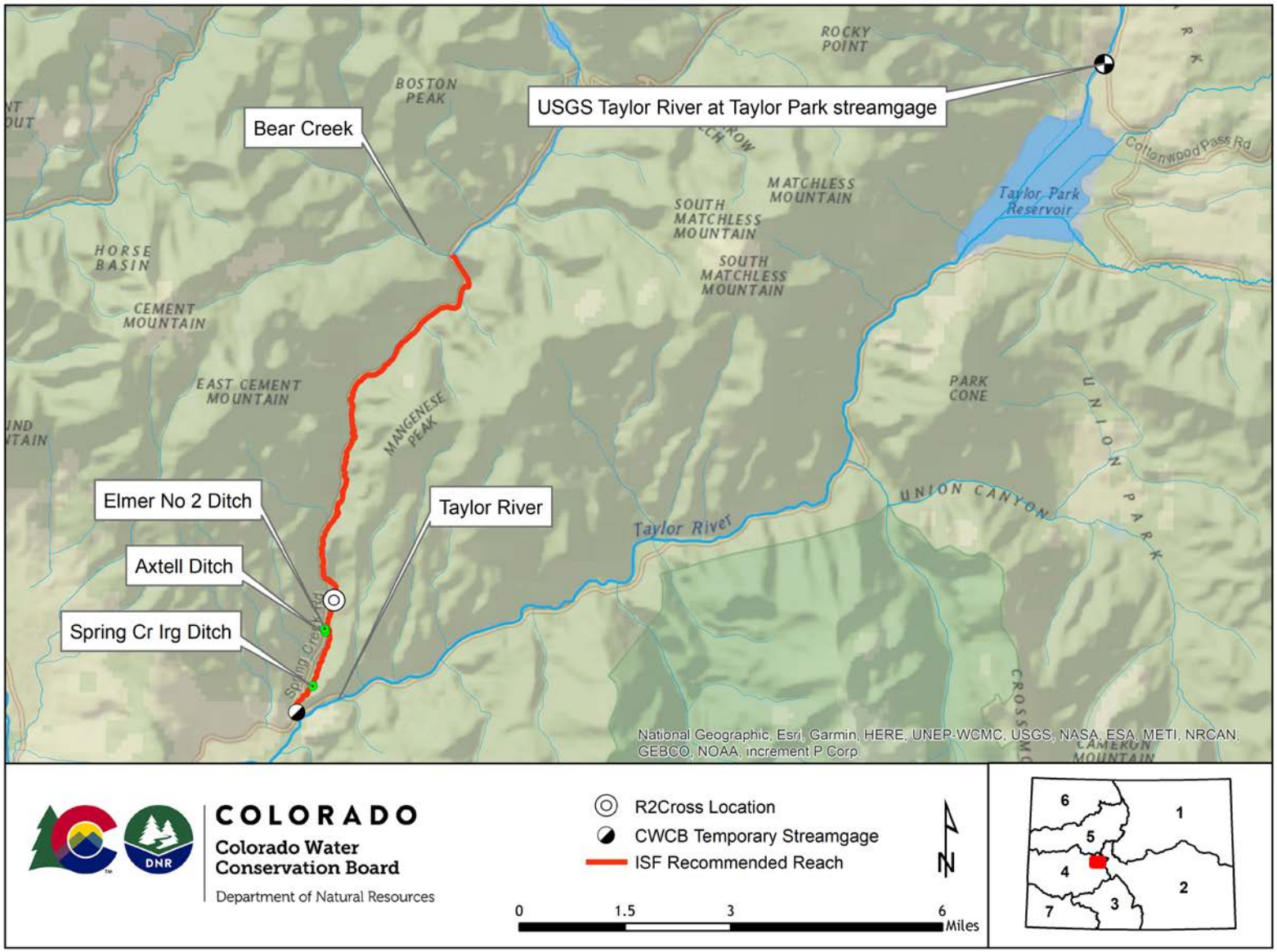
VICINITY MAP



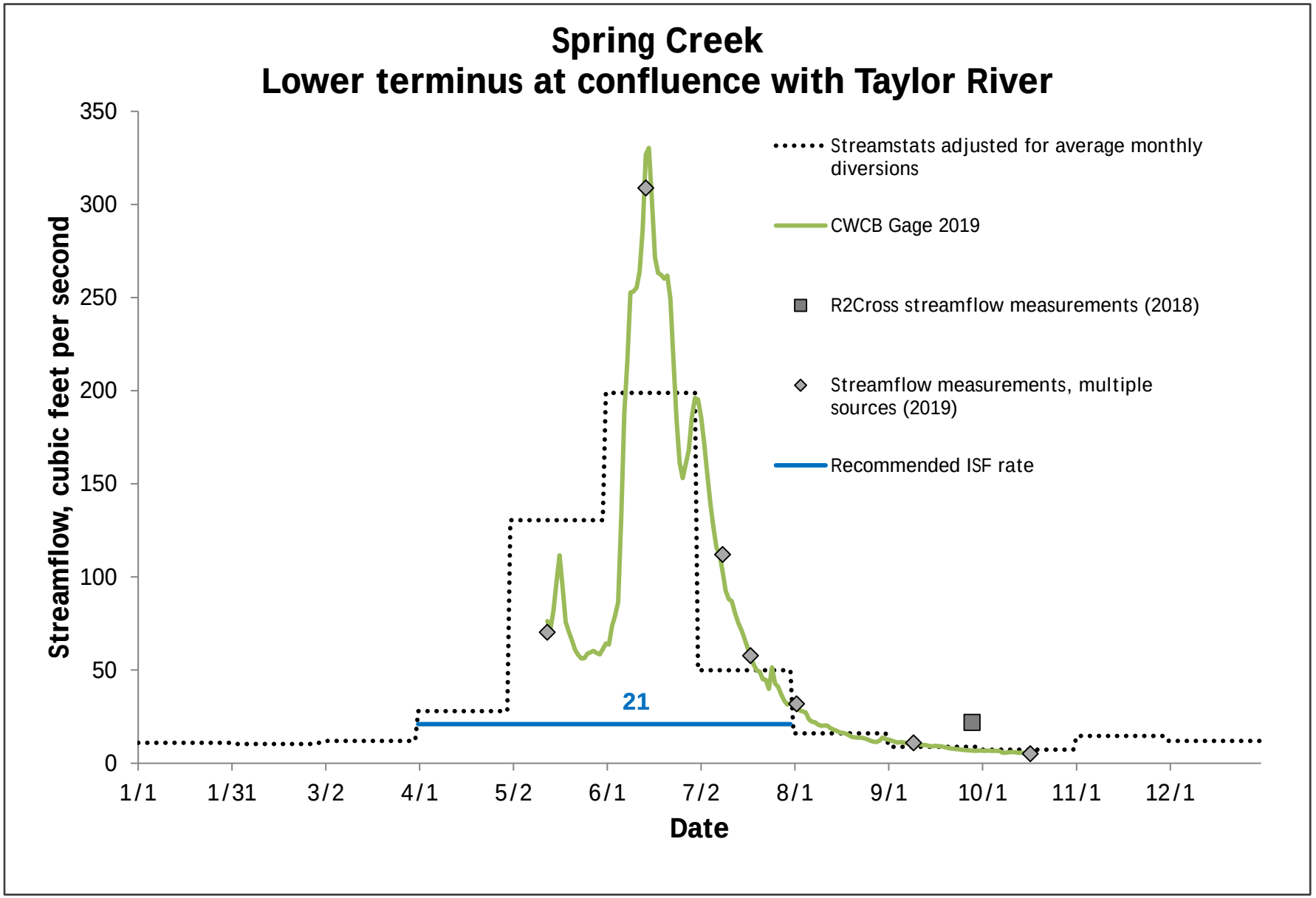
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80203

