COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street
Denver, CO 80203

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

John Hickenlooper, Governor

Robert Randall, DNR Executive Director

Rebecca Mitchell, CWCB Director

2018 Instream Flow Recommendations

Water Division 3

1. Miners Creek (Saguache County)
    a. Executive Summary
    b. Appendices

2. Prong Creek (Saguache County)
    a. Executive Summary
    b. Appendices

Water Division 4

3. Coyote Wash (Montrose County)
    a. Executive Summary
    b. Appendices

4. Dutchman Creek (Saguache County)
    a. Executive Summary
    b. Appendices

Water Division 5

5. Abrams Creek *(Increase)*(Eagle County)
    a. Executive Summary
    b. Appendices

Water Division 6

6. Douglas Creek (Rio Blanco County)
    a. Executive Summary
    b. Appendices

7. Hahn Creek (Rio Blanco County)
    a. Executive Summary
    b. Appendices

8. Lost Creek (Rio Blanco County)
    a. Executive Summary
    b. Appendices

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Miners Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the Vicinity of UTM North: 4200135.10 UTM East: 361754.34
LOWER TERMINUS:	Confluence with Prong Creek UTM North: 4201747.81 UTM East: 367461.17
WATER DIVISION:	3
WATER DISTRICT:	27
COUNTY:	Saguache
WATERSHED:	Saguache
CWCB ID:	18/3/A-001
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	4.35 miles
FLOW RECOMMENDATION:	0.56 cfs (09/01 - 04/30) 1.0 cfs (05/01 - 08/31)

Miners 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.

Colorado Parks and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Miners Creek. Miners Creek originates in the La Garita Mountains at an elevation of approximately 11,720 feet. It flows in a northeasterly direction for 4.35 miles until it joins Prong Creek at an elevation of approximately 9,950 feet. The proposed ISF reach extends from its headwaters downstream to the confluence with Prong Creek, and is located within Saguache County (See Vicinity Map). The U.S. Forest Service owns and manages one-hundred percent of the land on which the 4.35 mile proposed reach is located (See Land Ownership Map). CPW recommended this reach of Miners Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Miners Creek has a natural environment consisting of self-sustaining populations of Rio Grande cutthroat trout and brook trout. 2004 electrofishing data shows multiple age classes of both species and a wide range of sizes from 2-inch fish to individuals in excess of 8 inches. Genetic testing of the Rio Grande cutthroats in Miners Creek show approximately 5 -10% introgression with Yellowstone cutthroat trout. Miners Creek's natural environment also contains a diverse macroinvertebrate community and numerous beaver dam complexes.

Table 1. List of species identified in Miners Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	None
Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*	Federal – Sensitive Species State - Species of Greatest Conservation Need

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.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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 quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 3 transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 0.56 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 1.00 cfs, which is close to meeting 3 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW	09/22/1993 # 1	0.39	0.20 - 1.00	Out of range	1.00*
CPW	09/27/2017 # 1	0.99	0.40 - 2.50	Out of range	Out of range
CPW	09/27/2017 # 2	1.25	0.50 - 3.10	0.56	Out of range
			Mean	0.56	1.00

** This flow is derived from the upper limit of the R2CROSS modeling accuracy and is used in the computation of the summer flow recommendation. The flow that meets all three instream flow criteria is outside of the confidence interval for this data set. This data set came closest to meeting all three hydraulic criteria within the accuracy range or the R2cross model.*

ISF Recommendation

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

> 1.0 cfs is recommended for the period of May 1 to August 31.This recommendation meets two of the three hydraulic criteria (percent wetted perimeter and average depth), and is close (over 90%) to meeting the velocity criteria.
>
> 0.56 cfs is recommended for the period of September 1 to April 30.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be

employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Miners Creek is 3.27 square miles, with an average elevation of 11,215 feet and average annual precipitation of 41.48 inches (See the Hydrologic Features Map). No active surface water diversions were identified in 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 Miners Creek. The nearest streamflow gage is Carnero Creek near La Garita (USGS and DWR number 08230500), which is located approximately 11.6 miles southeast from the proposed lower terminus. The Carnero Creek gage period of record includes 1919 to present. The drainage basin tributary to the Carnero Creek gage is 106 square miles, with an average elevation of 10,056 feet, and an average precipitation of 26.53 inches. There are a number of diversions in the Carnero Creek drainage basin, resulting in altered hydrology at the gage. Due to the large difference in drainage basin size and the diversions that impact the gage, this data was not used to assess water availability on Miners Creek.

CWCB staff assisted CPW in collecting R2Cross information. No additional site visits were necessary.

Data Analysis
StreamStats provides the best available estimate of streamflow on Miners 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 Miners 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. (2017), 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.

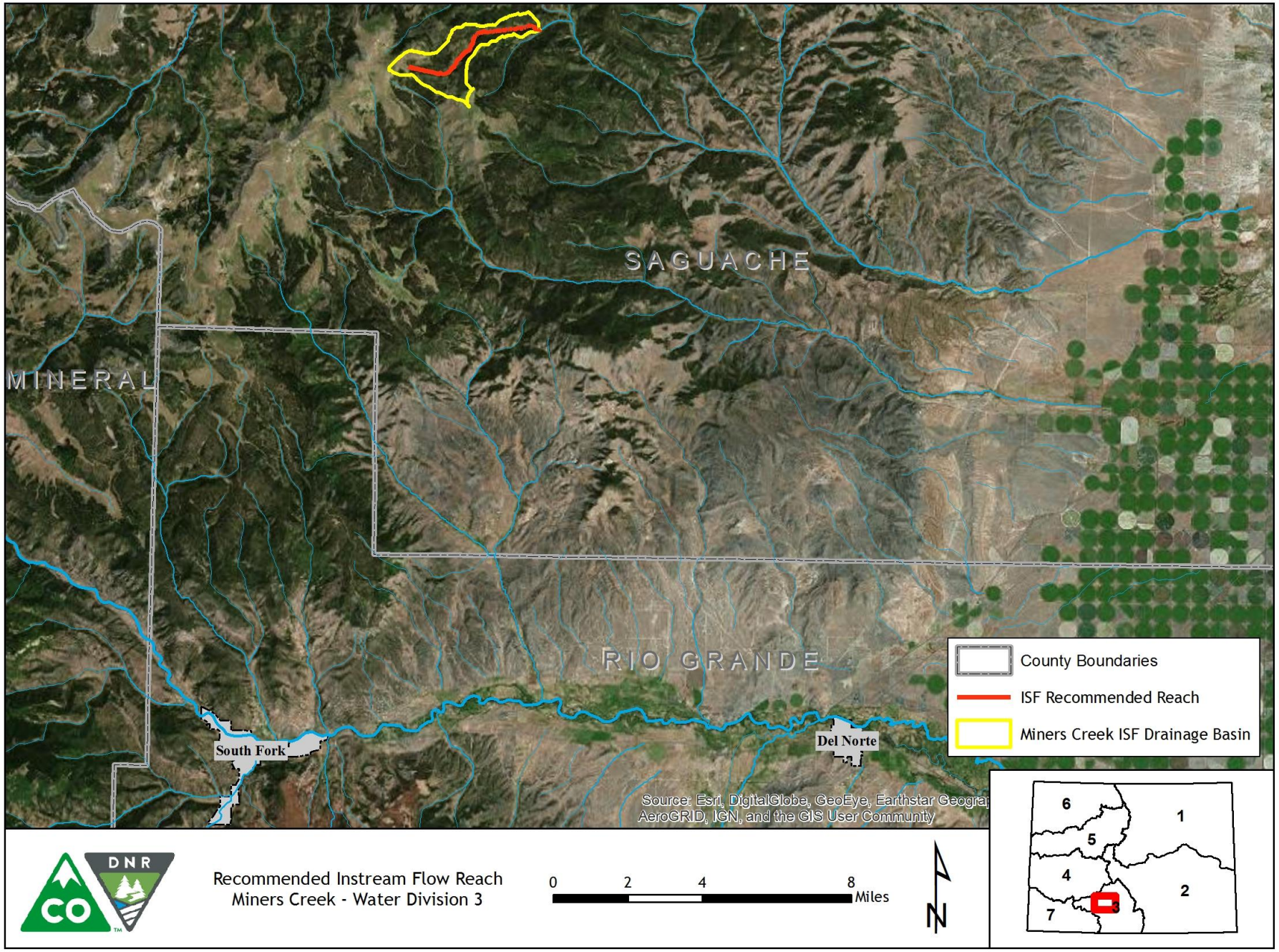
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

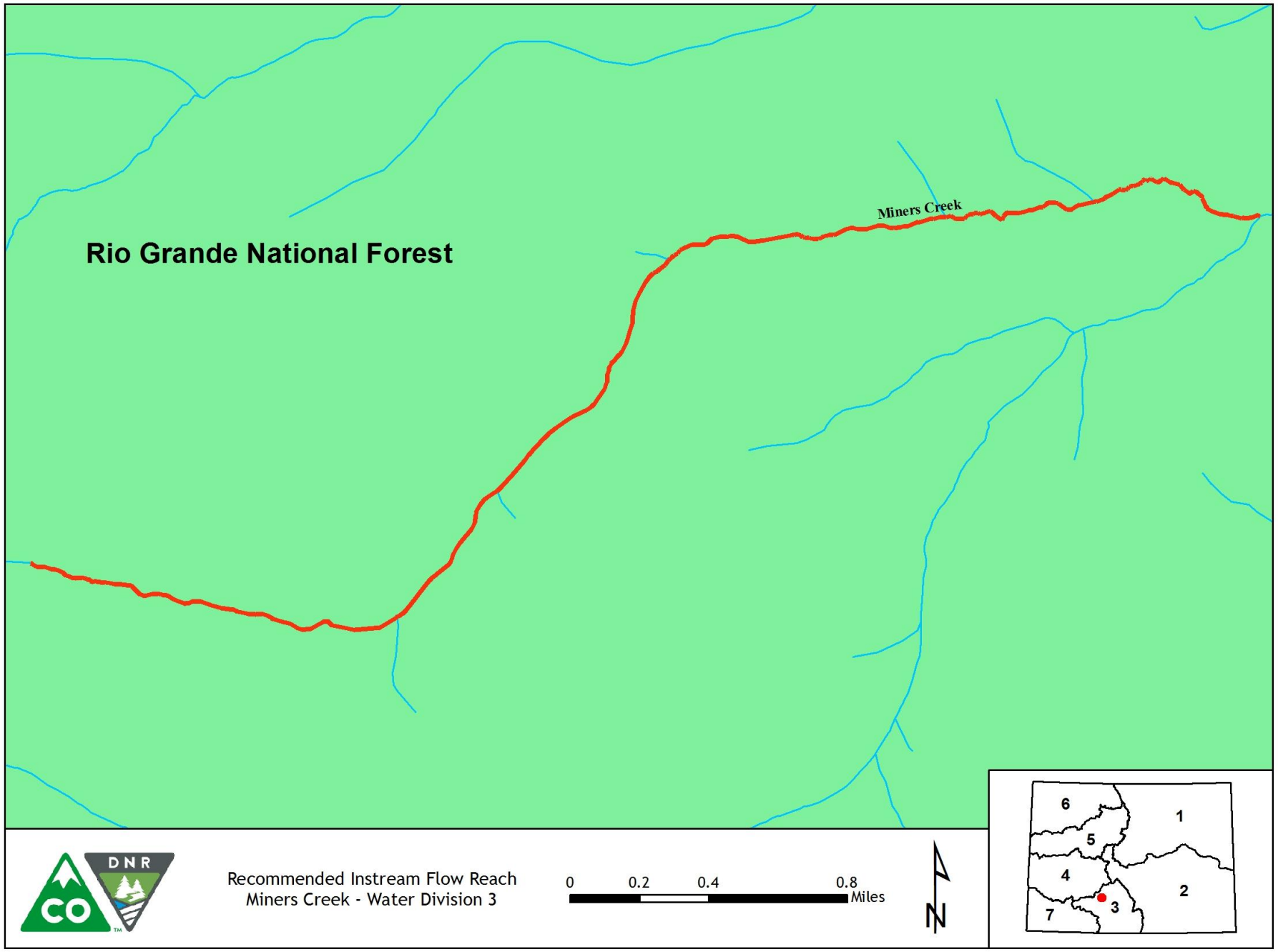
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

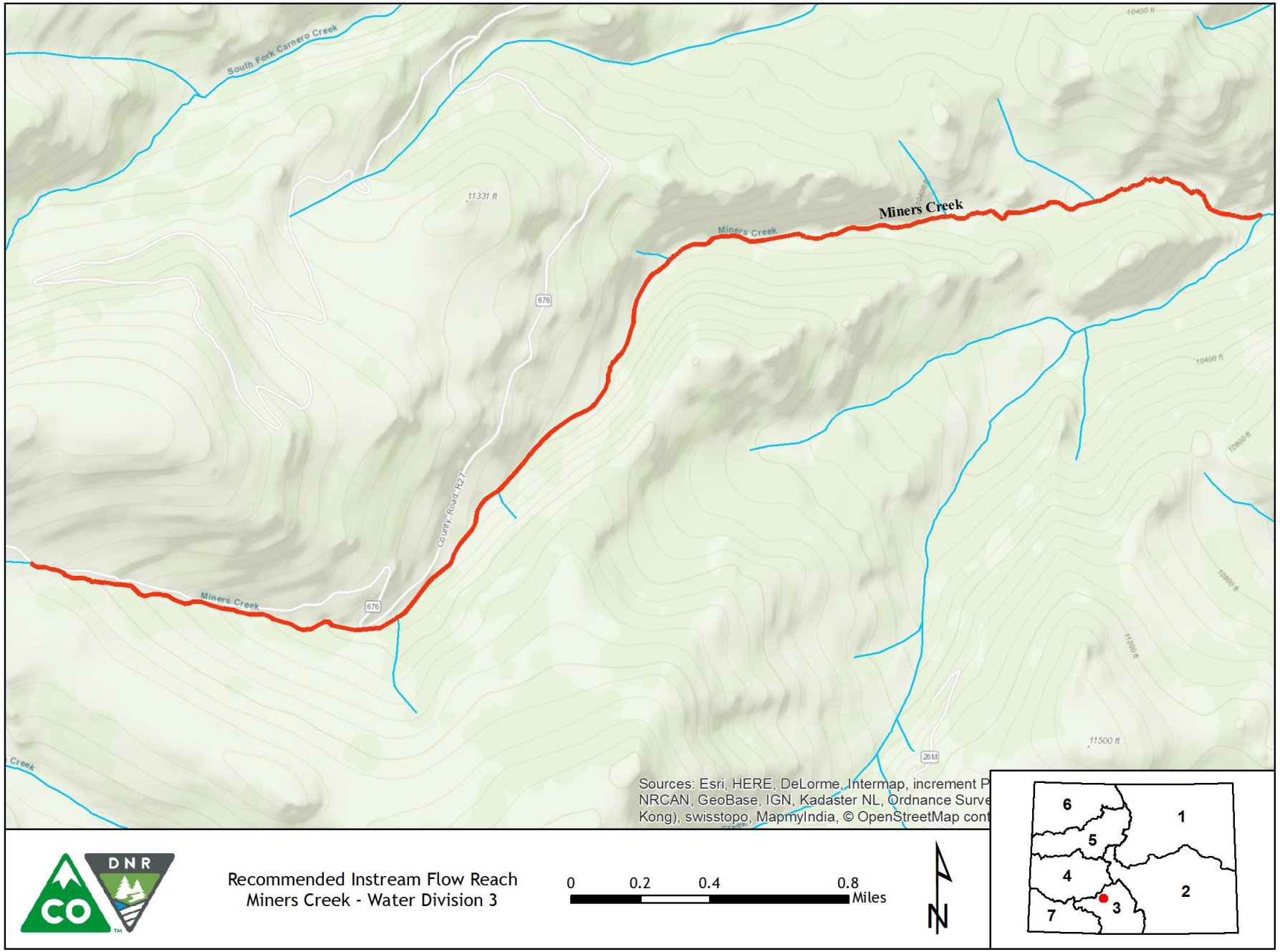
VICINITY MAP



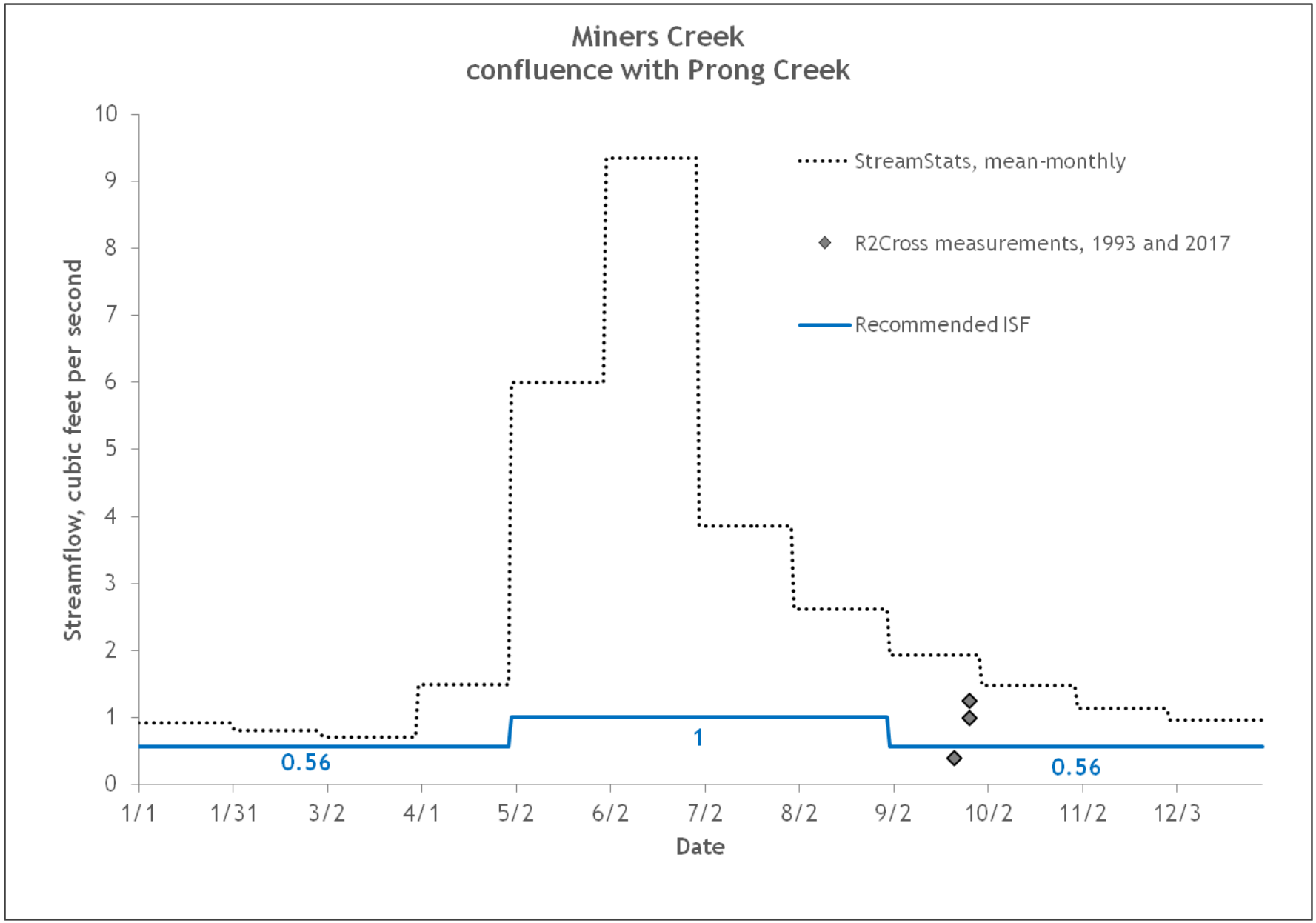
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Prong Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the Vicinity of UTM North: 4198791.92 UTM East: 364704.01
LOWER TERMINUS:	Confluence with South Carnero Creek at UTM North: 4202053.13 UTM East: 368816.09
WATER DIVISION:	3
WATER DISTRICT:	27
COUNTY:	Saguache
WATERSHED:	Saguache
CWCB ID:	18/3/A-002
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	3.71 miles
FLOW RECOMMENDATION:	0.4 cfs (09/01 - 04/30) 4.2 cfs (05/01 - 08/31)

Prong 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.