Spring Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	headwaters in the vicinity of UTM North: 4266062.60 UTM East: 187539.34
LOWER TERMINUS:	Crabtree Ditch headgate UTM North: 4258155.01 UTM East: 180820.03
WATER DIVISION:	4
WATER DISTRICT:	60
COUNTY:	Montrose
WATERSHED:	San Miguel
CWCB ID:	18/4/A-002
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	7.47 miles
FLOW RECOMMENDATION:	1.1 cfs (03/15 - 05/31)

Spring 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.

The BLM recommended that the CWCB appropriate an ISF water right on a reach of Spring Creek because it has a natural environment that can be preserved to a reasonable degree. Spring Creek is located within Montrose County (See Vicinity Map), and originates from the west slope of the Uncompahgre Plateau at an elevation of approximately 9,300 feet. Spring Creek flows southwest for 12 miles to the confluence with Tabeguache Creek at an elevation of approximately 5,100 feet. The proposed reach extends from the headwaters downstream to the Crabtree Ditch headgate. Combined, the U.S. Forest Service and Bureau of Land Management manage 85 percent of the land on the 7.47 mile proposed reach, and 15 percent is privately owned (See Land Ownership Map).

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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.

Spring Creek is a steep, cool-water stream located in a confined canyon that is typically less than 0.25 miles in width. The substrate is mostly sand and silt with some large cobbles. Abundant wood within the channel forms frequent large pools separated by riffles and runs. The forest on the canyon rim surrounding the stream is characterized as pinyon-juniper forest type, while the uplands lining the canyon walls are primarily oak woodland. Spring Creek supports a vibrant riparian community of narrowleaf cottonwood, three-leafed sumac, red-osier dogwood, and thinleaf alder (Lyon and Sovell, 2000) that depend on stable baseflows provided by numerous springs in the basin. Spring Creek does not support a fish population, but a macroinvertebrate community was observed during field surveys that included stoneflies, mayflies, and caddisflies.

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
BLM 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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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). BLM 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 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 Analysis
R2Cross data was collected at 2 transects for this proposed ISF reach by BLM (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 0.88 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 1.13 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Spring Creek.

Date, XS #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
06/16/2016, 3	8.50	1.79	0.72 - 4.48	0.94	1.33
06/16/2016, 4	7.80	1.98	0.79 - 4.95	0.82	0.93
	Mean			**0.88**	**1.13**

ISF Recommendation

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

1.1 cubic feet per second is recommended for the high temperature period from March 15 through May 31. The BLM concludes that meeting all three instream flow criteria will maintain a wetted root zone in the alluvial aquifer during the key part of growing season for the riparian community. Meeting all three instream flow criteria will also provide suitable conditions in the stream substrate for the aquatic macroinvertebrate community.

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 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) 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 Spring Creek is 10.7 square miles, with an average elevation of 7,779 feet and an average annual precipitation of 21.45 inches (See the Vicinity Map). There are a number of known surface water diversions in the drainage basin tributary to the proposed ISF on Spring Creek (Table 3). These surface water diversions potentially divert approximately 4.7 cfs, and there is approximately 9.6 AF in storage in the basin. Hydrology on Spring Creek is driven largely by snowfall on the west side of the Uncompahgre Plateau as well as rain events, particularly during monsoon season. Because of the relatively low elevation and the southwest aspect of the basin, runoff can start relatively early. This basin also experienced a wildfire in 2018 (the Burro Fire) that burned approximately 67% of the basin tributary to the proposed ISF.

Table 3. Primary surface water diversions in the vicinity of the proposed Spring Creek ISF. Diversions are listed roughly in order from upstream to downstream and the location relative to the lower terminus (LT) is noted.

Structure Name	WDID	Decreed rate, cfs	Appropriation Date	Relative Location
Spring Creek Ditch No 3	6001693	1	1905	Above LT
Spring Creek Ditch No 2	6001692	1.74	1916	Above LT
Burrow Creek Ditch	6000541	0.87	1916	Above LT
Tilton Ditch	6000779	1	1915	Above LT
Thormalean Spring	6005058	0.0569	1919 & 1915	Above LT
Crabtree Ditch	600568	6	1932 & 1993	At LT

Available Data

There is not a current or historic daily streamflow gage on Spring Creek. The nearest gage is the historic Tabeguache Creek near Nucla, CO gage (USGS 09176500), which operated from 1946 to 1953. Because diversions from Spring Creek result in differing impacts to the Tabeguache gage and the proposed Spring Creek ISF, and due to the relatively short period of gage record, this gage data was not used to assess water availability on Spring Creek.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. The Crabtree Ditch is the proposed lower terminus and has diversion records from 1974 to 2018 that show use in most years.

Due to the lack of streamflow information, CWCB staff installed a temporary gage on Spring Creek 1.4 miles upstream from the proposed lower terminus. The drainage basin of this gage is 9.96 square miles, with an average elevation of 7,877 feet and average annual precipitation of 21.91 inches. This gage has been in operation since 10/24/2016. The pressure transducer recorded water depth every 15 minutes, which was converted to streamflow based on stage discharge relationships developed by staff. This gage was maintained by CWCB staff with assistance from the BLM field office through fall of 2019; however, a number of data gaps exist due to various equipment issues. CWCB and BLM staff made 16 streamflow measurements on the proposed reach of Spring Creek as summarized in Table 4.

Table 4. Summary of streamflow measurements for Spring Creek.

Visit Date	Flow (cfs)	Collector
05/29/2017	1.82	CWCB *
05/29/2017	2.10	CWCB
11/17/2017	0.01	CWCB
10/24/2016	0.22	CWCB
04/28/2017	3.30	BLM
07/26/2017	0.47	BLM
04/03/2018	0.00	CWCB
07/03/2018	0.00	CWCB
05/08/2019	10.58	CWCB
04/09/2019	4.46	CWCB *
04/09/2019	5.64	CWCB
04/26/2019	7.40	BLM
07/03/2018	0.00	CWCB
08/01/2019	0.64	CWCB
08/01/2019	0.00	CWCB *
10/22/2019	0.04	CWCB

**measurement located near the confluence with Tabeguache Creek and not included on the hydrographs.*

In addition, Staff contacted both the Water Commissioner for District 60, Mark Ragsdale (various personal communications) and Division Engineer Bob Hurford (11/5/2019) to discuss hydrology on Spring Creek. According to Mr. Ragsdale, who has been the Water Commissioner for the last 15 years, spring runoff starts around mid-March and tapers off to near zero or zero flow during mid to late summer. Mr. Ragsdale confirmed that the recommended ISF flow rates were realistic

although not available in all years such as 2018. He also stated that the Bull Draw Fire altered hydrology in 2019 and impacted water users' ability to divert.

Data Analysis

The period for which the CWCB gage data and streamflow measurements exist on the proposed reach of Spring Creek was evaluated by looking at longer term precipitation data. The Columbine Pass climate station was the closest climate station identified with a relatively long period of record (USS0008L02S). This station is located roughly 13 miles east from the proposed lower terminus on Spring Creek. The Columbine climate station recorded precipitation data from 1986 – 2019. The average annual precipitation during this time frame was 32.8 inches. The average annual precipitation from 2016 to 2018 was less than the average while annual precipitation for 2019 is above average without including data from November and December (data was not available at time of analysis).

The CWCB streamgage was installed in the fall of 2016 and measured moderate base flows until spring runoff in 2017. Runoff in 2017 started in late February or early March and peaked in mid-May, receding to near zero flow by September. Issues with the gage resulted in missing data in the fall of 2017 and early winter in 2018. 2018 was particularly dry and no measureable streamflow was observed during that year. Runoff started in March 2019 and showed significantly higher streamflow than in previous years. It should be noted that the data from 2019 was impacted both by high precipitation and by impacts from the wildfire upstream from the gage. These factors result in flashier high flow events as well sudden drops in streamflow that may be caused by ash and other debris temporarily blocking the channel. The BLM estimates that it will take 3-5 years for the vegetation in the basin to recover (Jedd Sondergard, BLM personal communication).

The Tilton Ditch is the only intervening surface diversion between the CWCB gage and the lower terminus. This structure is decreed for 1 cfs and typically diverts water from mid-April to late July or August. The CWCB streamgage data was not adjusted to account for this diversion because diversions in 2018 and 2019 were negligible. Diversions in 2017 were considerably above both the decreed rate and the measured streamflow in May and June. Not adjusting the CWCB gage data based on the Tilton diversion may result in over estimating streamflow at the lower terminus primarily during May and June in 2017.

The CWCB streamgage data was also not adjusted to account for the additional contributing drainage basin below the gage. This was not done due to the small difference in drainage basin size and precipitation that result in a proration factor of 1.05%. No other adjustments were made to the CWCB streamgage data. Due to the short period of record, median streamflow and 95% confidence intervals for median streamflow were not calculated.

Staff also reviewed the diversion records from the Crabtree Ditch, which is located at the lower terminus. The decreed flow rate for this structure is 6.0 cfs; however, the Crabtree water right is the most junior water right in the basin and typically diverts less due to water limitations. This diversion is usually used from to mid to April to late July or August. It is not typically used during the early period of runoff. Based on the available Crabtree Ditch records, median diversions and 95% confidence intervals for median diversions were calculated and are displayed on the hydrograph.

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show the available data from the CWCB temporary gage as well as the median and upper confidence intervals for the Crabtree Ditch diversion records. With the exception of 2018, the temporary gage data demonstrates that runoff typically starts in late February to early March, and that flows can be in excess of 1.1 cfs through May and typically peak between March and May. After the peak, the gage data and 95% confidence interval for median Crabtree diversion records indicate that flows of 1.1 cfs are available until the end of May. Based on the combination of the CWCB gage data, the Crabtree diversion records, and discussions with the Water Commissioner, staff concludes that water is available for the seasonal ISF flow rates recommended for Spring Creek.

Material Injury
Because the proposed ISF on Spring 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. (2019), 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.

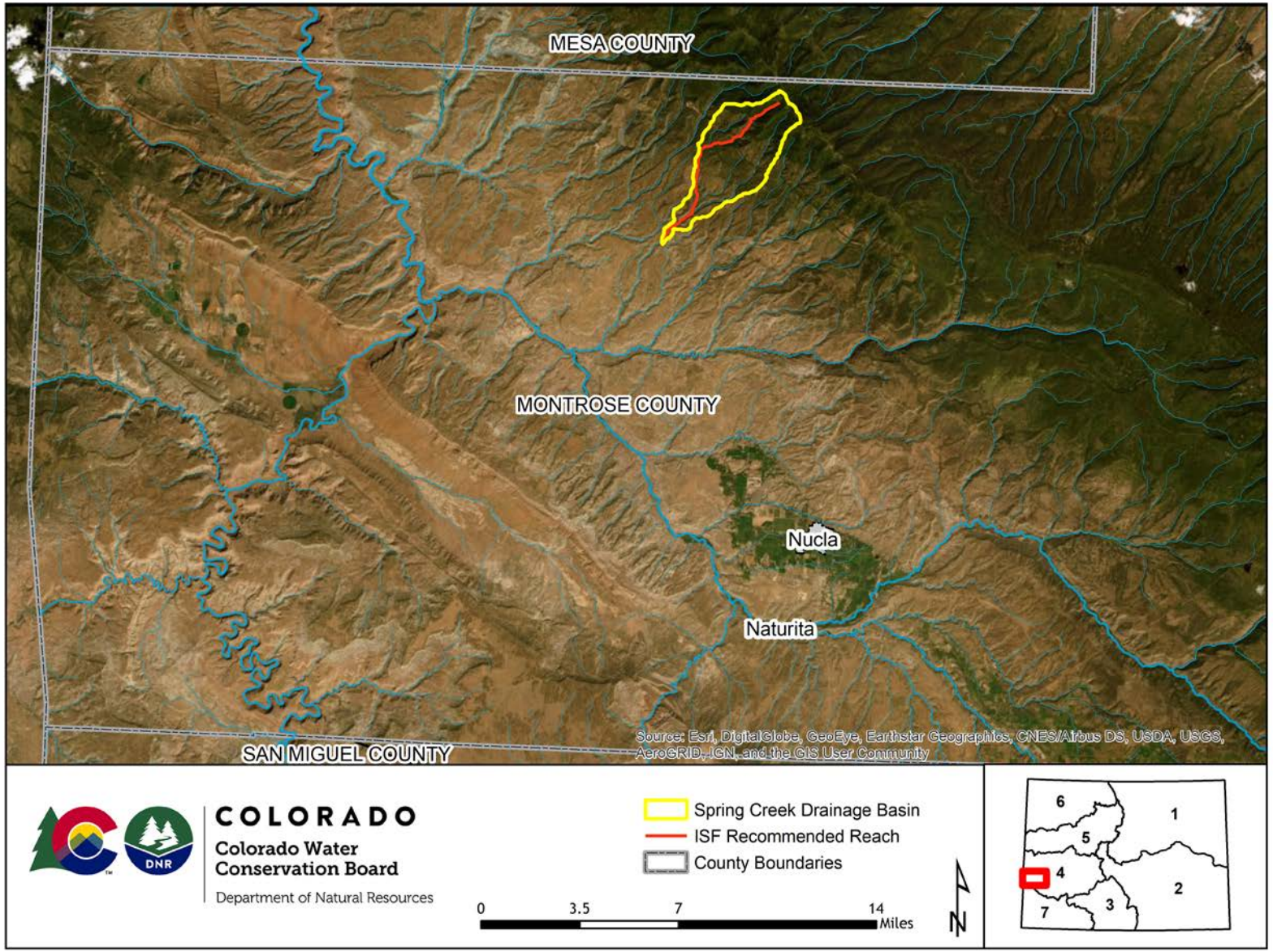
Lyon, P, and J. Sovell, 2000, A Natural Heritage Assessment – San Miguel and Western Montrose Counties, Colorado, p 313, Colorado Natural Heritage Program.