Colorado Parks and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Prong Creek. Prong Creek originates in the La Garita Mountains at an elevation of approximately 11,600 feet. It flows in a southeasterly direction to an elevation of approximately 9,750 feet where it joins South Carnero Creek. The proposed ISF reach extends from its headwaters downstream to the confluence with South Carnero Creek, and is located within Saguache County (See Vicinity Map). The U.S. Forest Service owns and manages one-hundred percent of the land on which the 3.71 mile proposed reach is located (See Land Ownership Map). CPW recommended this reach of Prong Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Prong Creek has a natural environment consisting of self-sustaining populations of Rio Grande cutthroat trout and brook trout. 2006 and 2012 electrofishing data shows multiple age classes of both species and a wide range of sizes from 3-inch fish to individuals in excess of 9 inches. Genetic testing of the Rio Grande cutthroats in Prong Creek show approximately 5 -10% introgression with Yellowstone cutthroat trout. Prong Creek's natural environment also contains a diverse macroinvertebrate community and numerous beaver dam complexes.

Table 1. List of species identified in Prong Creek.

Species Name	Scientific Name	Status
Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*	Federal - Sensitive Species State - Species of Greatest Conservation Need
brook trout	*Salvelinus fontinalis*	None

ISF Quantification
CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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 quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 3 transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 0.37 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 4.20 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW	09/22/1993 # 1	0.61	0.20 - 1.50	0.37	Out of range
CPW	09/27/2017 # 1	3.44	1.40 - 8.60	Out of range	4.86
CPW	09/27/2017 # 2	3.44	1.40 - 8.60	Out of range	3.54
			Mean	0.37	4.20

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

4.2 cfs is recommended for the period of May 1 to August 31.

0.4 cfs is recommended for the period of September 1 to April 30.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Prong Creek is 6.59 square miles, with an average elevation of 11,069 feet and average annual precipitation of 40.04 inches (See the Hydrologic Features Map). No active surface water diversions were identified in 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 Prong Creek. The nearest streamflow gage is Carnero Creek near La Garita (USGS and DWR number 08230500) which is located approximately 11.6 miles southeast from the proposed lower terminus. The Carnero Creek gage period of record includes 1919 to present. The drainage basin tributary to the Carnero Creek gage is 106 square miles, with an average elevation of 10,056 feet, and an average precipitation of 26.53 inches. There are a number of diversions in the Carnero Creek drainage basin, resulting in altered hydrology at the gage . Due to the large difference in drainage basin size and the diversions that impact the gage, this data was not used to assess water availability on Prong Creek.

CWCB staff assisted CPW in collecting R2Cross information. No additional site visits were necessary.

Data Analysis
StreamStats provides the best available estimate of streamflow on Prong 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 Prong 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. (2017), 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.

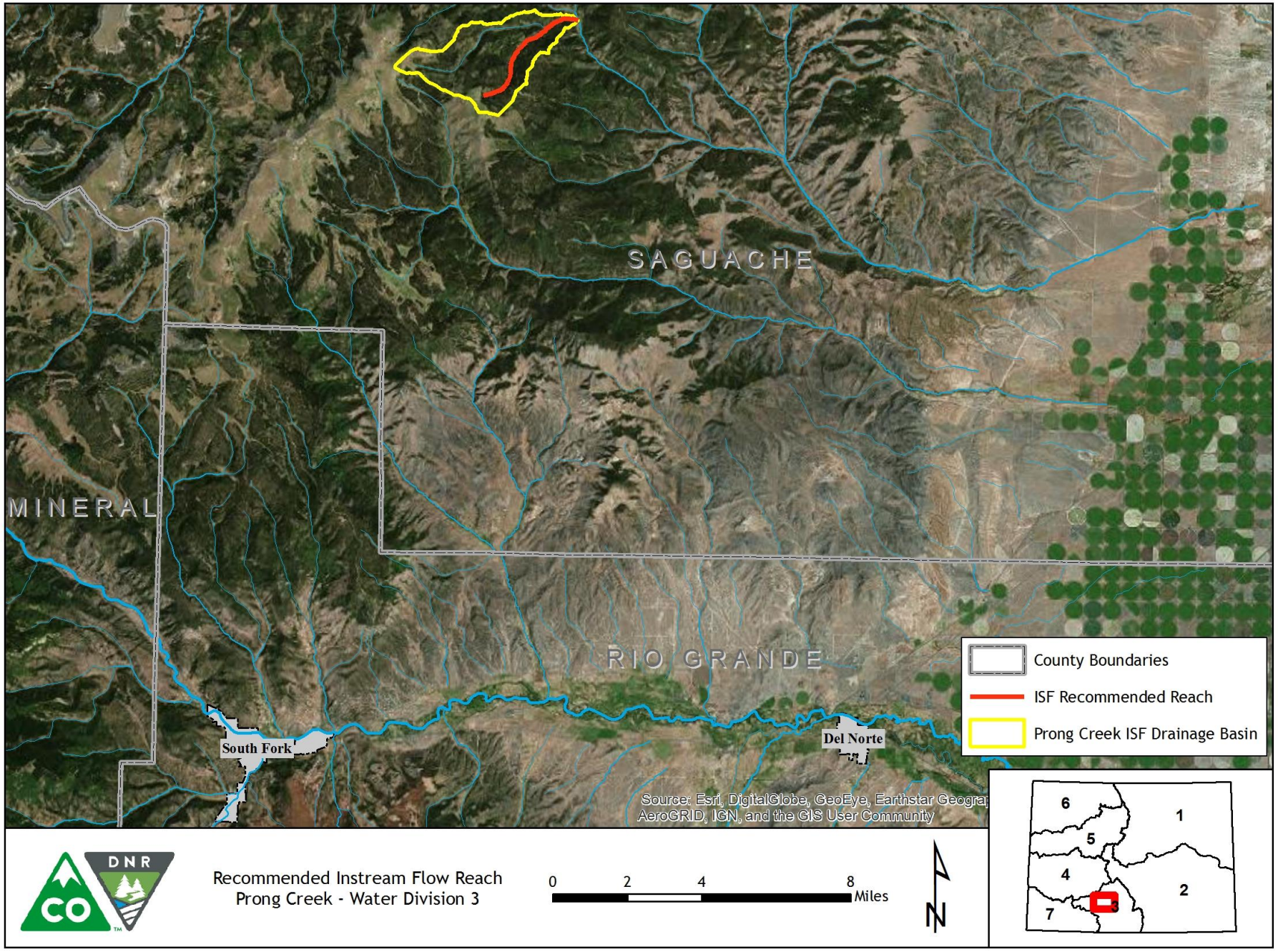
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

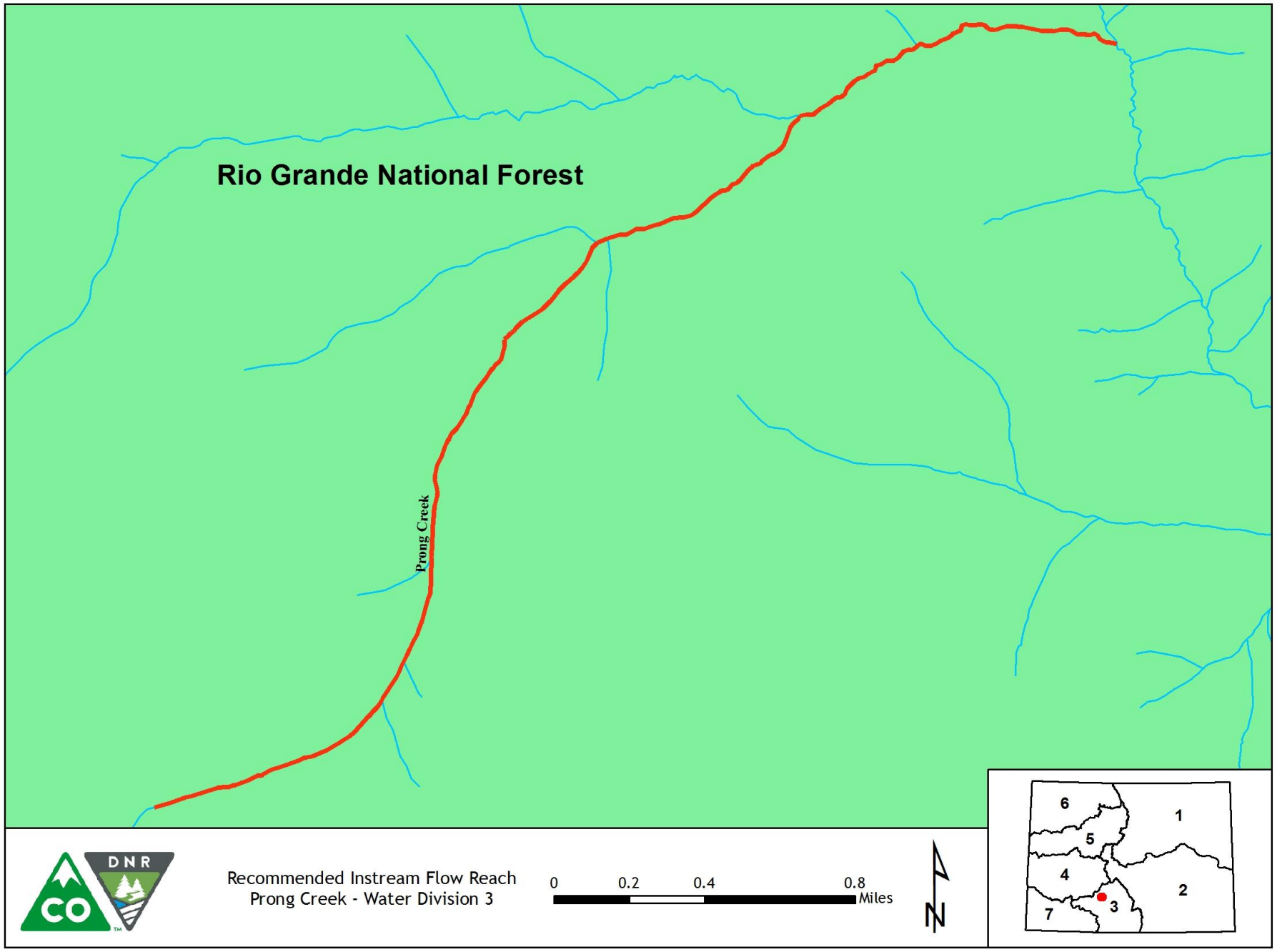
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

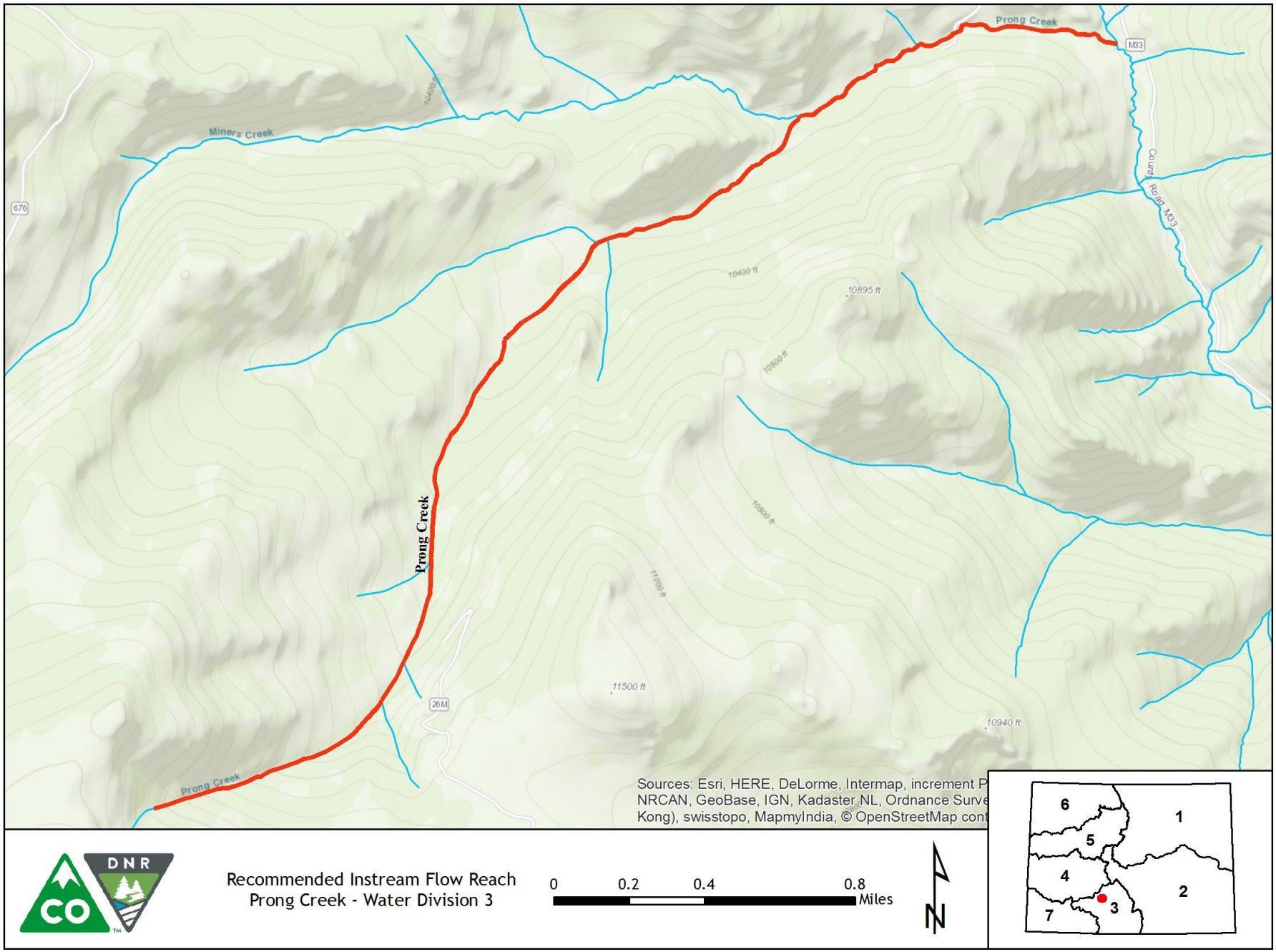
VICINITY MAP



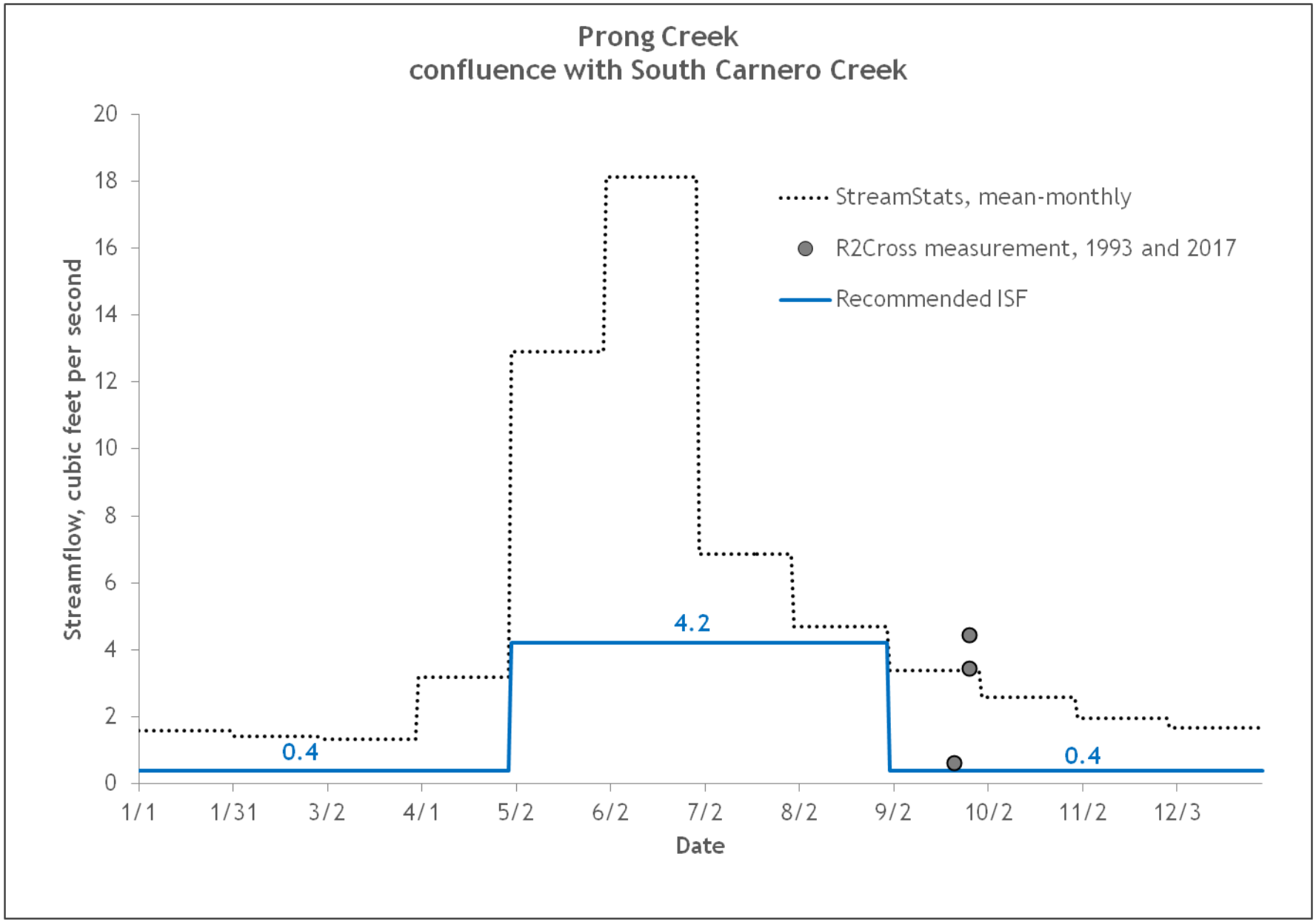
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP

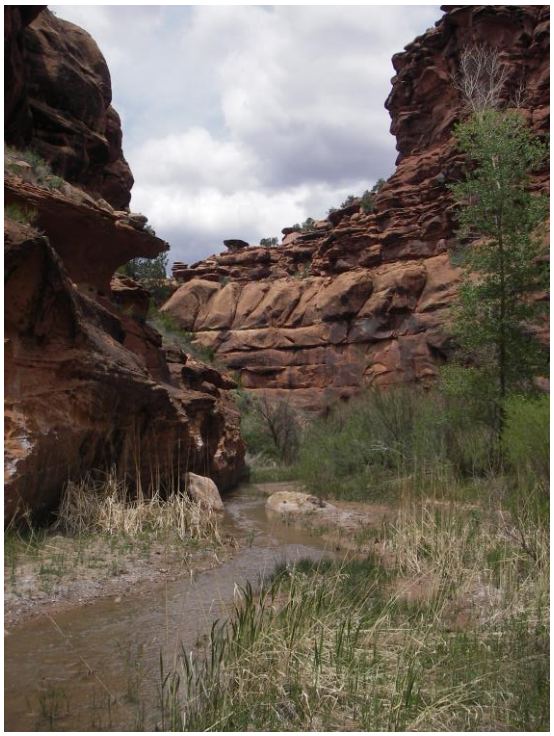


COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Coyote Wash
EXECUTIVE SUMMARY



CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Colorado/Utah Stateline UTM North: 4236977.92 UTM East: 145400.51
LOWER TERMINUS:	Confluence with the Dolores River UTM North: 4238974.99 UTM East: 154771.65
WATER DIVISION:	4
WATER DISTRICT:	61
COUNTY:	Montrose
WATERSHED:	Upper Dolores
CWCB ID:	18/4/A-001
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	10.48 miles
FLOW RECOMMENDATION:	0.8 cfs (09/01 - 02/29) 2.2 cfs (03/01 - 08/31)

Coyote Wash

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 Bureau of Land Management (BLM) recommended that the CWCB appropriate an ISF water right on a reach of Coyote Wash. Coyote Wash originates in Lisbon Valley and the southern slope of the La Sal Mountains in Utah. At the Colorado/Utah Stateline, Coyote Wash has an elevation of approximately 6,900 feet. It flows in a northeasterly direction for about ten miles and joins the Dolores River at an elevation of approximately 5,500 feet. The proposed reach covers the entire reach of Coyote Wash in Colorado from the Colorado/Utah Stateline downstream to the confluence with the Dolores River. This proposed reach is entirely located within Montrose County (See Vicinity Map). The BLM owns and manages one hundred percent of the land on which the 10.48 mile proposed reach is located, with approximately eighty percent located in the Dolores River Canyon Wilderness Study Area (See Land Ownership Map). The BLM recommended this reach of Coyote Wash because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Coyote Wash is a warm-water, low to moderate-gradient stream in a narrow canyon less than 0.25 mile wide. The stream is typically wide and shallow, with limited vegetative cover. Substrate size is highly variable, ranging from sand to 3-foot diameter boulders. Bank stability is generally good because the stream is confined in most locations by bedrock.