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.

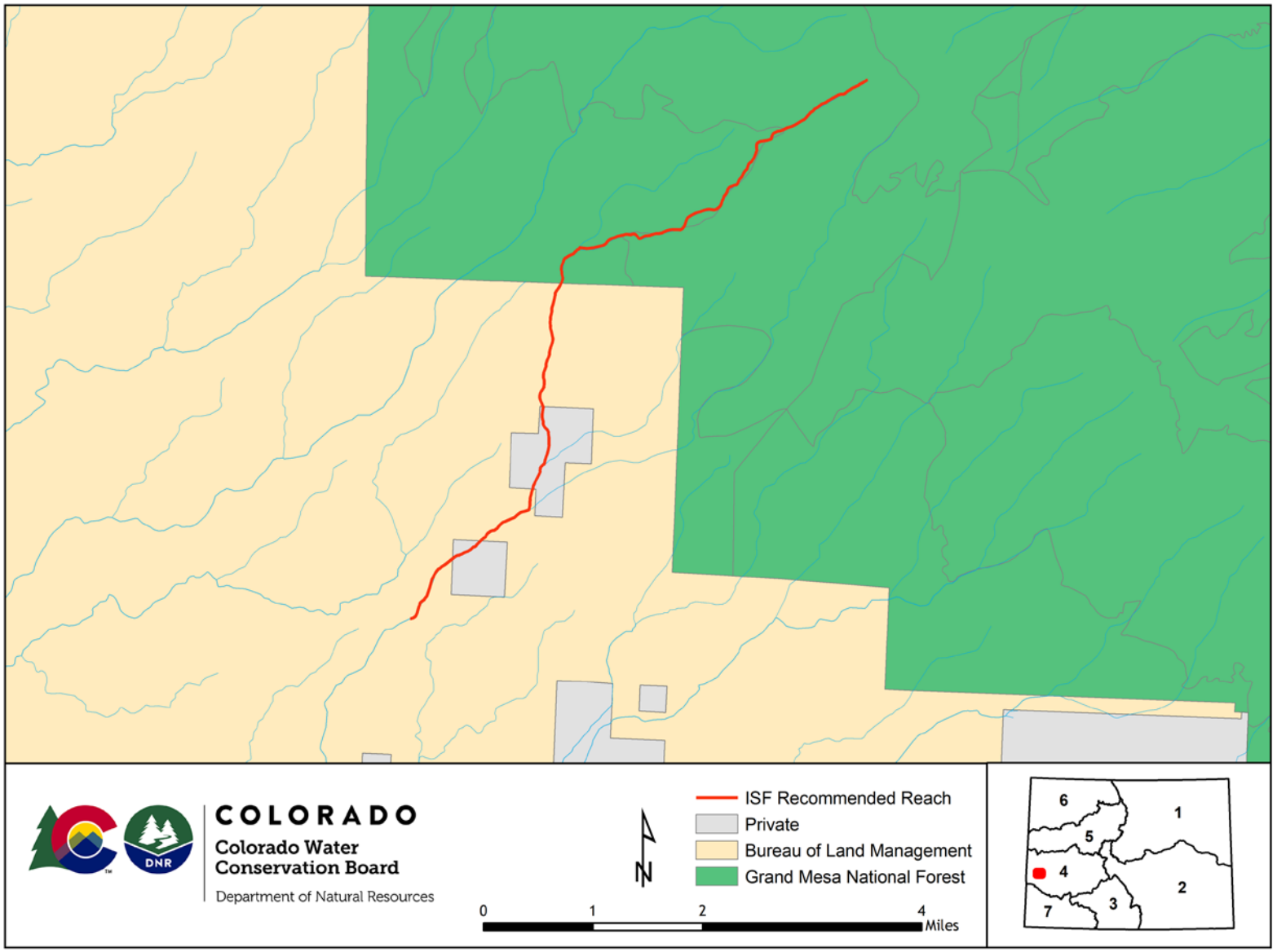
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

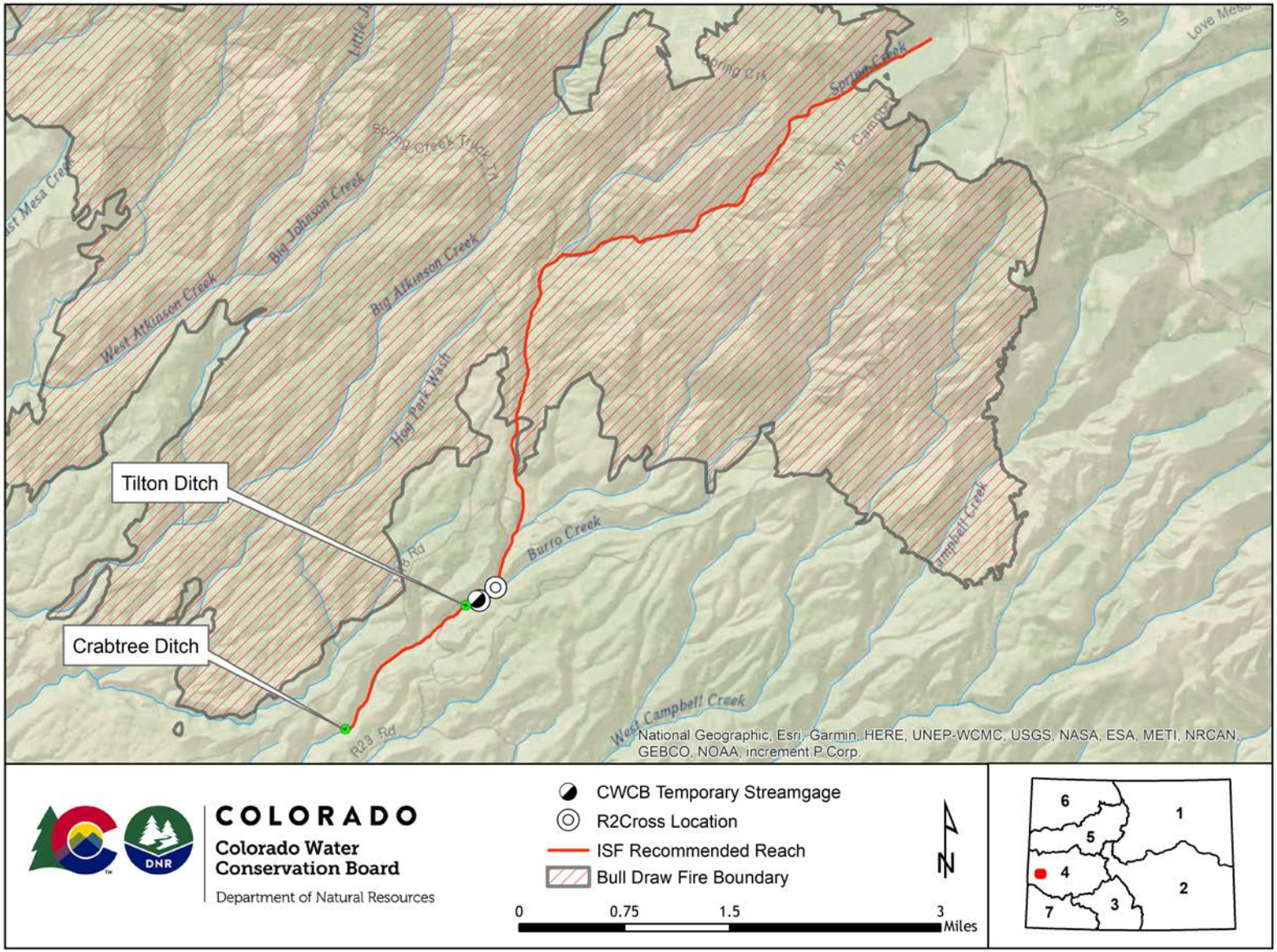
VICINITY MAP



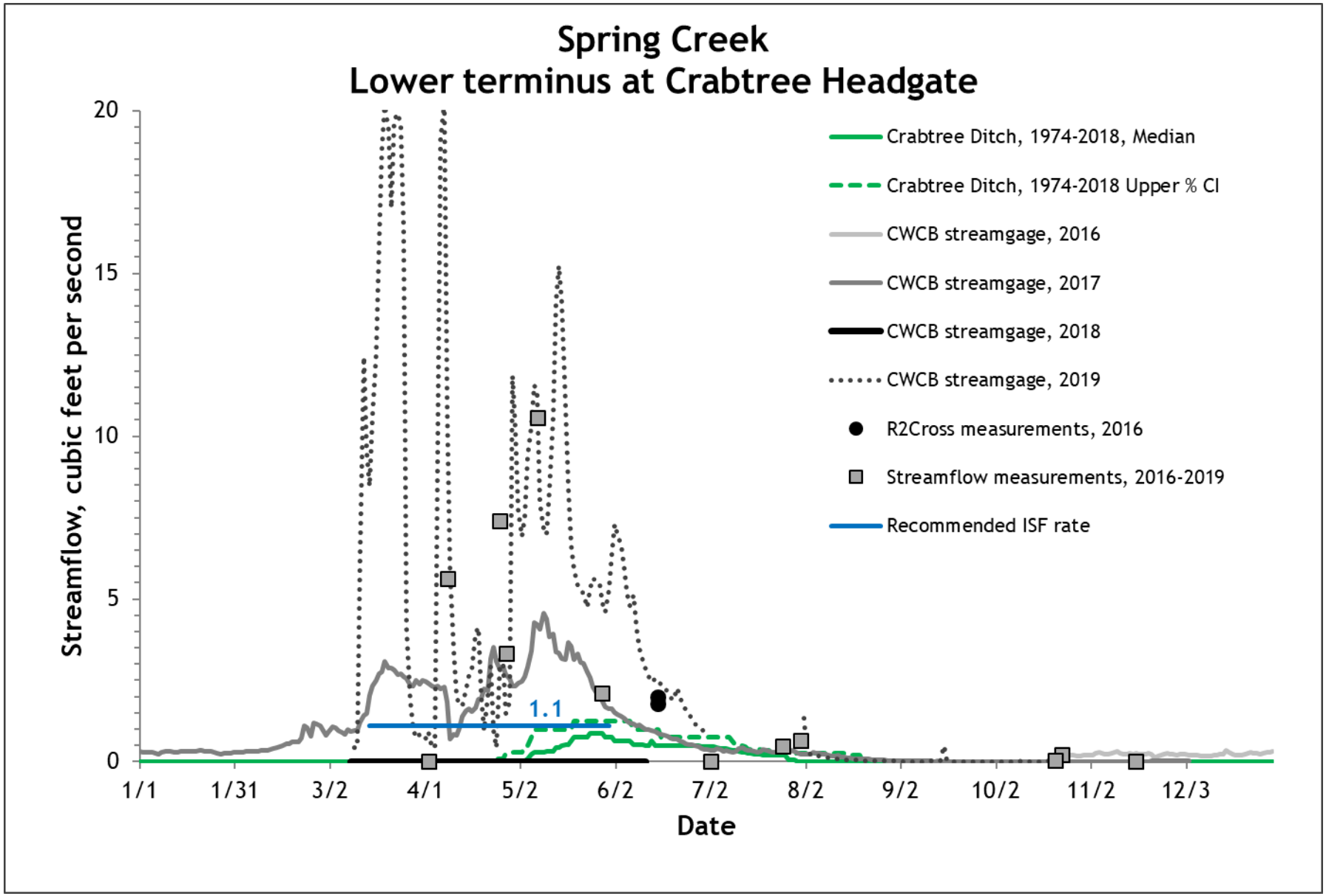
LAND OWNERSHIP MAP



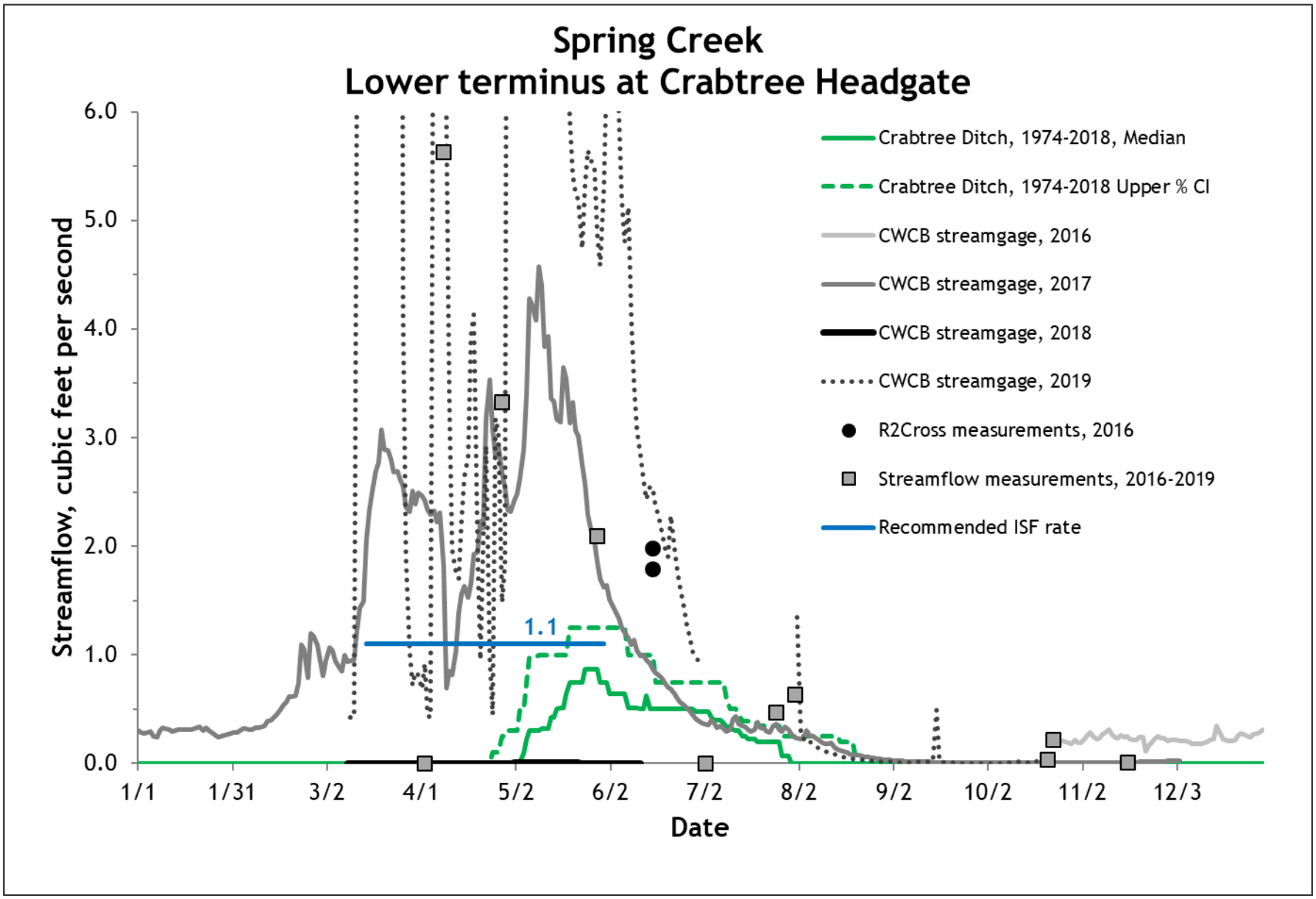
HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAIL HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80203

Unnamed tributary to Bunker Creek

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION JANUARY 2020

UPPER TERMINUS:	headwaters in the vicinity of UTM North: 4450351.49 UTM East: 317262.91
LOWER TERMINUS:	Bunker Ditch headgate UTM North: 4450579.57 UTM East: 314434.46
WATER DIVISION:	6
WATER DISTRICT:	44
COUNTY:	Rio Blanco
WATERSHED:	Upper Yampa
CWCB ID:	20/6/A-003
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	2.14 miles
FLOW RECOMMENDATION:	0.4 cfs (12/01 - 04/30) 1.75 cfs (05/01 - 07/31) 0.8 cfs (08/01 - 11/30)

Unnamed Tributary to Bunker 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.

The BLM recommended that the CWCB appropriate an ISF water right on a reach of the unnamed tributary to Bunker Creek because it has a natural environment that can be preserved to a reasonable degree. The unnamed tributary to Bunker Creek is located within Rio Blanco County (See Vicinity Map), and originates at an elevation of approximately 9,500 feet in the Routt National Forest. The creek flows west 3.6 miles to the confluence with Bunker Creek at an elevation of 8,000 feet. The proposed reach extends from the headwaters downstream to the Bunker Ditch headgate. The U.S. Forest Service manages 63 percent of the land on the 2.14 mile proposed reach, the BLM manages 21 percent, and the remaining 16 percent is privately owned.

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 available at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2020ProposedISFRecommendations.aspx.

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 unnamed tributary to Bunker Creek is a cold water, high gradient stream that flows through a narrow valley to the confluence with Bunker Creek. The riparian forest is composed of a mature pine and spruce forest with large aspen stands and meadows in the upland areas of the basin. The creek has large substrate of cobbles and boulders with some fine sediment. The mature riparian forest has contributed significant amounts of large wood to the active channel that forms pools and side-channels and creates complex habitat for all life stages of fish.