Fishery surveys indicate that Coyote Wash supports sand shiners, fathead minnows, and red shiners. One survey documented use of Coyote Wash by roundtail chub, but native species have not been consistently found in the creek. Intensive macroinvertebrate surveys have not been performed, but spot surveys have documented abundant midges, craneflies, damselflies, and mayflies. Surveys have also documented use of Coyote Wash by red spotted toads and Woodhouse's toads.

Very high flow events driven by thunderstorms limit the extent and vigor of the riparian community. The riparian community is comprised of coyote willow, giant reeds, bulrushes, Baltic rush, sedges, Fremont cottonwood, reed grass, and tamarisk.

Table 1. List of species identified in Coyote Wash.

Species Name	Scientific Name	Status
fathead minnow	*Pimephales promelas*	None
red shiner	*Cyprinella lutrensis*	None
sand shiner	*Notropis stramineus*	None
speckled dace	*Rhinichthys osculus*	None
roundtail chub	*Gila robusta*	Federal - Sensitive Species State - Species of Greatest Conservation Need

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.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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 quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 (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 1.65 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 2.19 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

Table 2. Summary of R2Cross transect measurements and results for Coyote Wash.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	05/12/2010 # 1	1.12	0.45 - 2.80	1.65	2.19
BLM	05/12/2010 # 2	1.04	0.42 - 2.60	Out of range	Out of range
			Mean	1.65	2.19

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

2.2 cubic feet per second is recommended for the high temperature period from March 1 through August 31. This recommendation is driven by the average velocity criteria. This creek experiences consistently low flows during fall and winter, so it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows and monsoonal flows are available. This flow rate should also help maintain water in the rooting zone for the riparian community associated with this creek.

0.8 cubic feet per second is recommended for the base flow period between September 1 and February 29. This flow rate does not meet any of the instream flow criteria, but should provide sufficient flow to prevent pools from freezing during the winter. This flow rate reflects limited water availability in this watershed.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream

gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics

The drainage basin of the proposed ISF on Coyote Wash is 178 square miles, with an average elevation of 6,580 feet and average annual precipitation of 15.09 inches (See the Vicinity Map). Approximately 20% of the drainage basin is located in Colorado and two spring water rights were identified in this area. The remainder of the basin is located in Utah and has approximately 17.1 cfs in decreed surface water rights. At least one ditch appears to import water from headwater streams that would otherwise end up in West Coyote Wash, which drains westward to the Colorado River. The Coyote Wash basin supports agriculture and mining, among other uses. Hydrology is altered to some decree by water use within the basin.

Available Data

Coyote Wash does not have any current or historical gages and gage data in the region is very limited. Coyote Wash is also very remote, making data collection efforts difficult.

CWCB staff, the BLM, and the USGS each made one streamflow measurement on the proposed reach of Coyote Wash as summarized in Table 3.

Table 3. Summary of streamflow measurement visits and results for Coyote Wash

Visit Date	Flow (cfs)	Method
7/8/1981	1.2	unknown
4/22/2017	3.74	wading
6/10/2017	0.29	wading

Data Analysis

StreamStats provides the best available estimate of streamflow on Coyote Wash.

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 Coyote Wash 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. (2017), 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.

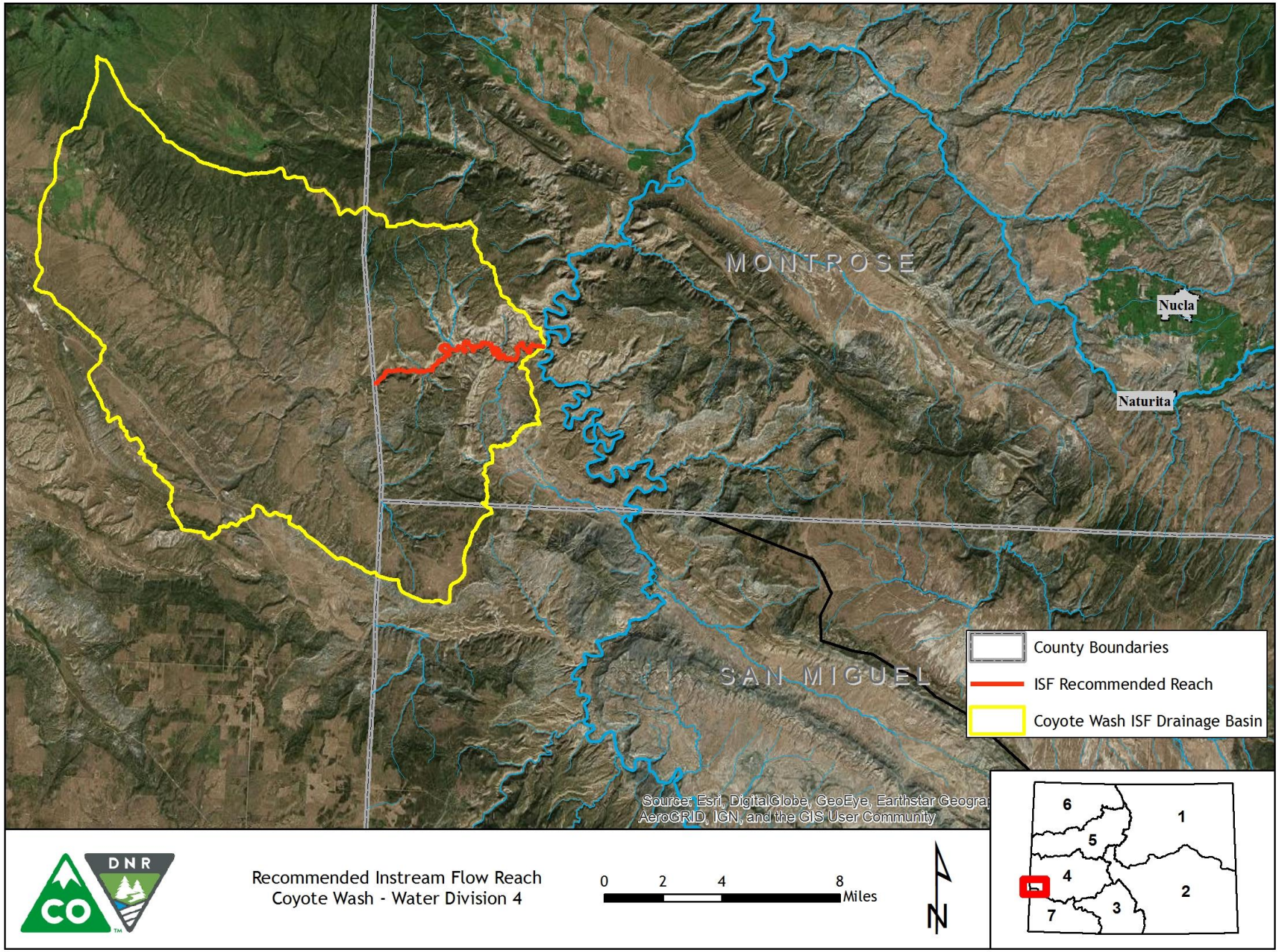
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

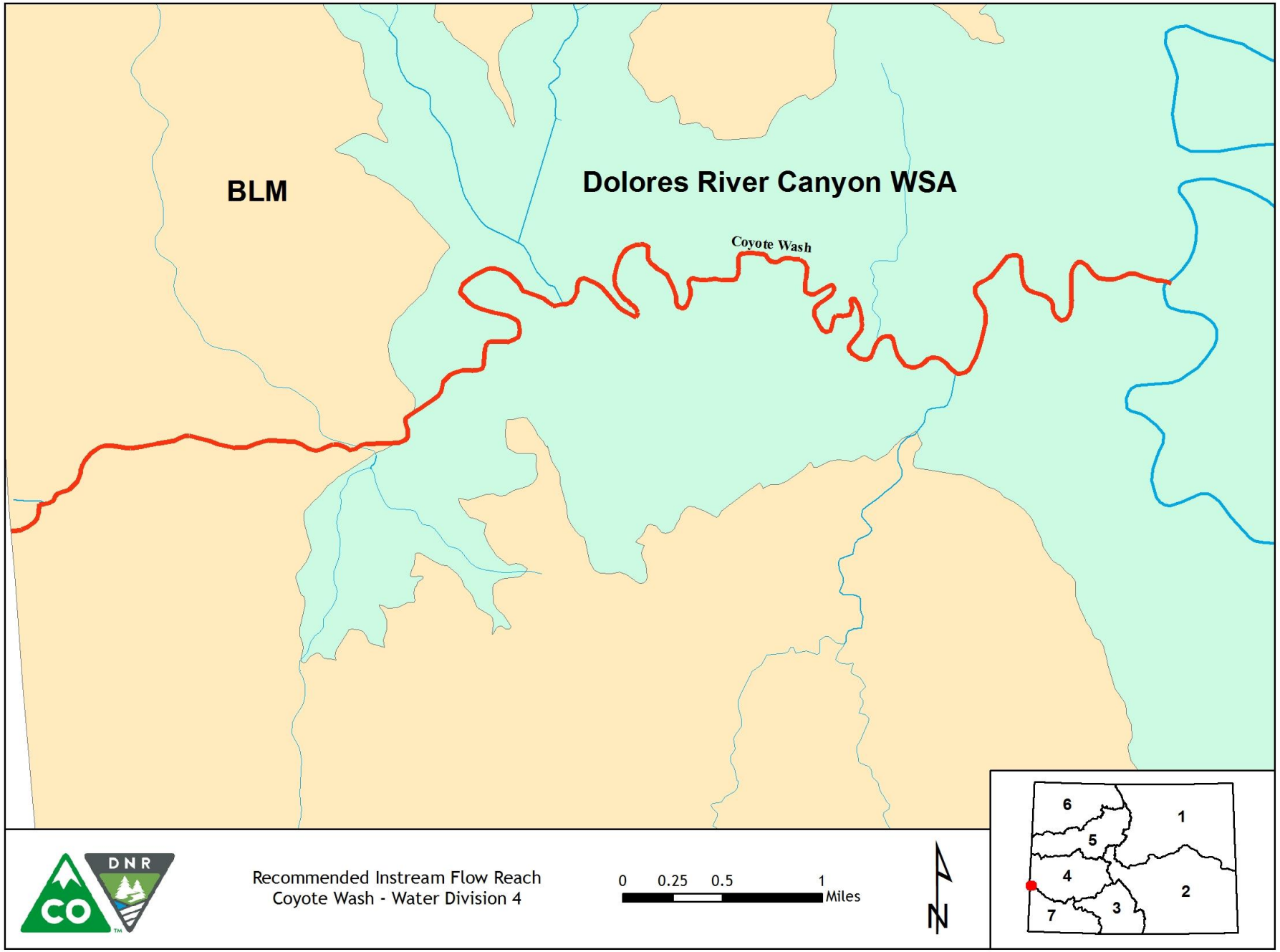
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

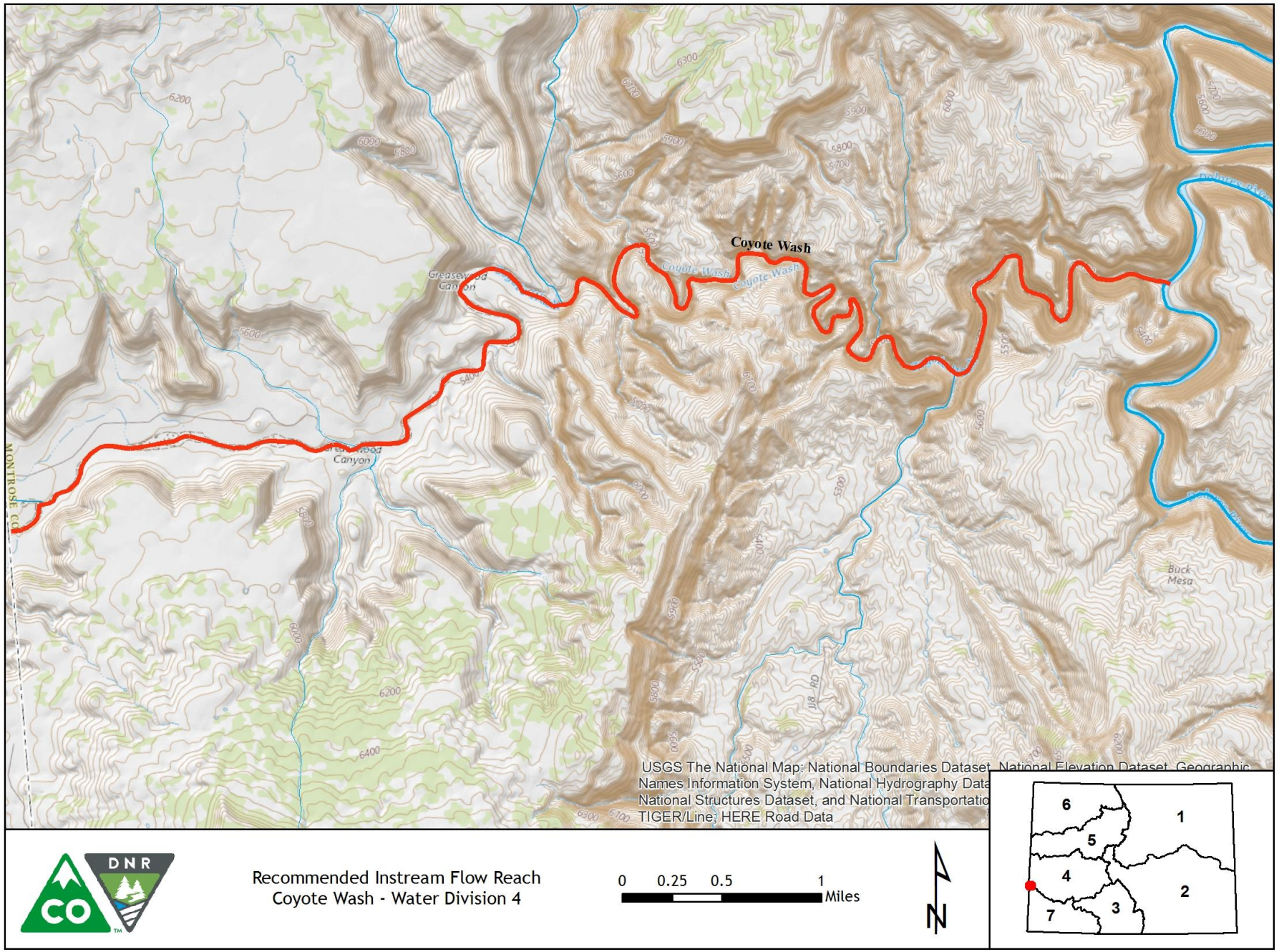
VICINITY MAP



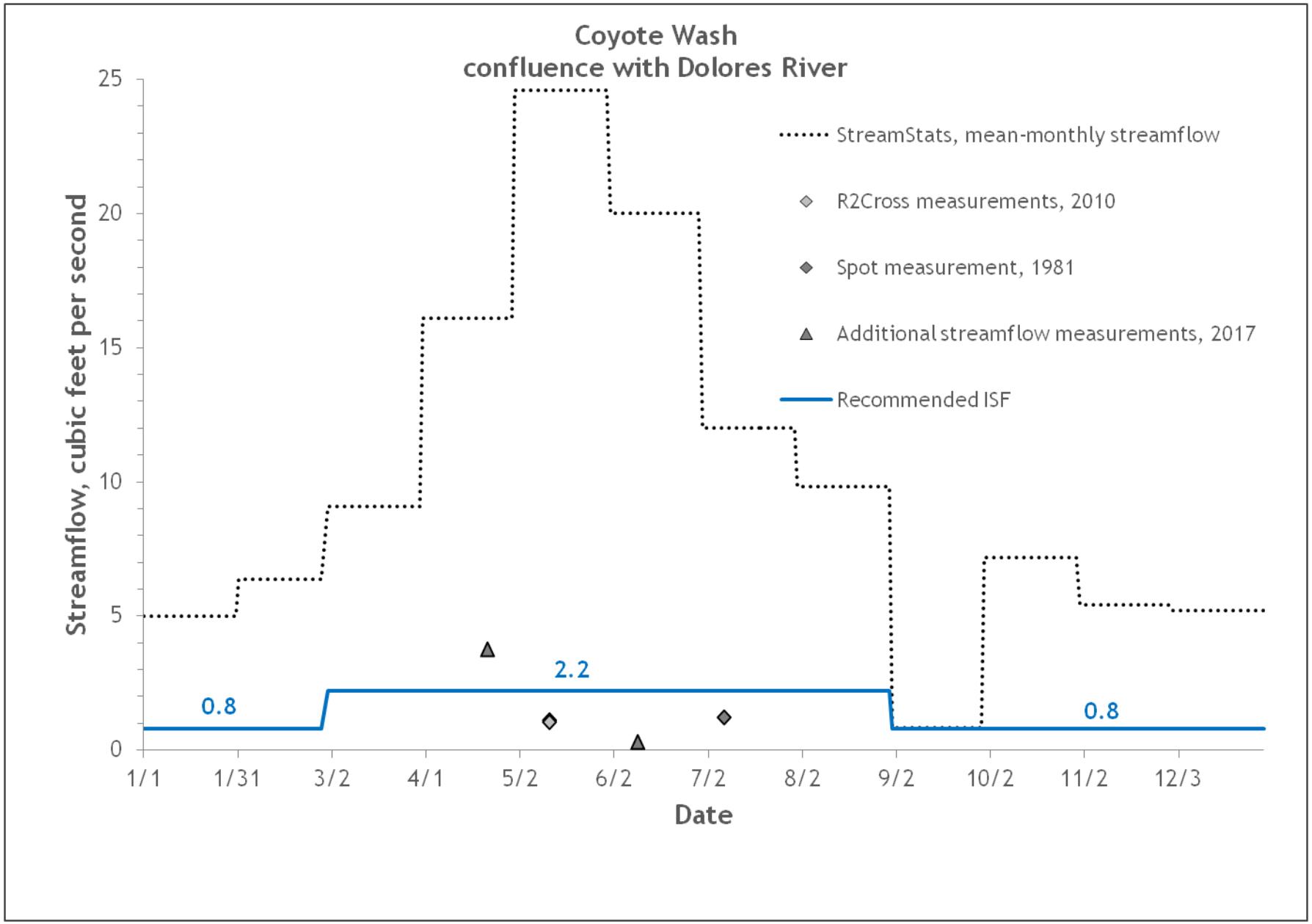
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Dutchman Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the vicinity of UTM North: 4242474.76 UTM East: 369063.00
LOWER TERMINUS:	Confluence with Owens Creek UTM North: 4251307.88 UTM East: 368109.13
WATER DIVISION:	4
WATER DISTRICT:	28
COUNTY:	Saguache
WATERSHED:	Tomichi
CWCB ID:	18/4/A-005
RECOMMENDER:	High Country Conservation Advocates (HCCA), Western Resource Advocates (WRA)
LENGTH:	6.78 miles
FLOW RECOMMENDATION:	0.94 cfs (04/01 - 08/31) 0.84 cfs (09/01 - 03/31)

Dutchman 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.

High Country Conservation Advocates (HCCA) and Western Resource Advocates (WRA) recommended that the CWCB appropriate an ISF water right on a reach of Dutchman Creek. Dutchman Creek originates at the top of the Continental Divide at an elevation of approximately 9,750 feet. It flows in a northwesterly direction for 6.78 miles before it joins Owens Creek at an elevation of approximately 8,440 feet. The proposed reach extends from Dutchman Creek's headwaters downstream to the confluence with Owens Creek, and is located within Saguache County (See Vicinity Map). The U.S. Forest Service owns and manages ninety-nine percent of the land on which the 6.78 mile proposed reach is located, with the remaining one percent privately owned (See Land Ownership Map). The HCCA, and WRA recommended this reach of Dutchman Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Dutchman Creek is a cold-water, high gradient stream located in western Saguache County. The stream generally has small-sized substrate consisting of fines, gravels, and small cobbles. There is a mixture of riffles and small pools.