Fish surveys have documented a core conservation population of blue lineage Colorado River cutthroat trout. Macroinvertebrate surveys have also documented abundant stonefly and caddisfly populations.

Table 1. List of species identified in the unnamed tributary to Bunker Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern Federal – Sensitive Species

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

BLM 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 data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey 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). BLM 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 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 Analysis

R2Cross data was collected at 4 transects for this proposed ISF reach by the BLM (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 0.83 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 1.76 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 the unnamed tributary to Bunker Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
06/15/2018, 1	14.00	0.89	0.36 - 2.23	1.38	1.76
06/15/2018, 2	7.67	0.80	0.32 - 2.00	0.57	Out of range
09/27/2017, 1	7.21	0.30	0.12 - 0.75	0.68	Out of range
09/27/2017, 2	5.89	0.33	0.13 - 0.83	0.69	Out of range
	Mean			0.83	1.76

ISF Recommendation

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

1.75 cubic feet per second is recommended during the snowmelt runoff period from May 1 to July 31. This recommendation is driven by the average velocity criteria. Given the small amount of riffle habitat in this reach, it is important to provide velocities that are suitable for spawning trout.

0.8 cubic feet per second is recommended during late summer and fall, from August 1 to November 30. This recommendation is driven by the average depth criteria. This flow rate will maintain sufficient physical habitat in the creek for the fish population to complete important parts of their life cycle before cold temperatures reduce fish activity for the winter.

0.4 cubic feet per second is recommended during the cold temperature period of the year from December 1 through April 30. This recommendation is driven by limited water availability. This flow rate should prevent complete icing of the numerous pools in this reach, allowing the fish population to overwinter.

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 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) 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 unnamed tributary to Bunker Creek is 2.81 square miles, with an average elevation of 9,257 feet and average annual precipitation of 31.49 inches (See the Hydrologic Features Map). Due to the lack of surface water diversions, hydrology in this drainage basin represents natural flow conditions.

Available Data

There are no current or historic streamflow gages in the vicinity of the proposed ISF reach. The nearest gage is East Fork of Williams Fork nr Willow Creek, CO (USGS 9248500), a historic gage located approximately 5 miles downstream on the East Fork Williams River. The gage has a short period of record from 1943 to 1947. Another historic gage exists 8 miles downstream of the proposed lower terminus, East Fork of Williams Fork ab Willow Creek, CO (USGS 9248600), and has a longer period of record from 1956 to 1972. Both historic gages have significantly larger drainage basins than that of the proposed ISF reach, as well as several intervening diversions. Due to the combination of water diversions and the large difference in drainage basin sizes that result in small proration factors, these gages are not suitable for estimating streamflow on the proposed ISF reach.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. Bunker Ditch (WDID 4400562) is located at the downstream terminus. Comments on Colorado's Decision Support System indicate that all water rights associated with this structure have been transferred to other locations. When the ditch was historically used, diversions were not made on a regular basis. Staff concluded that the diversion records for Bunker Ditch do not help estimate streamflow on the proposed ISF reach.

CWCB staff made one streamflow measurement on the proposed reach of the unnamed tributary to Bunker Creek as summarized in Table 3.

Table 3. Summary of streamflow measurement visits and results for the unnamed tributary to Bunker Creek.

Visit Date	Flow (cfs)	Collector
07/30/2019	1.01	CWCB

Data Analysis
StreamStats provides the best available estimate of streamflow on the unnamed tributary to Bunker Creek.

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

Material Injury
Because the proposed ISF on the unnamed tributary to Bunker 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. (2019), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
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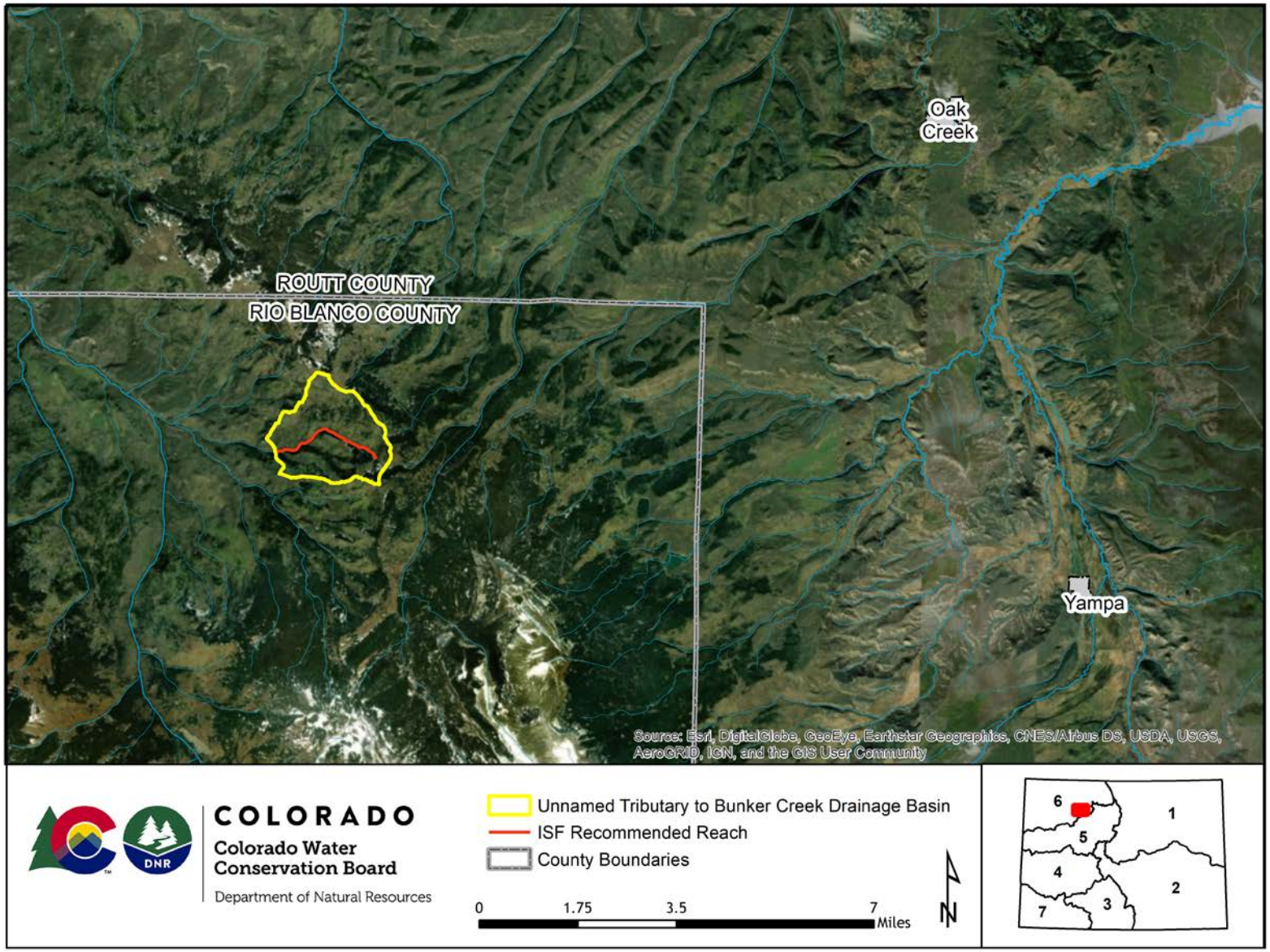
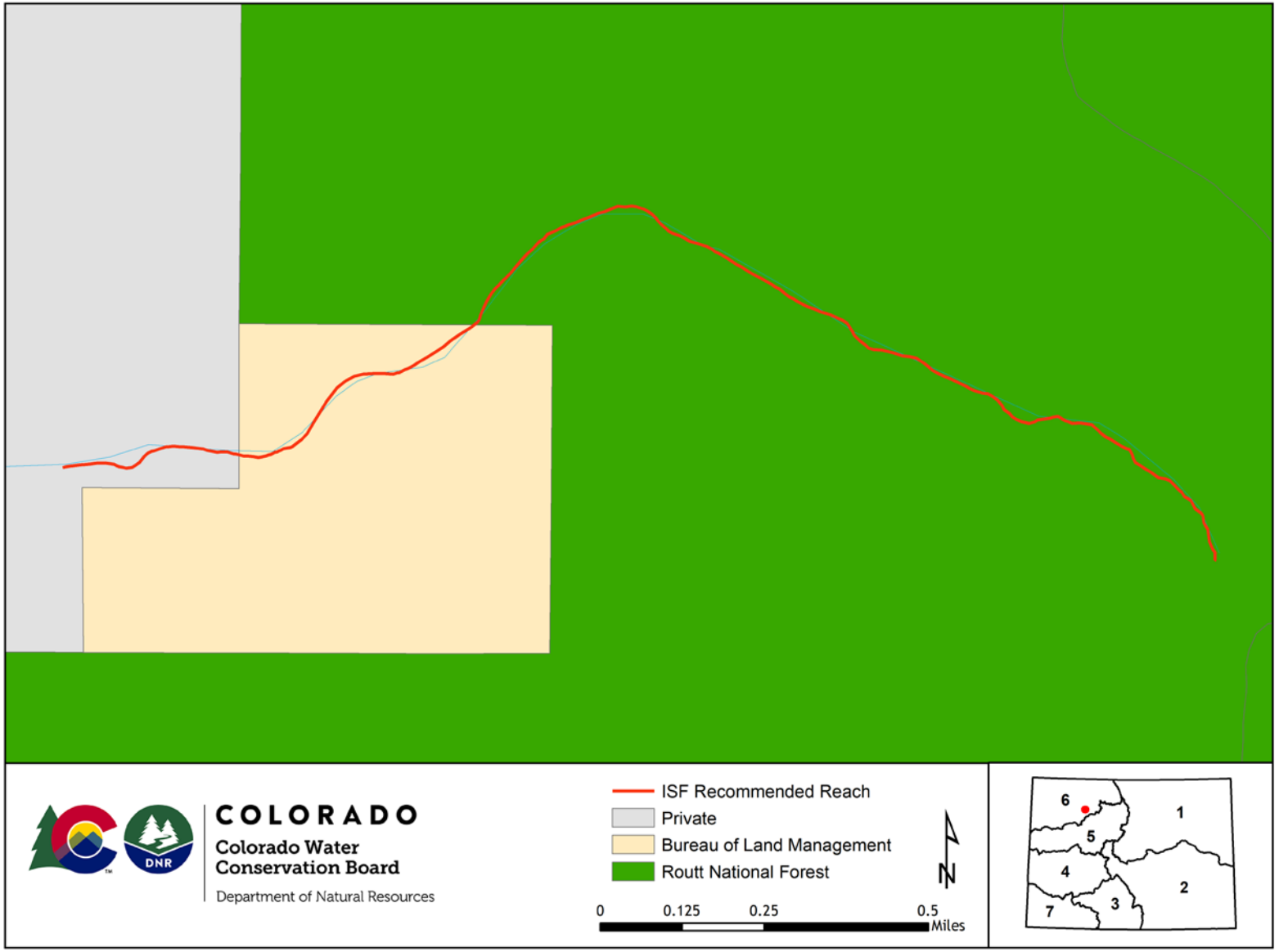
Projected Coordinate System: NAD 1983 UTM Zone 13N.