Dutchman Creek supports a healthy aquatic ecosystem. U.S. Forest Service biologist Matt Dare and colleagues conducted stream sampling on Dutchman Creek in 2015. They identified a healthy brook trout population. Several fish (salmonids less than 6 inches) were also observed by Alpine Environmental Consultants during field reconnaissance and sampling in 2016 and 2017.

In addition to supporting a healthy aquatic ecosystem, flows in Dutchman Creek support a robust riparian area. The riparian community is substantial and composed of willow and alder. The riparian zone is in good condition and provides shade and cover for the extant fish community. There are some active and abandoned beaver ponds and extensive wet meadows alongside the creek.

Table 1. List of species identified in Dutchman Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	None

ISF Quantification
CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

Methodology
HCCA and WRA staff used the R2Cross methodology to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996). Riffles are most easily visualized as the stream habitat types that would dry up first should streamflow cease. The field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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, and WRA staff interpret the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides the biological quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 1 transect for this proposed ISF reach (Table 2). The R2Cross model results in a winter flow of 0.84 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 0.94 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
HCCA	07/14/2017 # 1	1.15	0.46 - 2.88	0.84	0.94
			Mean	0.84	0.94

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

0.84 cfs is recommended from September 1 to March 31 to protect biotic resources during winter months. This flow satisfies two of the three hydraulic criteria (50 percent wetted perimeter and average depth) at the assessed cross section.

0.94 cfs is recommended from April 1 to August 31 for the summer flow, which satisfies all three of the hydraulic criteria.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly

streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Dutchman Creek is 7.61 square miles, with an average elevation of 9,905 feet and average annual precipitation of 21.67 inches (See the Hydrologic Features Map). No active surface water diversions were identified in 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 Dutchman Creek. The nearest streamflow gage is the Razor Creek above Vouga Reservoir gage (RAZBGVCO). The gage is located approximately 8.9 miles southwest from the proposed lower terminus, with headwaters on the west side of Middle Baldy Peak. The gage record is 06/7/2004 to 8/15/2017; however, the gage operates seasonally from approximately early April to early November (personal communication Jack Brazinsky, Water Commissioner, 9/13/2017). Due to the seasonal nature of the gage and difficulties determining when the gage was operating and when it was not (streamflow is reported when the gage was not operated), this gage was not used to assess water availability on Dutchman Creek.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. There are no active diversion structures on Dutchman Creek, but there are some structures on Owens Creek, which Dutchman Creek joins at the lower terminus. A number of active surface water rights exist on Owens Creek, including the Hellmuth Ditch 1&2 (appropriated 1887, 1.62 cfs). This ditch appears to have two physical diversion points, one of which is located upstream from the confluence with Dutchman Creek and one is located downstream from the confluence. The diversion records for these two locations are combined in Hydrobase (personal communication Jack Brazinsky, Water Commissioner, 9/13/2017). Because the records have been combined, it is not possible to assess how much of the diverted flow comes from Dutchman Creek versus Owens Creek; therefore, the record has limited utility for water availability analyses.

CWCB staff made one streamflow measurements near the proposed reach of Dutchman Creek as summarized in Table 3. This measurement was made just downstream from the confluence with Owens Creek, which was contributing negligible streamflow.

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

Visit Date	Flow (cfs)	Collector
07/17/2017	0.79	CWCB

Data Analysis
StreamStats provides the best available estimate of streamflow on Dutchman 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 Dutchman 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. (2017), 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.

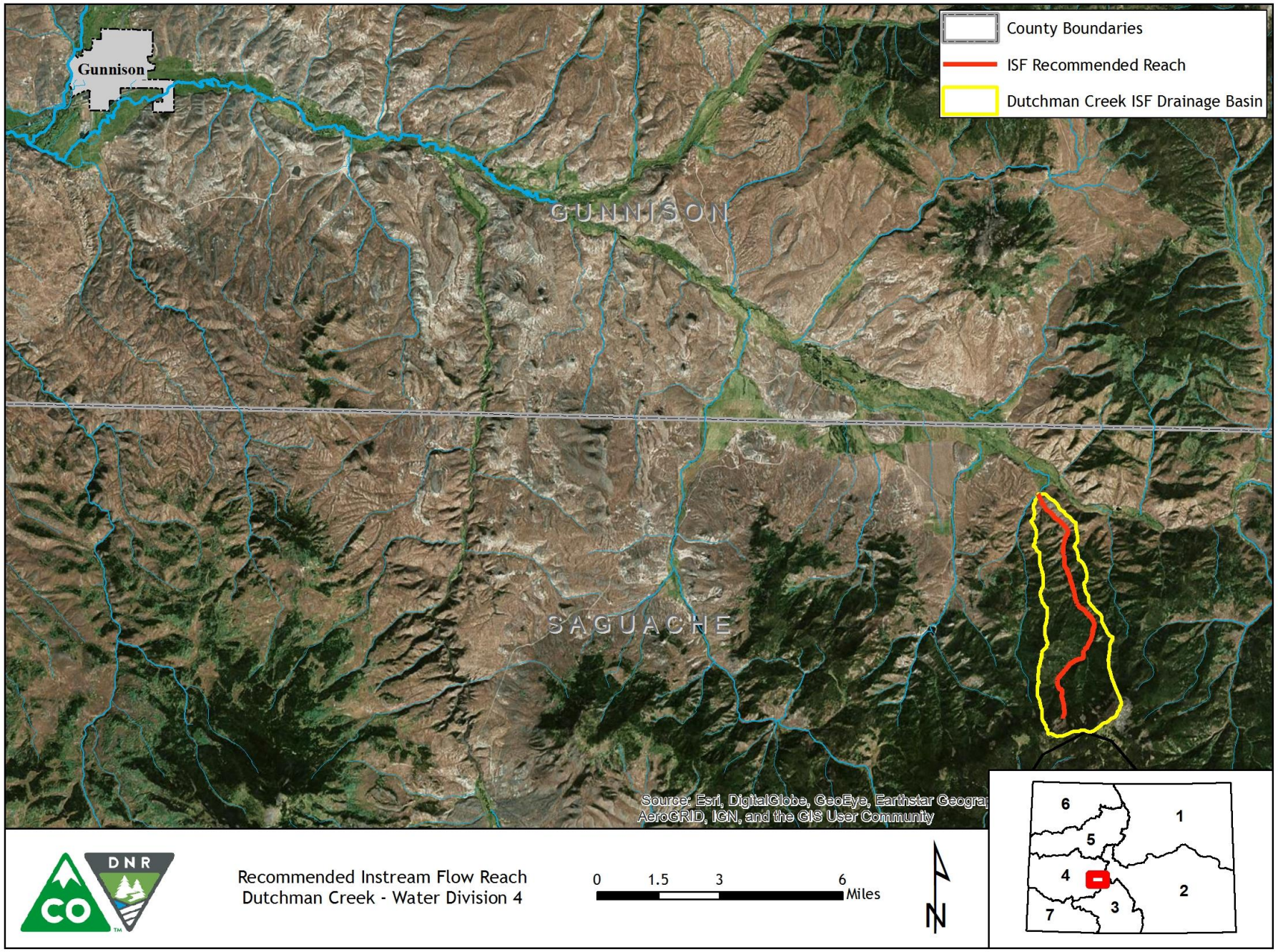
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

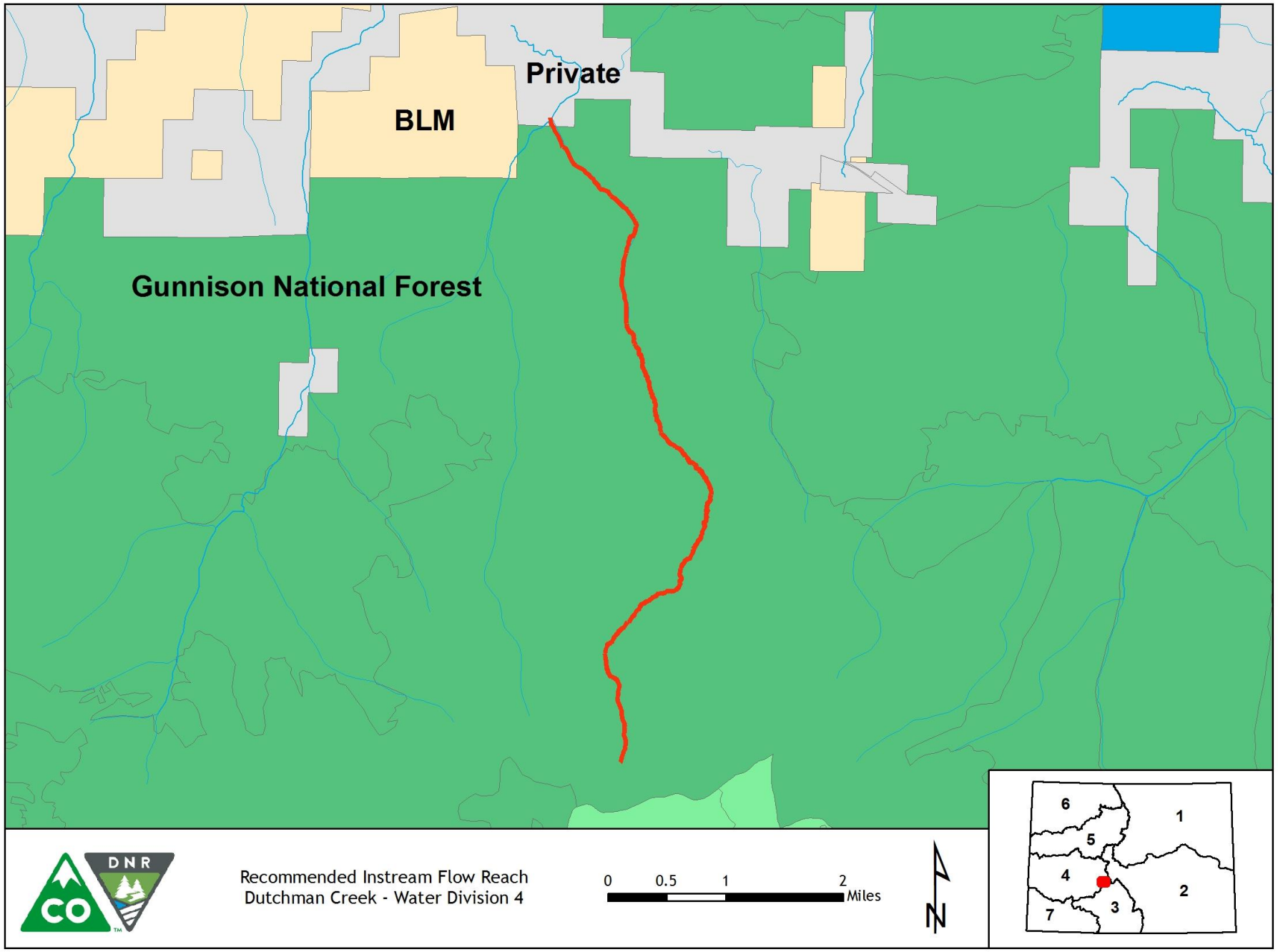
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

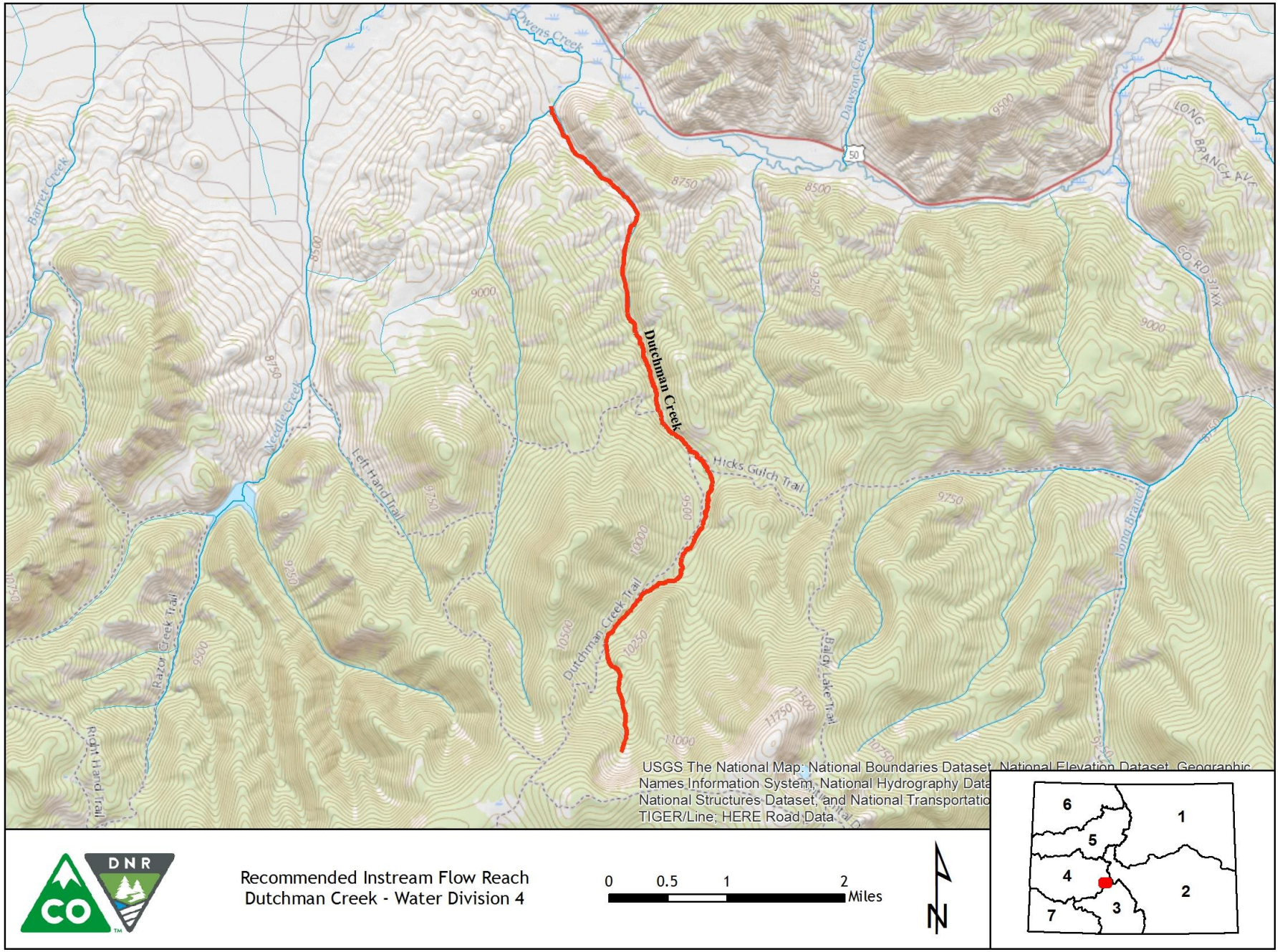
VICINITY MAP



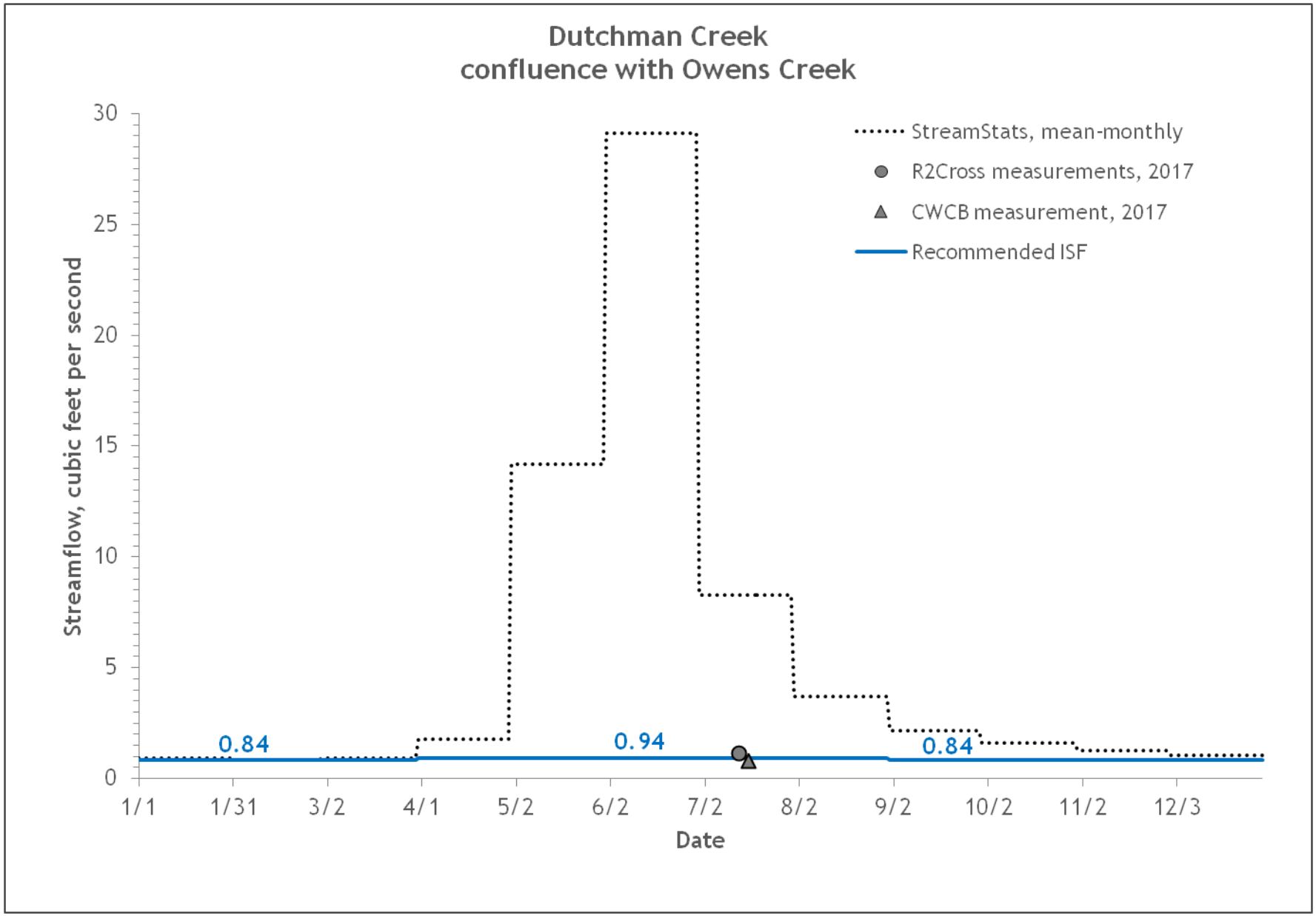
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Abrams Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the Vicinity of UTM North: 4383025.55 UTM East: 339836.18
LOWER TERMINUS:	Mrs. Paye Ditch Headgate UTM North: 4387351.32 UTM East: 343811.41
WATER DIVISION:	5
WATER DISTRICT:	37
COUNTY:	Eagle
WATERSHED:	Eagle
CWCB ID:	16/5/A-001
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	3.95 miles
Existing ISF:	80CW0118, 0.5 cfs (1/1 - 12/31)
FLOW RECOMMENDATION:	0.75 cfs (05/01 - 09/30)

Abrams 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 Bureau of Land Mangement (BLM) recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Abrams Creek. The CWCB currently holds an instream flow water right on Abrams Creek for 0.5 cfs (1/1-12/31), decreed in Case No. 80CW0118. This increased instream flow water right will help preserve the improved flow regime on Abrams Creek that will result from the implementation of the Abrams Creek project. The Abrams Creek project is an irrigation delivery efficiency project that has been facilitated by Trout Unlimited (TU) and partially funded by the CWCB.

Abrams Creek originates on the northeastern flank of Hardscrabble Mountain at an elevation of approximately 10,000 feet. It flows in a northeasterly direction for 5.5 miles as it drops to an elevation of approximately 6,670 feet where it joins Brush Creek. The proposed ISF reach extends from its headwaters downstream to the Mrs. Paye Ditch headgate, and is located within Eagle County (See Vicinity Map). The BLM owns and manages eighty-six percent of the land on which the 3.95 mile proposed reach is located, with the remaining fourteen percent privately owned (See Land Ownership Map). The BLM recommended this reach of Abrams Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Abrams Creek is a cold-water, high gradient stream. It flows through a narrow valley with a valley floor of up to one-fourth mile in width. The stream is often confined by bedrock, and the horizontal extent of alluvium along the stream is typically less than 100 feet. The stream generally has large substrate, typically consisting of cobbles and small boulder mixed with gravels. The stream also exhibits a large amount of woody debris in the stream channel, which adds to stream stability and habitat complexity. While riffle habitat is sufficient, Abrams Creek generally lacks extensive pool habitat, which could be a limiting factor for the fish population.

Fisheries surveys have revealed a self-sustaining population of native cutthroat trout. The Abrams Creek population is considered a Core Conservation population of pure Green-Lineage Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*). This is the only known aboriginal cutthroat population in the Eagle River watershed and is important with respect to future watershed planning and overall conservation efforts for the species. The population is small and limited in part by reduced water flow – primarily during irrigation season. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community is generally comprised of blue spruce and aspen in the higher elevation parts of the creek and is comprised of narrowleaf cottonwood and willow species in the lower elevation part of the creek. The riparian community is in very good condition, and provides adequate shading and cover for the fish habitat.

Table 1. List of species identified in Abrams Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	Federal – Sensitive Species State - Species of Greatest Conservation Need

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.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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 quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 7 transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 0.7 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 1.25 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	07/01/2013 # 1	0.87	0.35 - 2.18	0.75	1.71
BLM	07/01/2013 # 2	0.93	0.37 - 2.33	0.75	Out of range
BLM	07/01/2013 # 3	0.56	0.22 - 1.40	0.56	Out of range
BLM	07/01/2013 # 4	0.59	0.24 - 1.48	0.59	1.22
BLM	06/26/2014 # 1	1.56	0.62 - 3.90	Out of range	Out of range
BLM	06/26/2014 # 2	1.36	0.54 - 3.40	0.86	Out of range
BLM	06/26/2014 # 3	1.74	0.70 - 4.35	Out of range	0.83
			Mean	0.70	1.25

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

An increase of 0.75 cfs to the existing 0.5 cfs ISF water right is recommended from May 1 to September 30. The combined total of the two water rights would be 1.25 cfs. This recommendation is driven by the average velocity criteria. According to wetted perimeter criteria, this flow rate also makes a very high percentage of the physical habitat available for fish usage, such as spawning during the spring.

No recommendation is being requested at this time for the period October 1 to April 30 because insufficient water is available to support an increase.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Abrams Creek is 5.68 square miles, with an average elevation of 8,720 feet and average annual precipitation of 30.5 inches (See the Hydrologic Features Map). There is one surface water diversion near the top of the proposed ISF reach (JPO No 2 Ditch, 3 cfs, appropriation dates 1908 and 1916) which exports water out of the basin into Alkali Creek. The lower terminus is the Mrs Paye Ditch (3 cfs, appropriation dates 1899 and 1923). 0.8 cfs of the Mrs. Paye Ditch water right is senior to the JPO No 2 Ditch water right on Abrams Creek. The Mrs. Paye Ditch water right effectively brings 0.8 cfs through the proposed ISF reach. The JPO No 2 Ditch has the next priority water rights and can take the fully decreed 3 cfs before other Mrs Paye Ditch water rights are in priority again. No other active water rights are located within the proposed ISF reach.

Trout Unlimited has partnered with the owner of the JPO No 2 Ditch (Buckhorn Valley Metropolitan District #1) in an effort to increase streamflow in Abrams Creek to support the Colorado River cutthroat trout population. The Buckhorn Valley Metropolitan District #1 has agreed to leave 40% of all streamflow available at the JPO No 2 Ditch in the stream, and no less than 1.25 cfs in the stream. In exchange, Trout Unlimited will secure funding to build a pipeline that will increase the diversion efficiency of the JPO No 2 Ditch. The CWCB has funded portions of the pipeline through a Water

Supply Reserve Account Grant for the Abrams Creek Cutthroat Trout Project, of $45,000 from the Colorado Basin Account and $319,711 from the Statewide Account, and a Fish and Wildlife Resources Fund grant for $550,000. Mely Whiting, Trout Unlimited representative, indicated that all necessary funding has been secured and construction is expected to be completed in 2018 (personal communication, 12/8/2017).

Available Data

There are no current or historic streamflow gages on Abrams Creek or any nearby creeks that are representative of hydrology in Abrams Creek.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. Although the Mrs. Paye Ditch is located at the lower terminus, the diversion record has a large number of comments of "water taken but no data available" and "water available, but not taken." Data gaps and inconsistent use of a water right limit the usefulness of the diversion records to evaluate typical water availability.

According to Bill McEwen, Water Commissioner, an 18 inch Parshall flume was installed on Abrams Creek upstream from the JPO No 2 Ditch (personal communication 8/1/2017) and monitored by the Buckhorn Valley Metropolitan District #1. A pressure transducer was mounted in the flume and records are available from 2011 to present (David Graf, personal communication). The flume records are seasonal, typically starting in May and ending in late September or early October. This data was reviewed, but not used in the water availability analysis because the flume is not located near the lower terminus.

Due to limited available data near the lower terminus, CWCB staff installed a pressure transducer in a flume associated with the Mrs. Paye Ditch. This flume measured all of the flow in Abrams Creek near the lower terminus. The pressure transducer was installed on 6/13/2017 and was removed on 11/8/2017 for analysis. The pressure transducer recorded water depth every 15 minutes, which was converted to streamflow based on the standard equations for a 9 inch Parshall flume. It should be noted that the JPO No 2 Ditch is believed to have been operated in 2017, which would reduce the amount of water available recorded by this device. The data collected in the Mrs Paye Ditch flume was not relied upon for the water availability analysis due to the short period of data collection.

CWCB staff made 5 streamflow measurements on the proposed reach of Abrams Creek. These measurements are included in the water availability analysis and are summarized in Table 3.

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

Visit Date	Flow (cfs)	Collector
08/10/2016	0.90	CWCB
09/21/2016	0.65	CWCB
07/12/2017	1.23	CWCB
09/14/2017	1.06	CWCB
11/08/2017	1.26	CWCB

Data Analysis
StreamStats provides the best available estimate of streamflow on Abrams Creek.

Water Availability Summary
The hydrograph (See Complete and Detailed Hydrographs) show StreamStats results for mean-monthly streamflow. Changing irrigation practices based on the TU and Buckhorn Valley Metropolitan District #1 agreement would further support water availability on Abrams Creek. Staff has concluded that water is available for appropriation.

Material Injury
Because the proposed ISF on Abrams 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. (2017), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

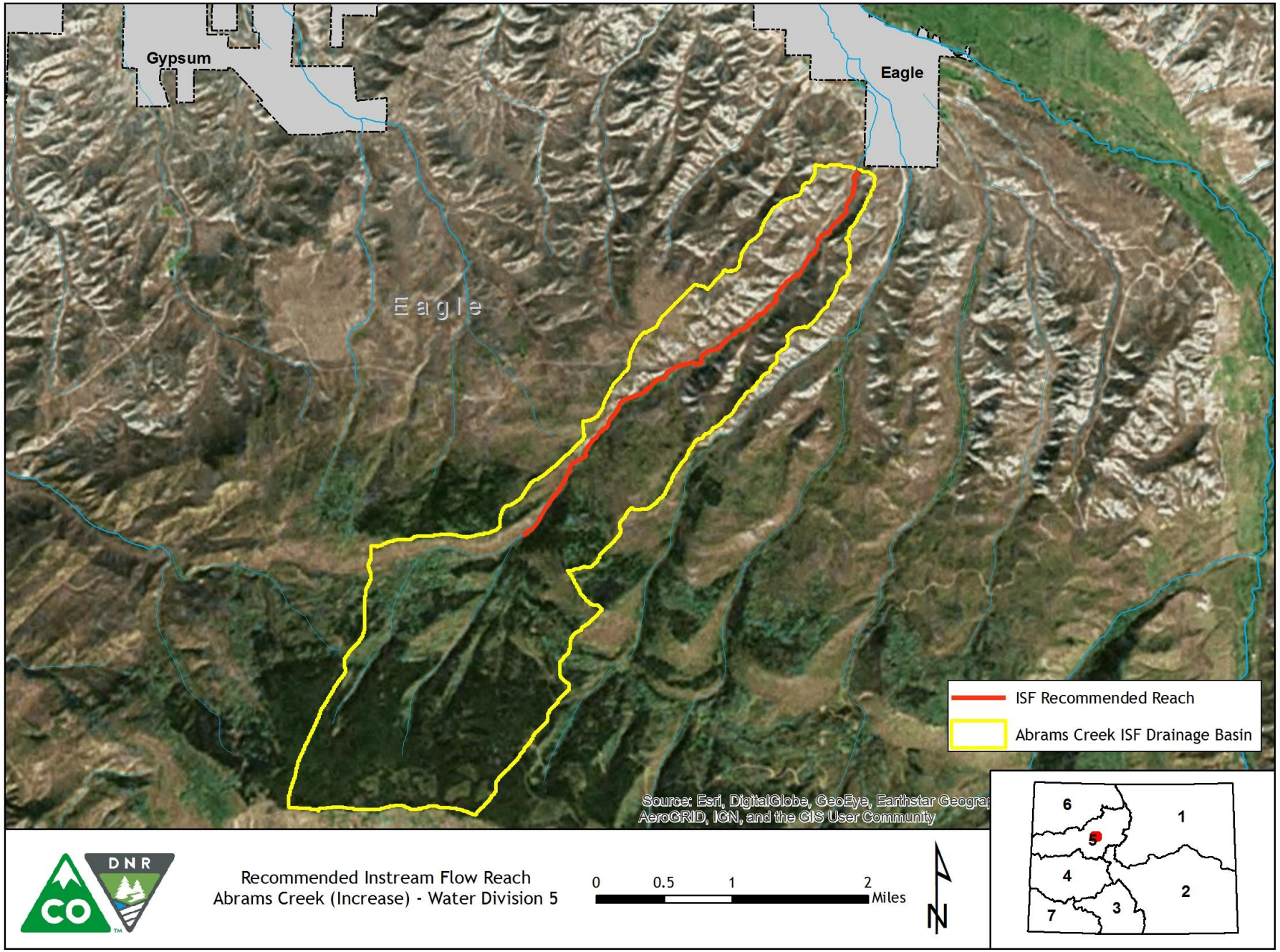
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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

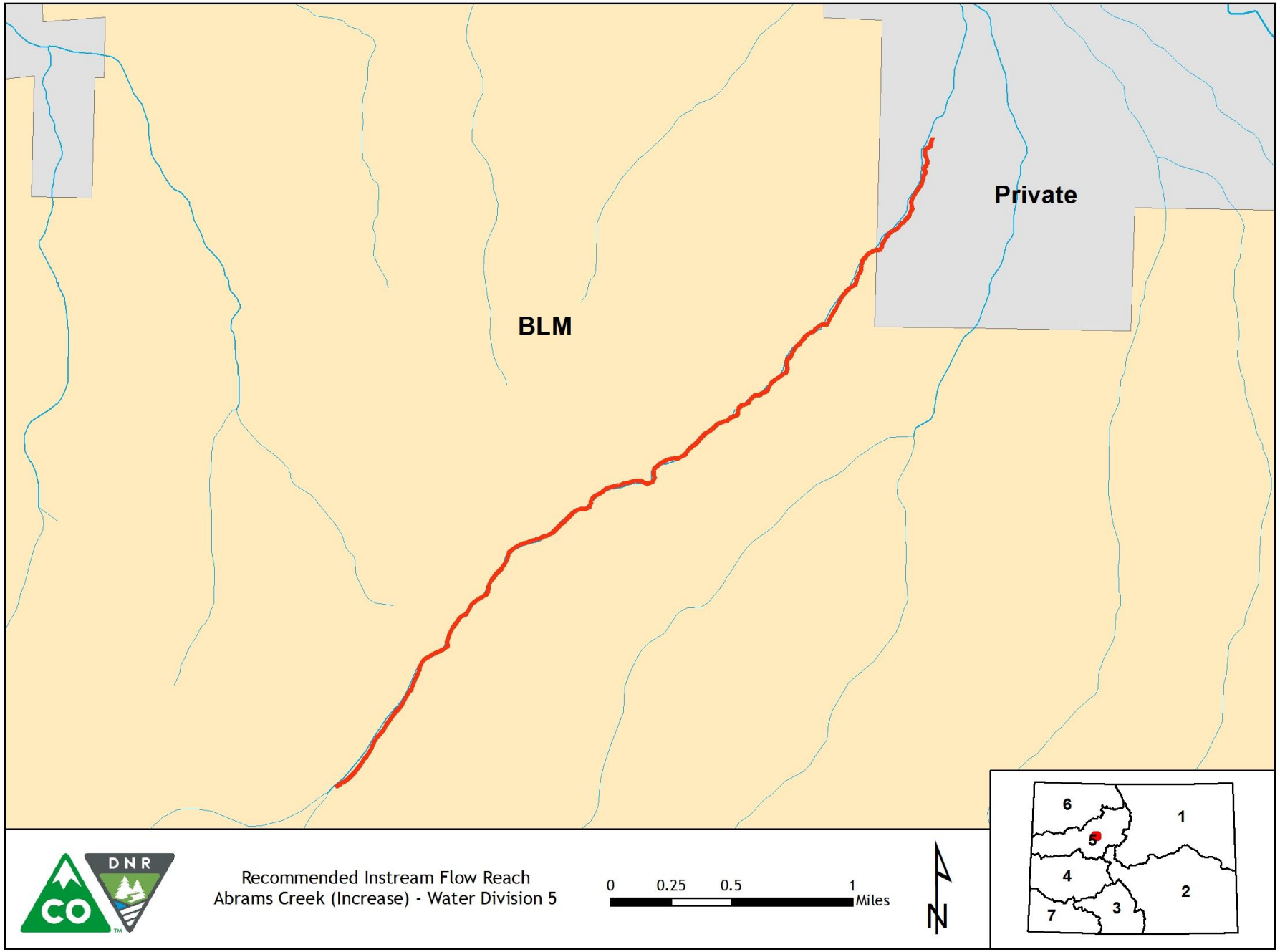
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

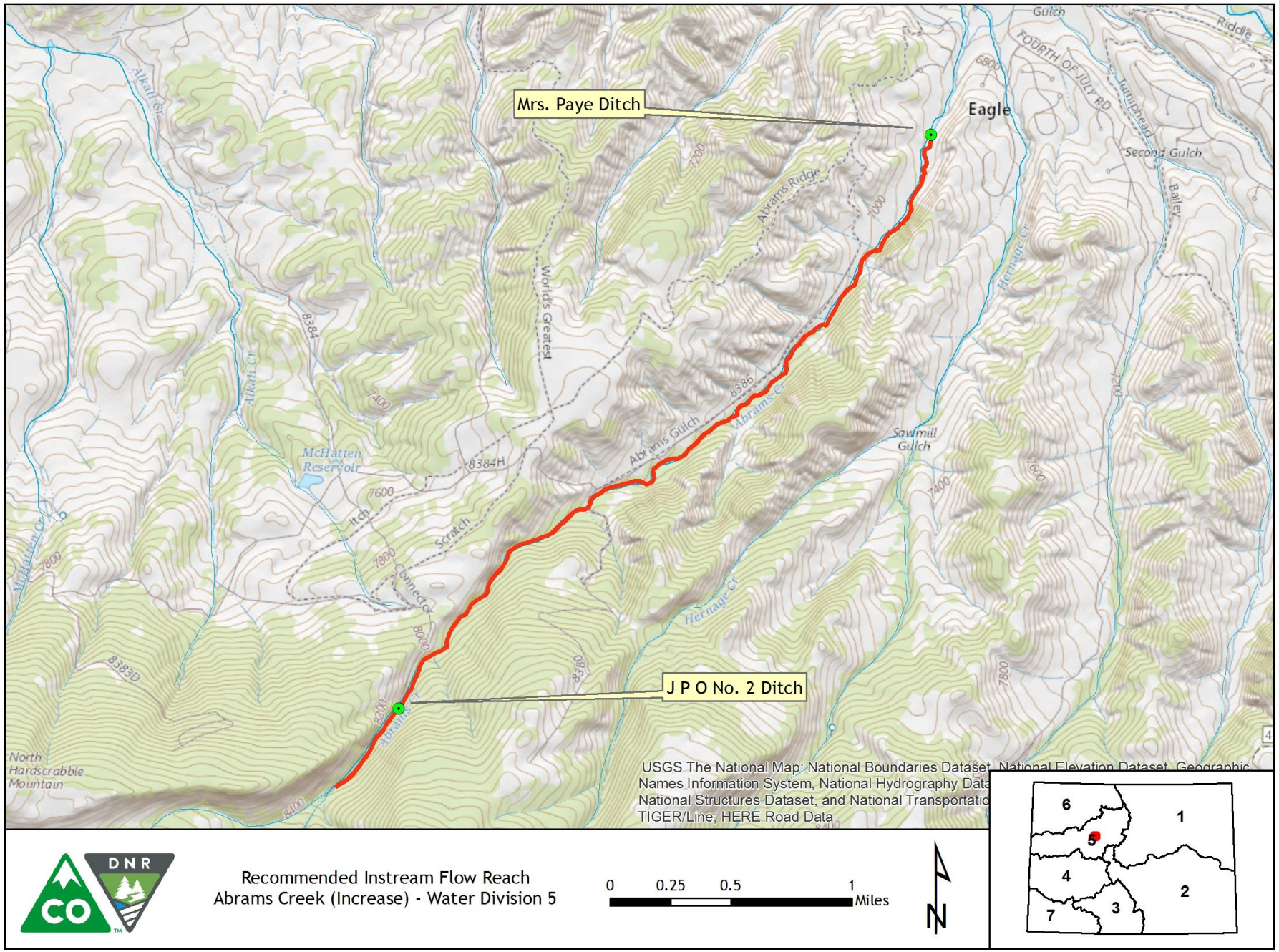
VICINITY MAP



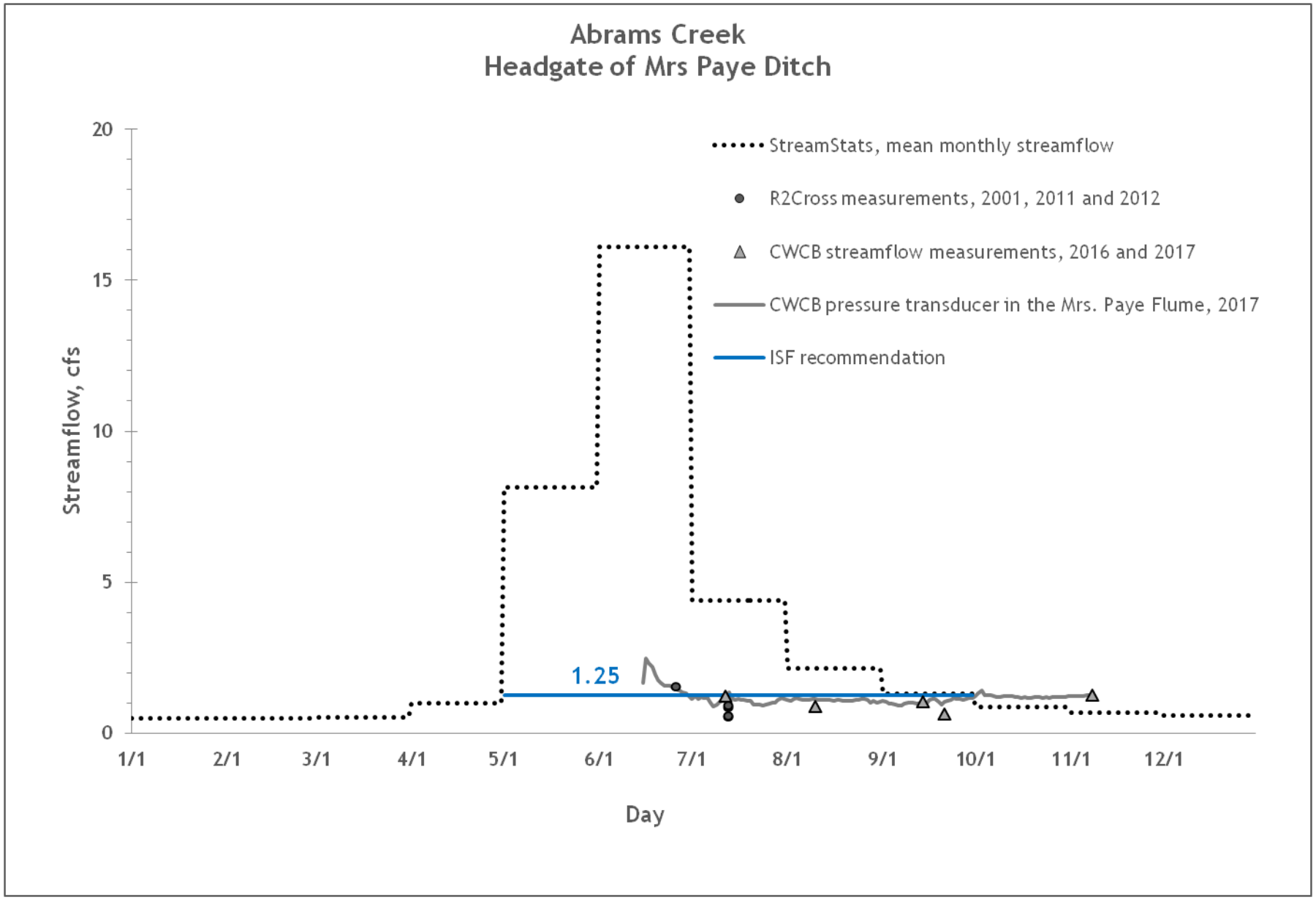
LAND OWNERSHIP MAP



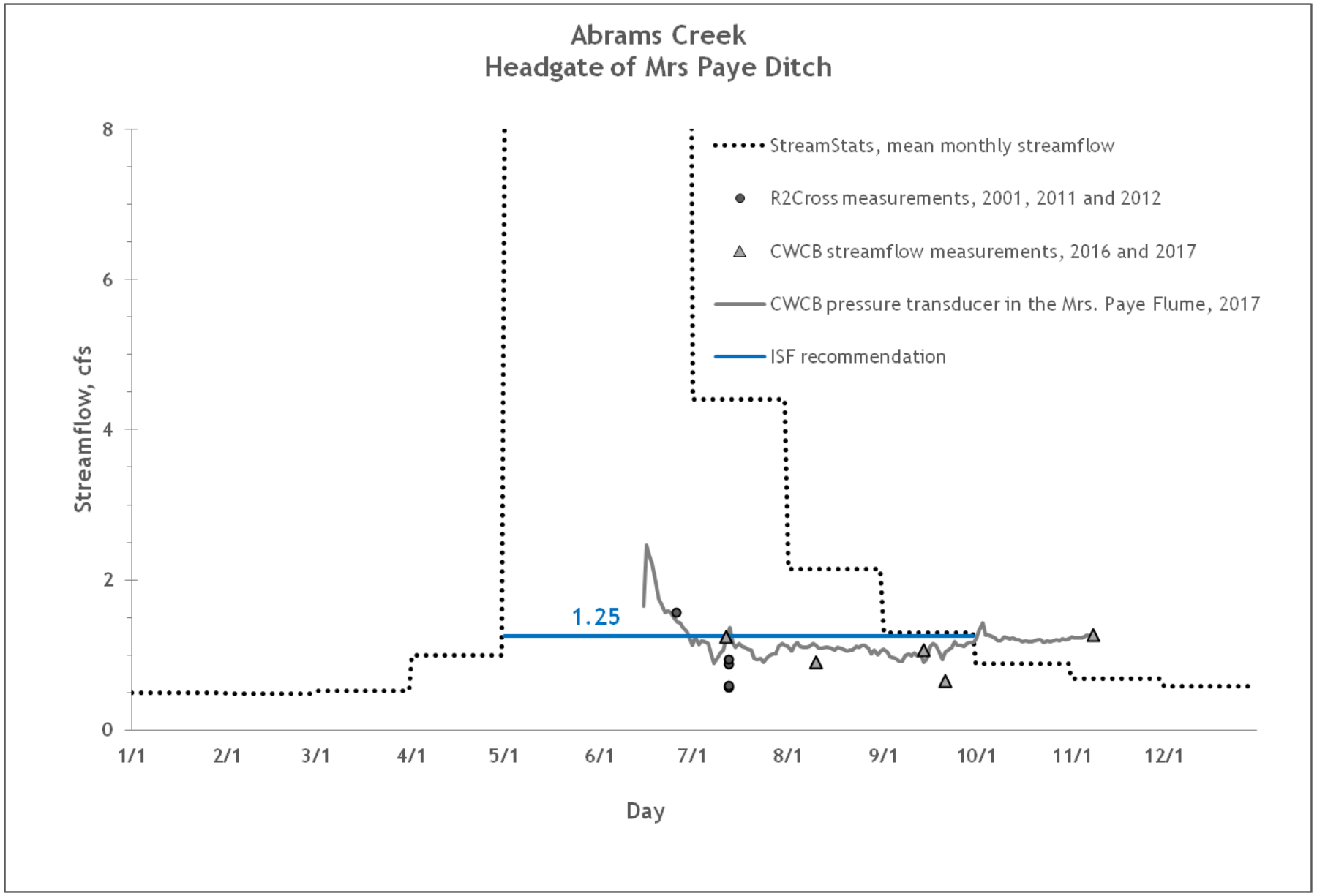
HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Douglas Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Confluence of East & West Douglas Creeks UTM North: 4418708.38 UTM East: 181274.73
LOWER TERMINUS:	Confluence with White River UTM North: 4444930.57 UTM East: 177669.10
WATER DIVISION:	6
WATER DISTRICT:	43
COUNTY:	Rio Blanco
WATERSHED:	Lower White
CWCB ID:	18/6/A-001
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	26.29 miles
FLOW RECOMMENDATION:	2.7 cfs (03/16 - 06/15) 1.7 cfs (06/16 - 06/30)

Douglas 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 Bureau of Land Management (BLM) recommended that the CWCB appropriate an ISF water right on a reach of Douglas Creek. Douglas Creek originates at the confluence of East and West Douglas Creeks at an elevation of approximately 5,980 feet. It flows in a northerly direction for 26.69 miles until it joins the White River at an elevation of approximately 5,280 feet. The proposed reach extends from the confluence of East and West Douglas Creeks downstream to the confluence with the White River. The entire proposed reach is located within Rio Blanco County (See Vicinity Map). The BLM owns and manages eighty-nine percent of the land on which the 26.29 mile proposed reach is located, with the remaining eleven percent privately owned (See Land Ownership Map). The BLM recommended this reach of Douglas Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Douglas Creek is a moderate gradient stream in a canyon with variable widths. In some locations, there is sufficient width in the canyon bottom for the stream to meander over time. In other locations, stream movement is confined by bedrock. As such, the stream has a stable channel but has a variable substrate size, ranging from gravels to six-inch cobbles. The stream has abundant run and pool habitat, but very limited riffle habitat. Water quality, water temperatures, and food sources are suitable for native species, but very low flows during certain portions of the year limit fish abundance and do not allow for a wide distribution of age classes.

Fishery surveys indicate that the creek supports self-sustaining populations of speckled dace. In addition, the creek environment supports occurrences of northern leopard frog, a BLM sensitive species.

The creek supports a riparian community comprised of willows, sedges, and rushes, but the tamarisk population is extensive. The riparian community has been impacted by historic grazing practices but is recovering.

Table 1. List of species identified in Douglas Creek.

Species Name	Scientific Name	Status
speckled dace	*Rhinichthys osculus*	None
northern leopard frog	*Rana pipiens*	Federal - Sensitive Species State - Species of Greatest Conservation Need

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.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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 quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 (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 1.79 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 2.69 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	04/23/2015 # 1	4.84	1.94 - 12.10	2.15	2.80
BLM	04/23/2015 # 2	4.00	1.60 - 10.00	Out of range	2.16
BLM	06/28/2016 # 1	3.41	1.36 - 8.53	1.43	2.25
BLM	06/28/2016 # 2	3.87	1.55 - 9.68	Out of range	3.55
			Mean	1.79	2.69

ISF Recommendation

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

2.70 cubic feet per second is recommended from March 16 to June 15. In most of the cross sections collected, the recommended flow rates are driven by the average depth and average velocity criteria. Protecting average velocity for spawning habitat is important because many portions of this reach that are suitable for spawning are low gradient. Because some portions of this reach have high width-to-depth ratio, it is also important to maintain sufficient depth for fish passage. BLM believes that maintaining 2.70 cfs will maintain acceptable physical habitat characteristics over a wide variety of riffle widths.

1.70 cubic feet per second is recommended from June 16 to June 30. This recommendation is driven by limited water availability. The BLM believes that this flow rate will support passage by fish that are exiting the creek to the White River before the creek typically dries up during July.

No recommendation is made for the period between July 1 and March 15. Very limited runoff, combined with irrigation diversion in upstream locations, results in a dry stream channel in average to low water years.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics

The drainage basin of the proposed ISF on Douglas Creek is 426.00 square miles, with an average elevation of 6,940 feet and average annual precipitation of 16.30 inches (See the Hydrologic Features Map). The Douglas Creek basin supports agriculture, among other uses. There are less than 50 cfs in decreed absolute surface water diversions and 162 AF in storage in the basin. There are no known diversions within the recommended reach. Hydrology is altered to some degree by water use within the basin.

Available Data

There is not a current streamflow gage on the proposed reach of Douglas Creek. Douglas Creek had a historical gage located near the confluence with the White River approximately 0.6 miles upstream from the proposed lower terminus. The Douglas Creek near Rangley, CO gage (USGS 09306380) had two short periods of record, 10/1/1976 to 9/29/1978 and 3/9/1994 to 9/30/1995. The drainage basin of the gage is 425 square miles, with an average elevation of 6,940 feet and average annual precipitation of 16.3 inches. This gage is affected by diversion practices. There are no known intervening diversions between the gage location and the proposed lower terminus.

CWCB staff made no streamflow measurements on the proposed reach of Douglas Creek. Staff conducted a site visit on 7/7/2015 when flows were too high to measure safely.

Data Analysis

The USGS Douglas Creek gage record is very short, with typically just three or four measurements for any given day of the year. Other gages in the region were evaluated for potential regression extension of the record but none were found suitable.

The White River near Watson, UT gage (USGS 09306500) was used to evaluate streamflow conditions on a regional scale to better understand the data from the Douglas Creek gage. The White River gage is located approximately 23 miles downstream from the proposed lower terminus and has a long period of record, 1923 to present (with a 6-year gap between 1979 and 1985). Based on review of annual streamflow from the White River gage, the available data from the Douglas Creek occurred during 3 years classified as Very Dry (<25th percentile), one year classified as Wet Typical (50th to 75th percentile), and one year classified as Very Wet (>75th percentile). This data suggests that median streamflow calculated from the available record will underestimate typical conditions. Nevertheless, median was calculated based on the USGS approved data available through HydroBase on 5/1/2017. Insufficient data was available to calculate confidence intervals for median streamflow.

Water Availability Summary
The hydrographs (See Complete Hydrograph and Detailed Hydrograph) show median streamflow based on the Douglas Creek gage record. The proposed ISF rate is below the median streamflow at all times. Staff has concluded that water is available for appropriation.

Material Injury
Because the proposed ISF on Douglas 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. (2017), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

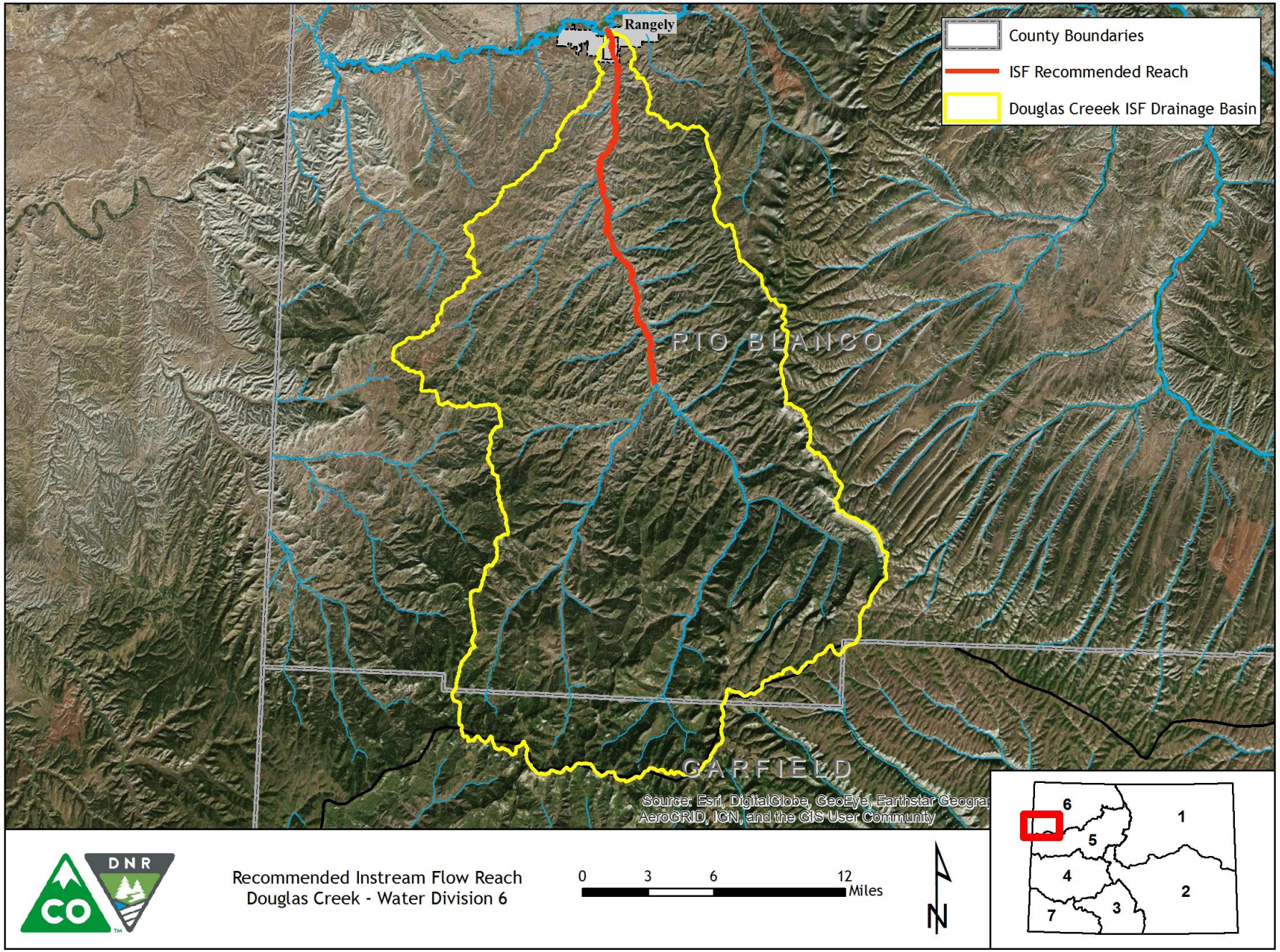
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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

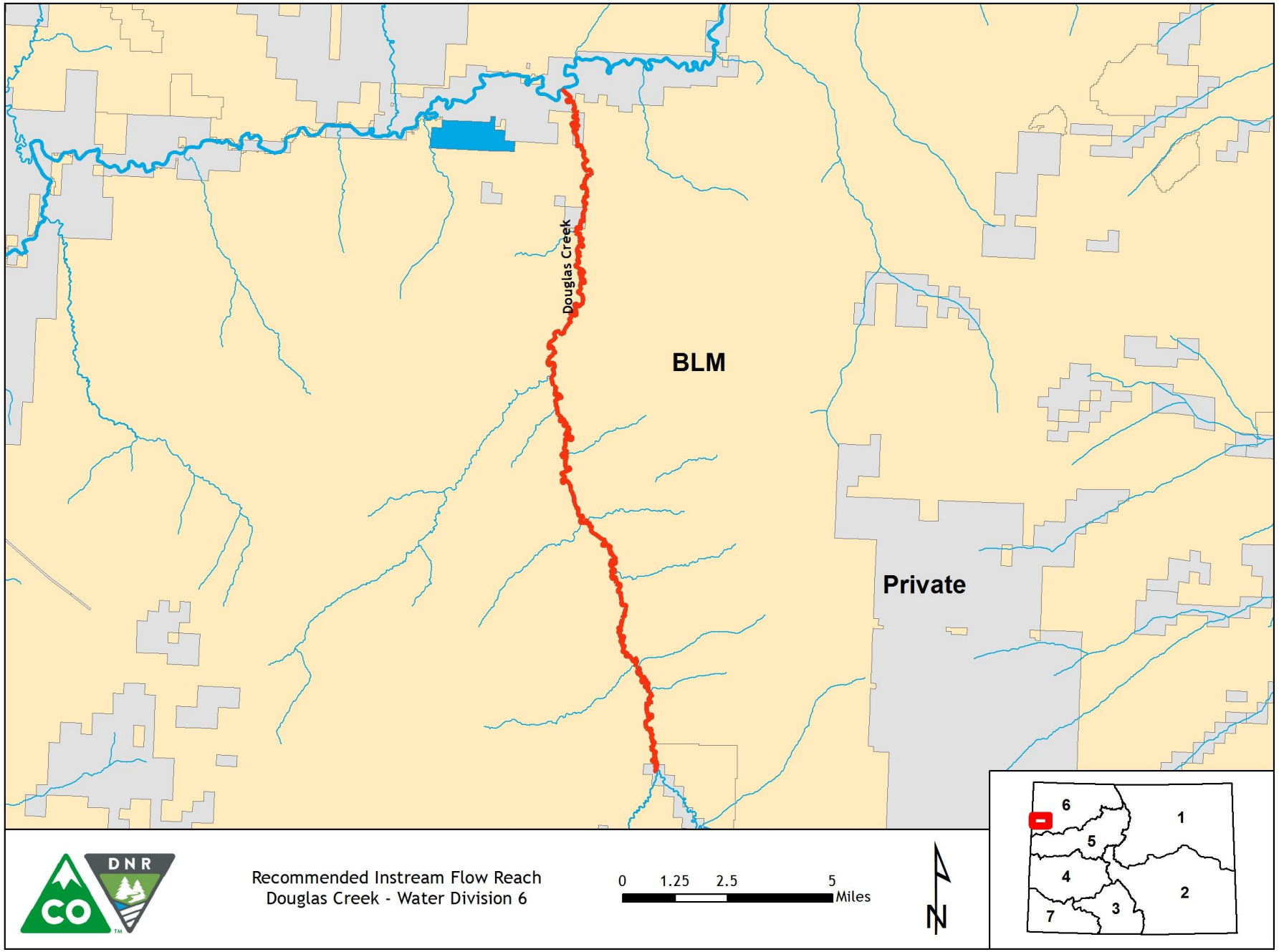
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

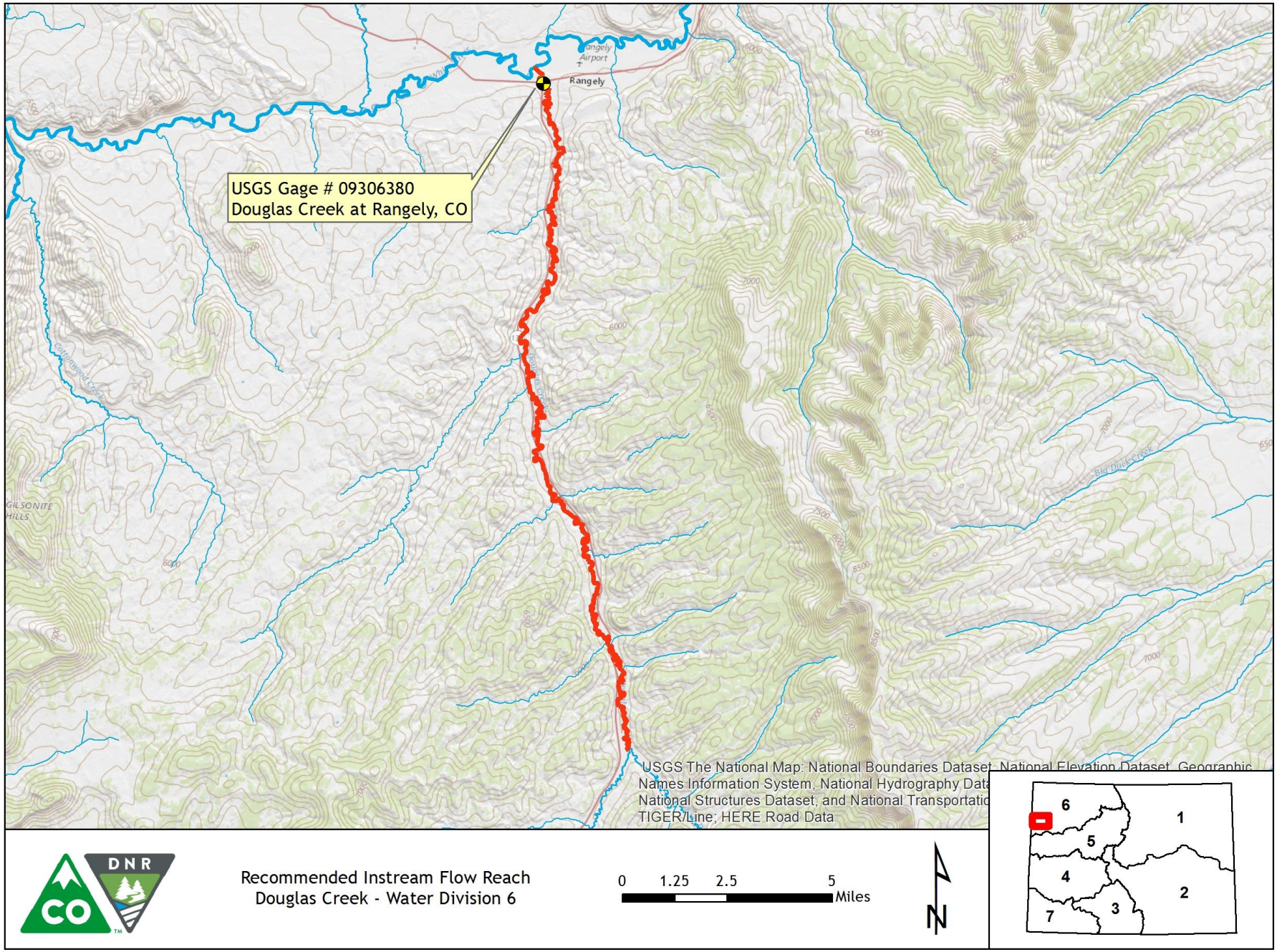
VICINITY MAP



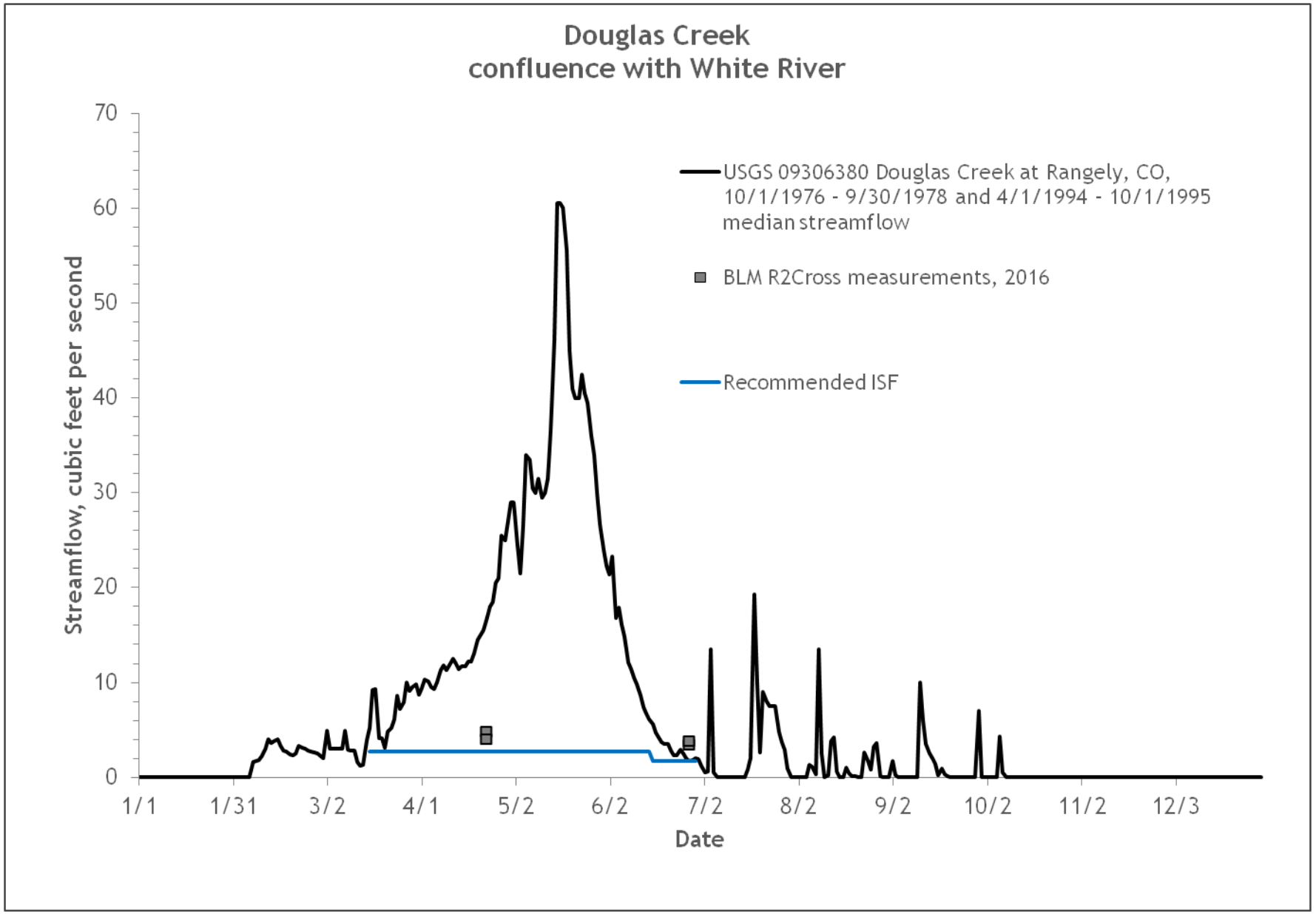
LAND OWNERSHIP MAP



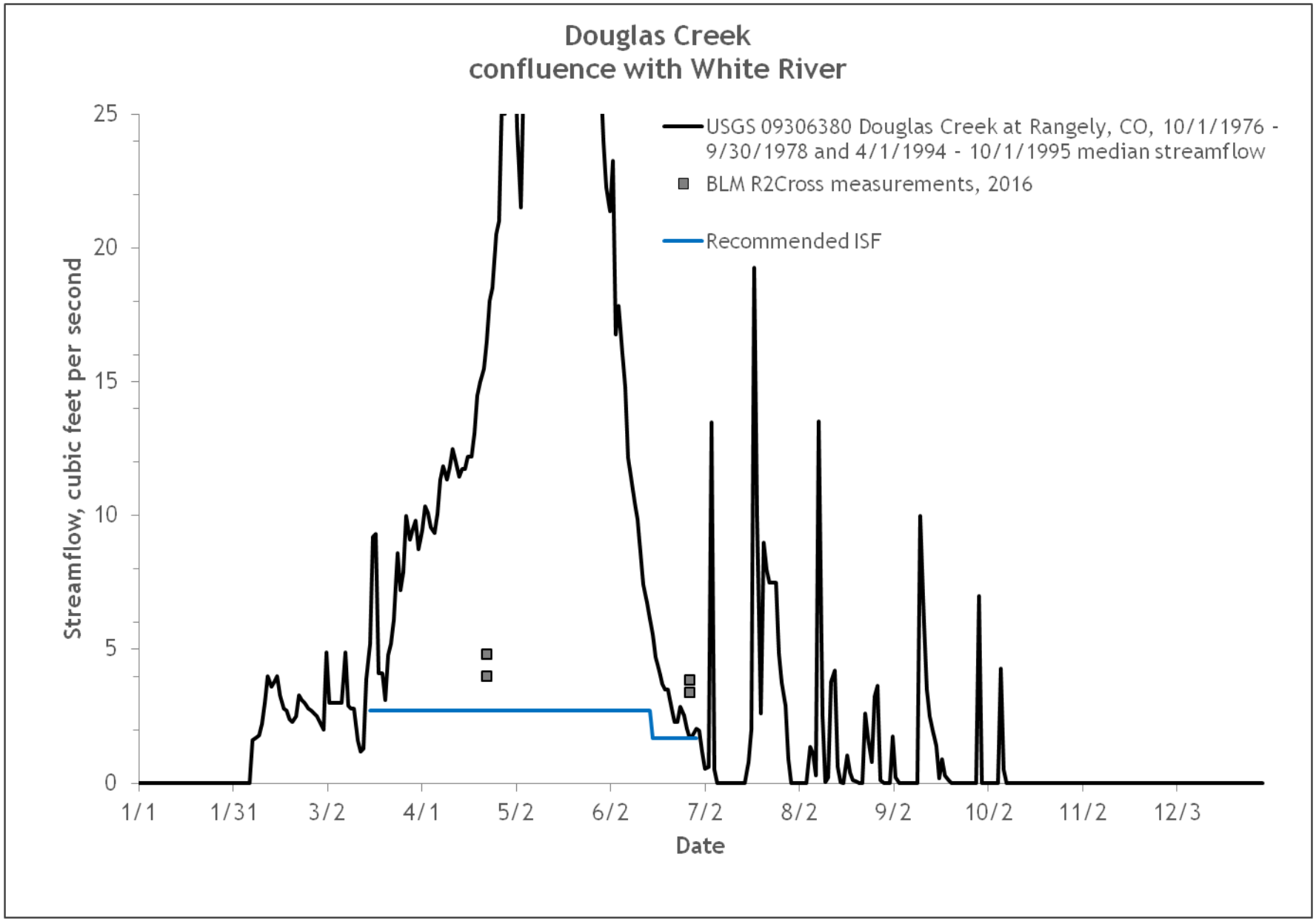
HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Hahn Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the Vicinity of UTM North: 4445142.66 UTM East: 285101.12
LOWER TERMINUS:	Confluence with Lost Creek UTM North: 4441691.21 UTM East: 290147.03
WATER DIVISION:	6
WATER DISTRICT:	43
COUNTY:	Rio Blanco
WATERSHED:	Upper White
CWCB ID:	18/6/A-003
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	4.71 miles
FLOW RECOMMENDATION:	0.75 cfs (11/01 - 04/30) 2.6 cfs (05/01 - 08/31) 1.6 cfs (09/01 - 10/31)

Hahn 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.

Colorado Parks and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Hahn Creek. Hahn Creek originates on the east flank of Sleepy Cat Peak in the White River National Forest at an elevation of approximately 10,080 feet. It flows in a southeasterly direction to an elevation of approximately 8,320 feet where it joins Lost Creek. The proposed ISF reach extends from its headwaters downstream to the confluence with Lost Creek and is located within Rio Blanco County (See Vicinity Map). The U.S. Forest Service owns and manages one-hundred percent of the land on which the 4.71 mile proposed reach is located (See Land Ownership Map). CPW recommended this reach of Hahn Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Hahn Creek has a high-value natural environment that supports a self-sustaining population of native Colorado River cutthroat trout. The Colorado River Cutthroat Trout Conservation Plan recognizes the importance of Hahn Creek as one Colorado's streams that contains a pure conservation population of this species. Hahn Creek was last sampled in August 2015, utilizing standard electrofishing techniques. The 2015 data shows multiple age classes (5 or more) of Colorado River cutthroat trout and a wide range of sizes from young of the year (1 inch) to 11 inch adults. Hahn Creek's natural environment also contains a diverse macroinvertebrate community and some beaver dam complexes in the headwaters.

Table 1. List of species identified in Hahn Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	Federal – Sensitive Species State - Species of Greatest Conservation Need

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.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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. However, the R2Cross model also contains the Thorne and Zevenbergen subroutine which uses field measured bed material grain size to estimate velocity. This method is not constrained by the accuracy range of the Manning's n subroutine.

The R2Cross methodology provides the biological quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 (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 1.55 cfs, which meets 2 of 3 criteria, and the R2Cross model results in a summer flow of 2.55 cfs, which meets 3 of 3 criteria.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW	08/23/2017 # 1	0.81	NA*	1.2	2.4
CPW	08/23/2017 # 2	0.98	NA*	1.9	2.7
			Mean	**1.55**	**2.55**

**Results calculated using the R2Cross Thorne-Zevenbergen subroutine*

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

2.6 cfs is recommended for the period of May 1 to August 31.

1.6 cfs is recommended for the period of September 1 to October 31.

0.75 cfs is recommended for the period of November 1 to April 30. This flow rate is needed for overwintering adults and juveniles. This recommendation is limited by water availability.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Hahn Creek is 3.44 square miles, with an average elevation of 9,634 feet and average annual precipitation of 34.63 inches (See the Hydrologic Features Map). There are two spring water rights in the basin tributary to this reach. These water uses appear to be small and hydrology is essentially natural.

Available Data
There is not a current streamflow gage on Hahn Creek, but there was a historical gage located on Lost Creek, downstream from the proposed ISF reach. The Lost Creek near Buford, CO gage (USGS 9302450) was located approximately 0.64 miles downstream from the proposed lower terminus. The gage had a continuous period of record from 10/1/1964 to 9/29/1989. The drainage basin of the Lost Creek gage is 21.6 square miles, with an average elevation of 8,971 feet and average annual precipitation of 30.3 inches. The gage is impacted by some additional spring water rights and the Lost Creek Ranger Station pipeline (0.1 cfs; appropriated 1891 and 1931).

CWCB staff made no streamflow measurements on the proposed reach of Hahn Creek, but did assist CPW in collecting field data.

Data Analysis
Staff conducted a site visit to Hahn Creek and observed that there was almost no perceptible flow associated with Lost Creek above the Hahn Creek confluence. In other words, Hahn Creek appeared to be contributing nearly all of the flow in Lost Creek. Based on this observation, it is not reasonable to prorate the Lost Creek gage to Hahn Creek because it will likely significantly underestimate streamflow. StreamStats provides the best available estimate of streamflow on Hahn 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 Hahn 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. (2017), 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.

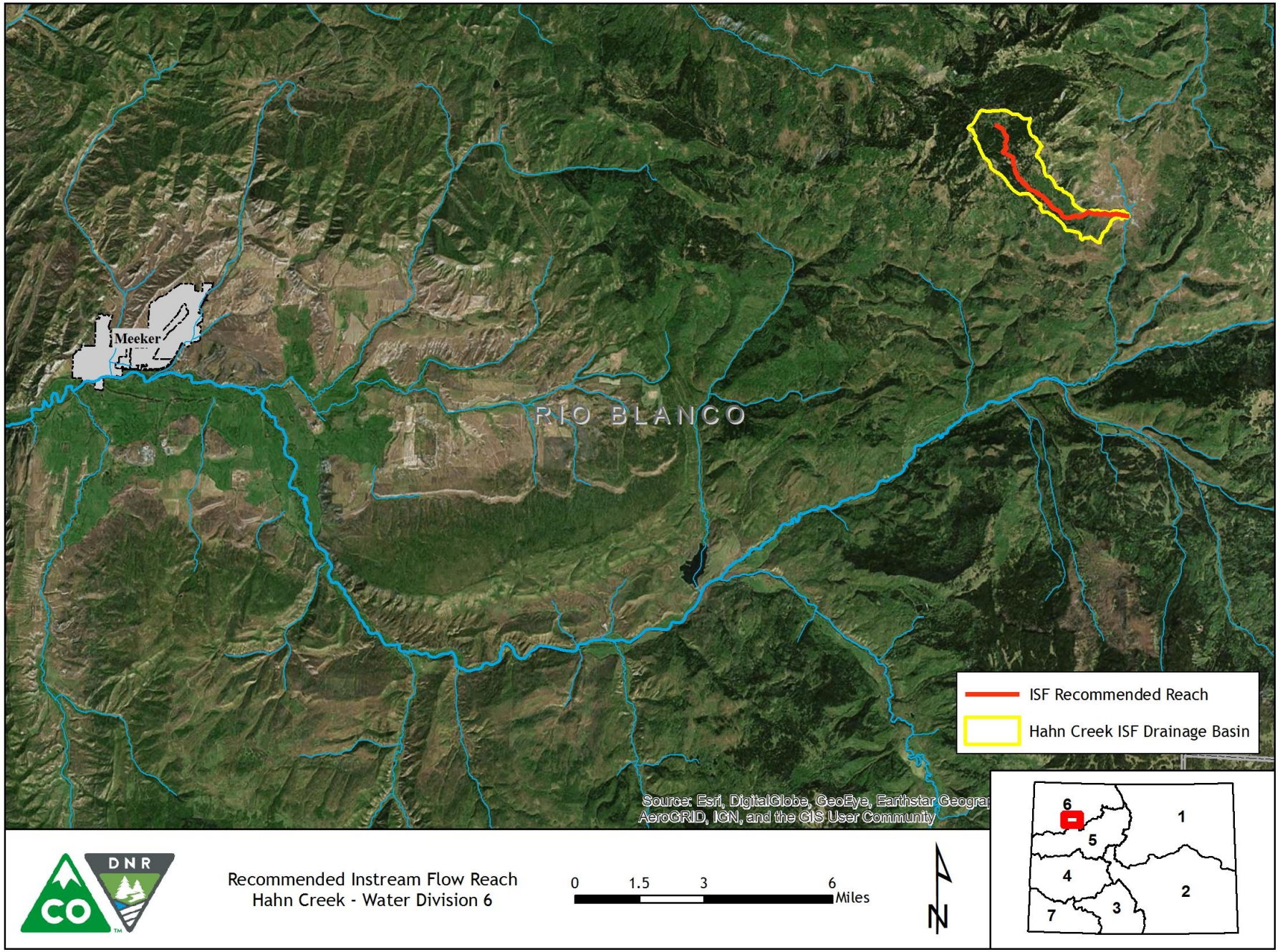
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

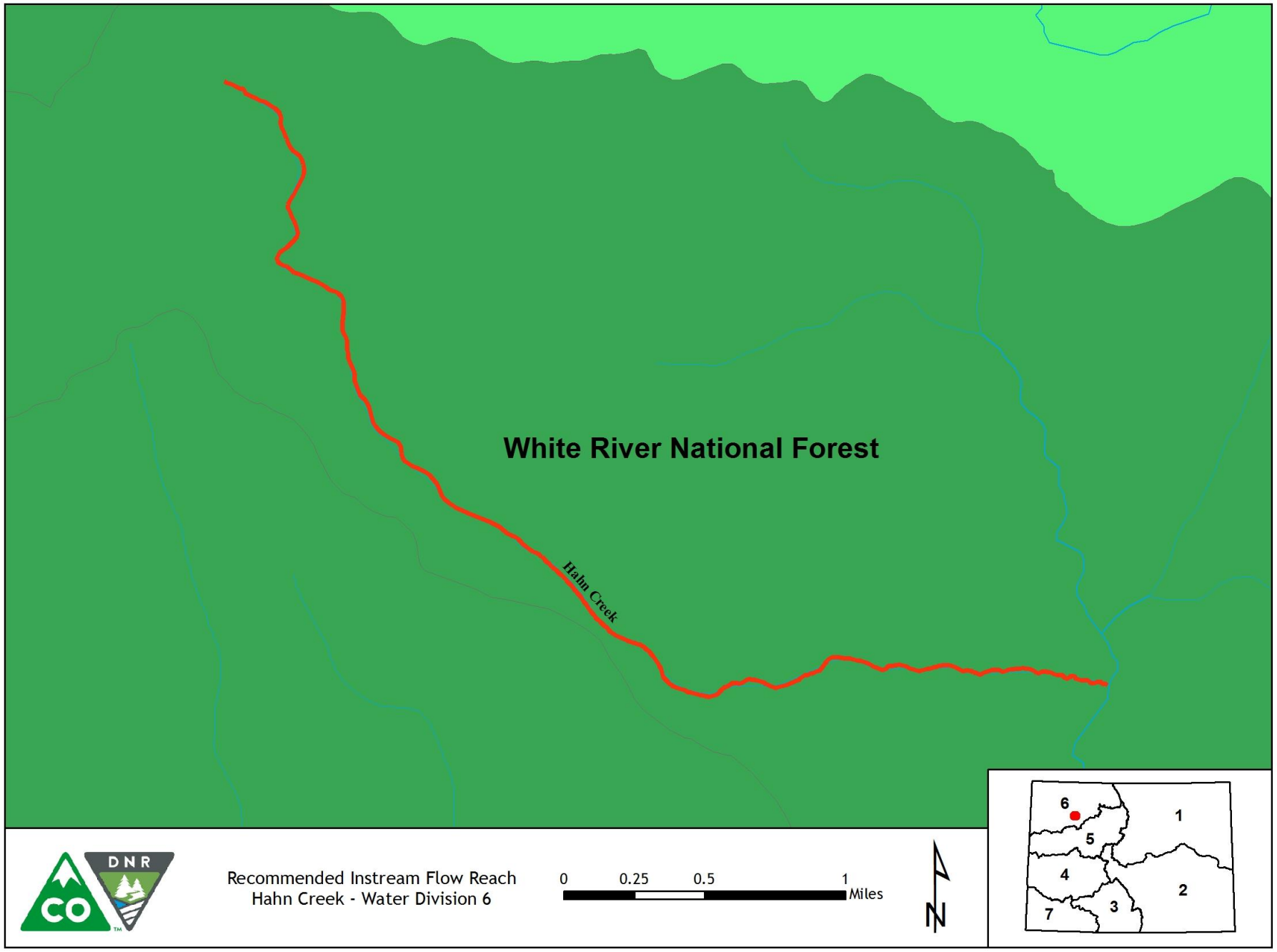
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

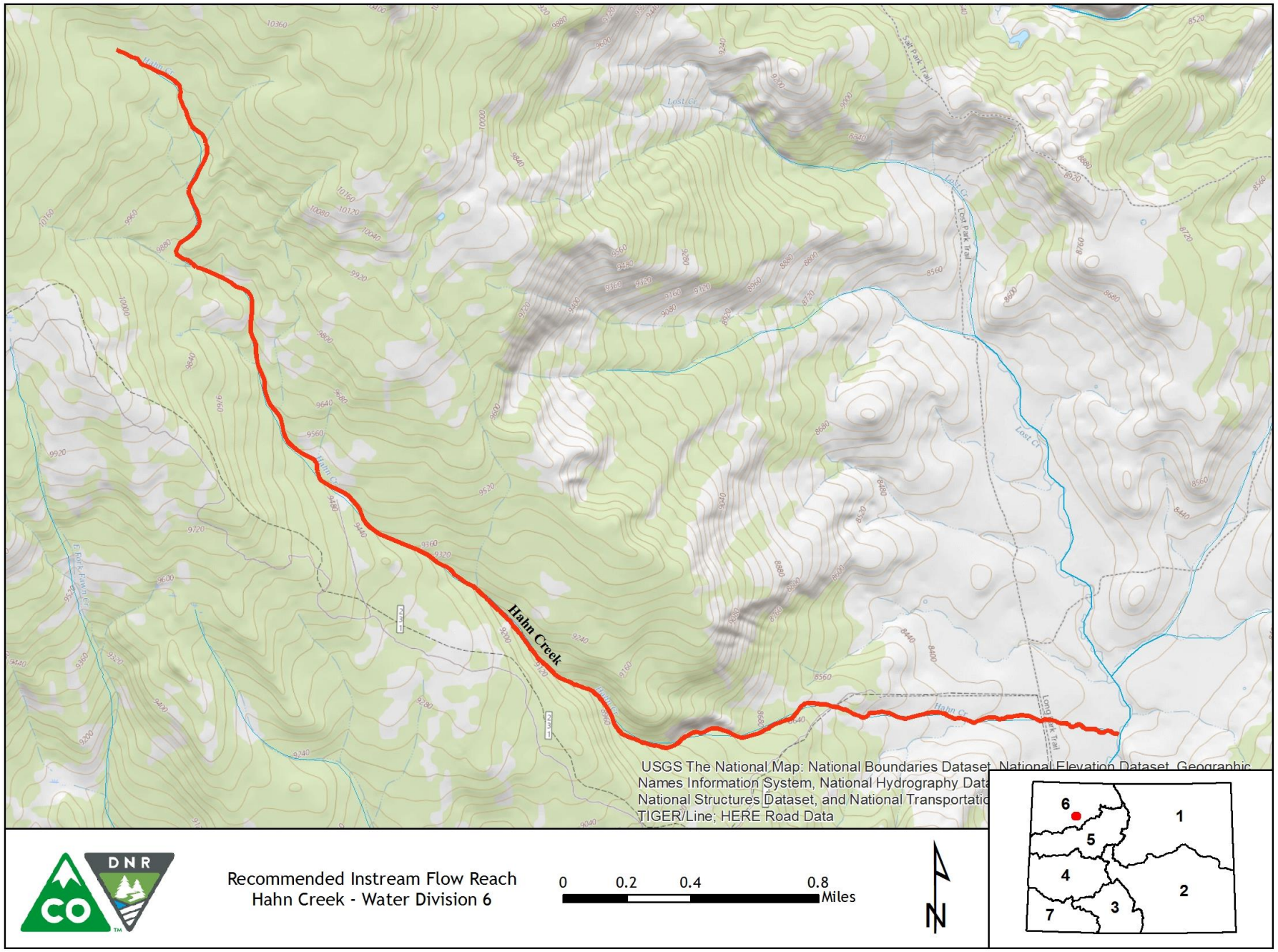
VICINITY MAP



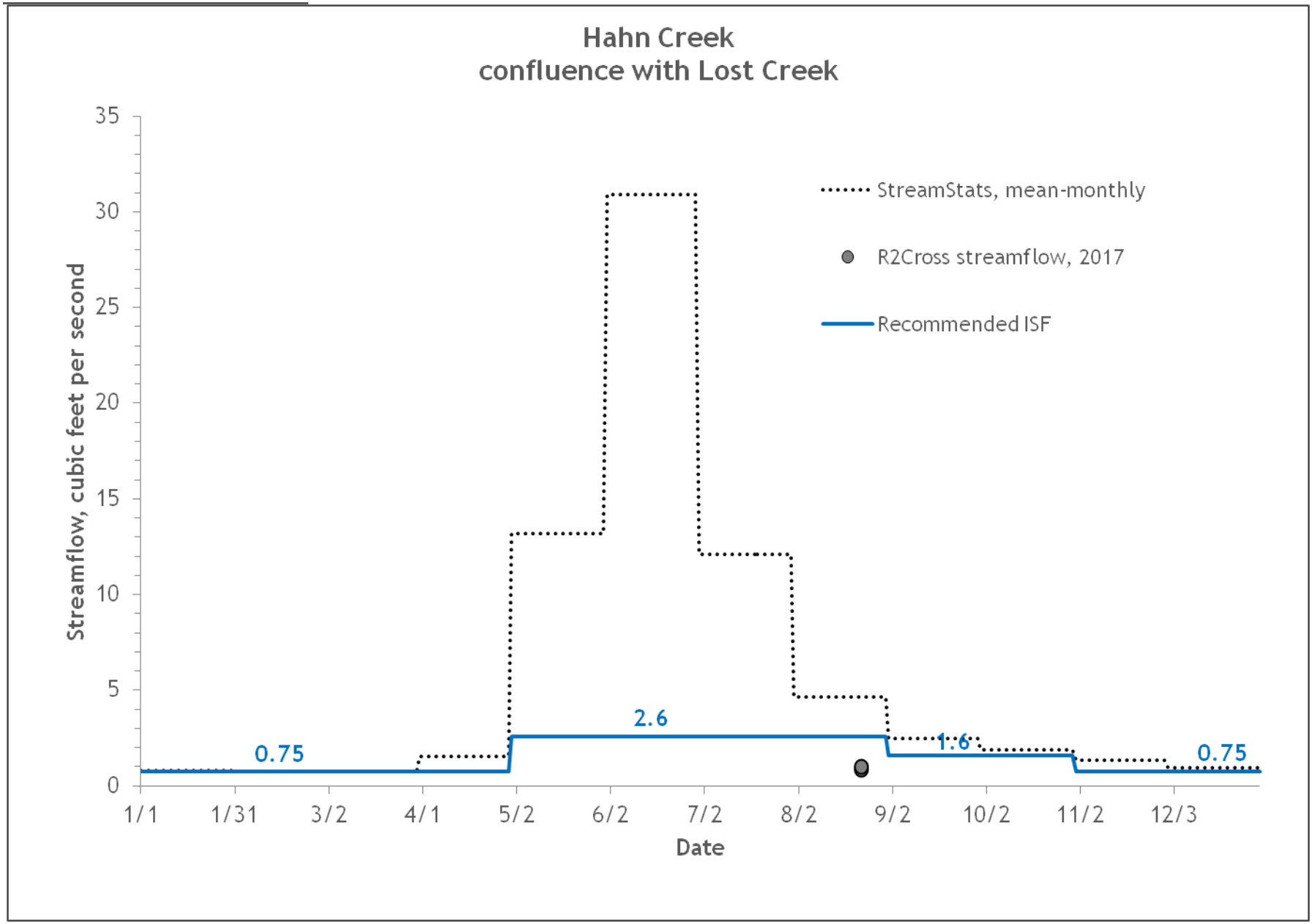
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Lost Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Confluence with Hahn Creek UTM North: 4441691.21 UTM East: 290147.03
LOWER TERMINUS:	Confluence with Long Park Creek UTM North: 4436992.17 UTM East: 289667.03
WATER DIVISION:	6
WATER DISTRICT:	43
COUNTY:	Rio Blanco
WATERSHED:	Upper White
CWCB ID:	18/6/A-006
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	3.64 miles
FLOW RECOMMENDATION:	1.3 cfs (10/01 - 03/31) 2.3 cfs (04/01 - 08/15) 1.8 cfs (08/16 - 09/30)

Lost 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.

Colorado Parks and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Lost Creek. Lost Creek originates in the White River National Forest at an elevation of approximately 9,640 feet. It flows in a southeasterly direction for 8.3 miles and drops to an elevation of approximately 7,560 feet where it joins the North Fork White River. The proposed ISF reach extends from the confluence with Hahn Creek downstream to the confluence with Long Park Creek, and is located within Rio Blanco County (See Vicinity Map). The U.S. Forest Service owns and manages one-hundred percent of the land on which the 3.64 mile proposed reach is located (See Land Ownership Map). CPW recommended this reach of Lost Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2018ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Lost Creek has a high-value natural environment that supports a self-sustaining population of native Colorado River cutthroat trout. The Colorado River Cutthroat Trout Conservation Plan also recognizes the importance of Lost Creek as one of Colorado's streams that contains a pure conservation population of this species. Lost Creek was last sampled in August 2015, utilizing standard electrofishing techniques. The 2015 data shows multiple age classes (5 or more) of Colorado River cutthroat trout and a wide range of sizes from juvenile fish (3 inch) to 11 inch adults. Lost Creek's natural environment also contains a diverse macroinvertebrate community and some extensive beaver dam complexes in the lower reaches of the stream (downstream of this proposed ISF segment).

Table 1. List of species identified in Lost Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	Federal – Sensitive Species State - Species of Greatest Conservation Need

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.

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 field data collected consists of streamflow measurements, surveys of channel geometry at a transect, and 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. However, the R2Cross model also contains the Thorne and Zevenbergen subroutine which uses field measured bed material grain size to estimate velocity. This method is not constrained by the accuracy range of the Manning's n subroutine.

The R2Cross methodology provides the biological quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and 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 1 transect for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 1.3 cfs, which meets 2 of 3 criteria, and the R2Cross model results in a summer flow of 2.3 cfs, which meets 3 of 3 criteria.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
None	08/23/2017 # 1	0.75	NA*	1.3	2.3
			Mean	1.3	2.3

**Results calculated using the R2Cross Thorne-Zevenbergen subroutine*

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

2.3 cfs is recommended for the period of April 1 to August 15.

1.8 cfs is recommended for the period of August 16 to September 30. This flow rate is needed for cutthroat trout rearing and growth. This recommendation is limited by water availability.

1.3 cfs is recommended for the period of October 1 to March 31. This flow rate is needed for overwintering adults and juveniles.

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 streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on Lost Creek is 16.9 square miles, with an average elevation of 8,994 feet and average annual precipitation of 30.6 inches (See the Hydrologic Features Map). There are a number of spring water rights in the basin tributary to this reach. These water uses appear to be small and hydrology is essentially natural flow conditions.

Available Data
There is not a current streamflow gage on Lost Creek, but there was a historical gage located downstream from the proposed ISF reach. The Lost Creek near Buford, CO gage (USGS 9302450) was located approximately 0.64 miles downstream from the proposed lower terminus. The gage had a continuous period of record from 10/1/1964 to 9/29/1989. The drainage basin of the Lost Creek gage is 21.6 square miles, with an average elevation of 8,971 feet and average annual precipitation of 30.3 inches. In addition to the spring water rights, the gage is impacted by the Lost Creek Ranger Station pipeline (0.1 cfs; appropriated 1891 and 1931).

CWCB staff made no streamflow measurements on the proposed reach of Lost Creek, but did assist CPW in collecting field data.

Data Analysis
The Lost Creek gage has 25 years of record for each day of the year. This record is relatively long, which should provide good information about the range of hydrologic conditions in the area. The area-precipitation method was used to scale the Lost Creek gage data to the lower terminus on Lost Creek at the confluence with Long Park Creek. The method estimates streamflow based on the ratio of the precipitation weighted drainage area. The scaling factor for Brush Creek basin at the lower terminus is 0.79. Median streamflow and 95% confidence intervals for median streamflow were calculated.

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show median and 95% confidence interval for median streamflow estimated at the lower terminus of Lost Creek. The proposed ISF is below the median streamflow estimate most of the time and below the 95% confidence interval for median streamflow at all times. Staff concludes that water is available for appropriation on Lost Creek.

Material Injury
Because the proposed ISF on Lost 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. (2017), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations

Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

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

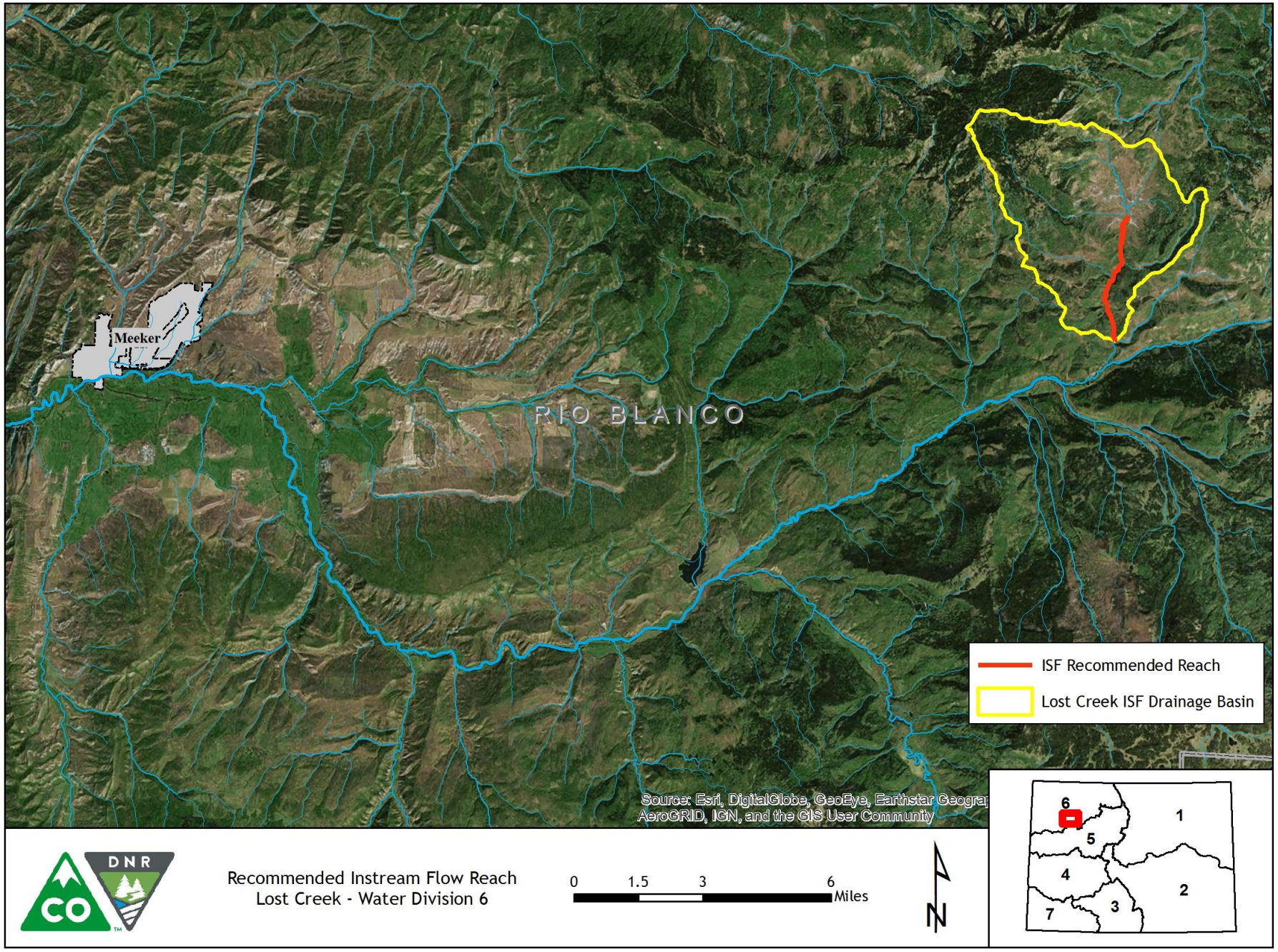
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

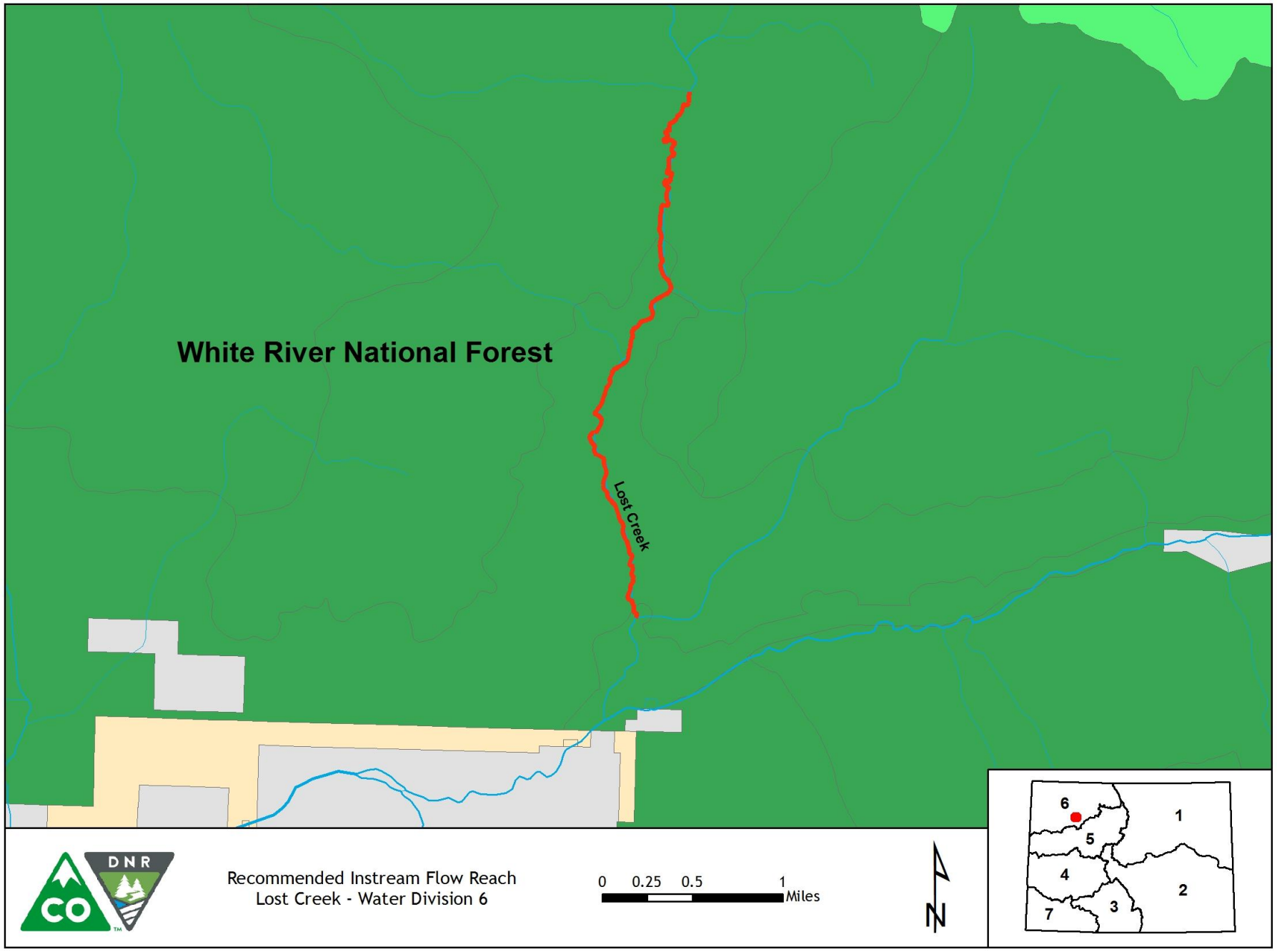
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