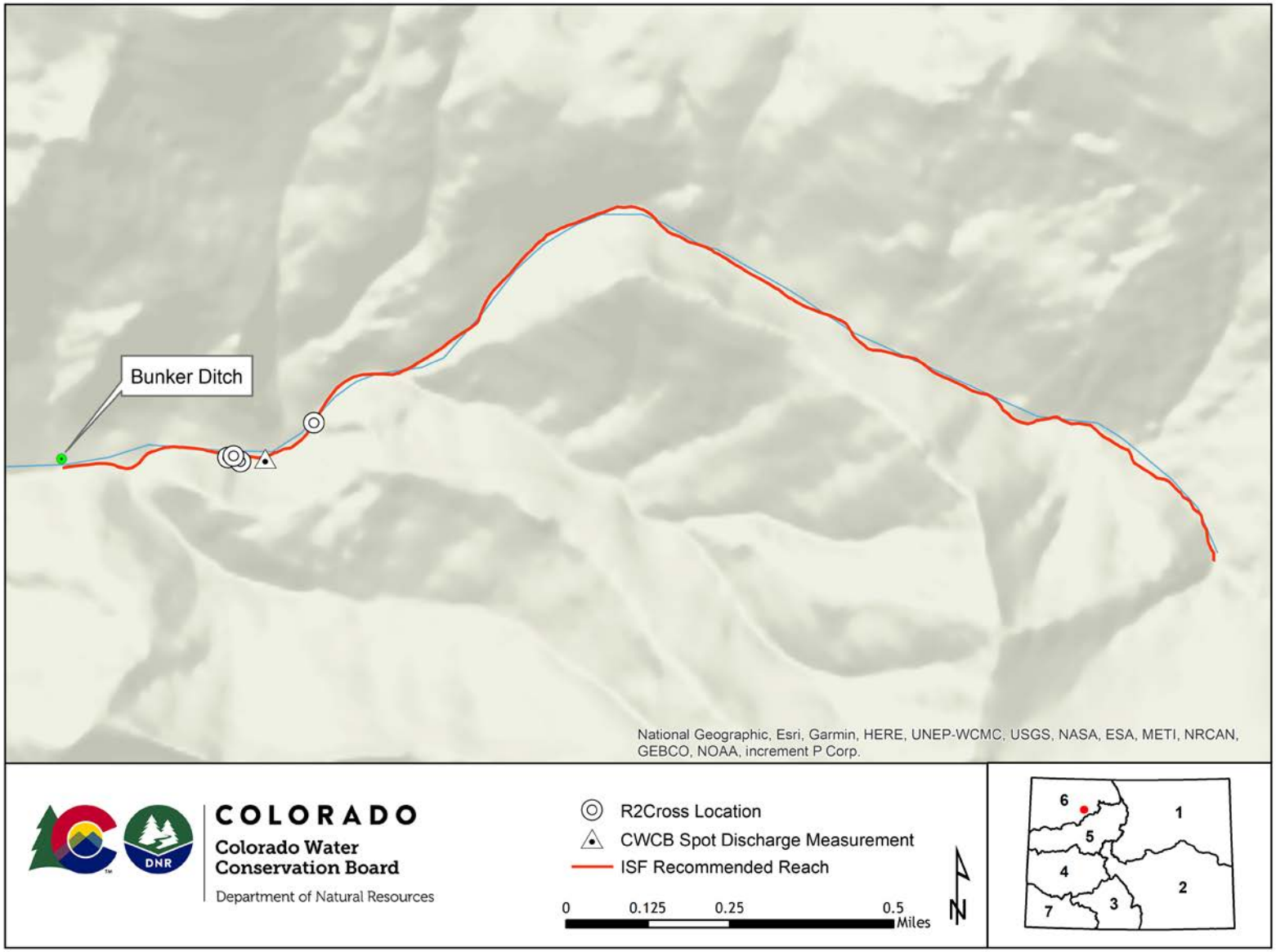
VICINITY MAP



LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH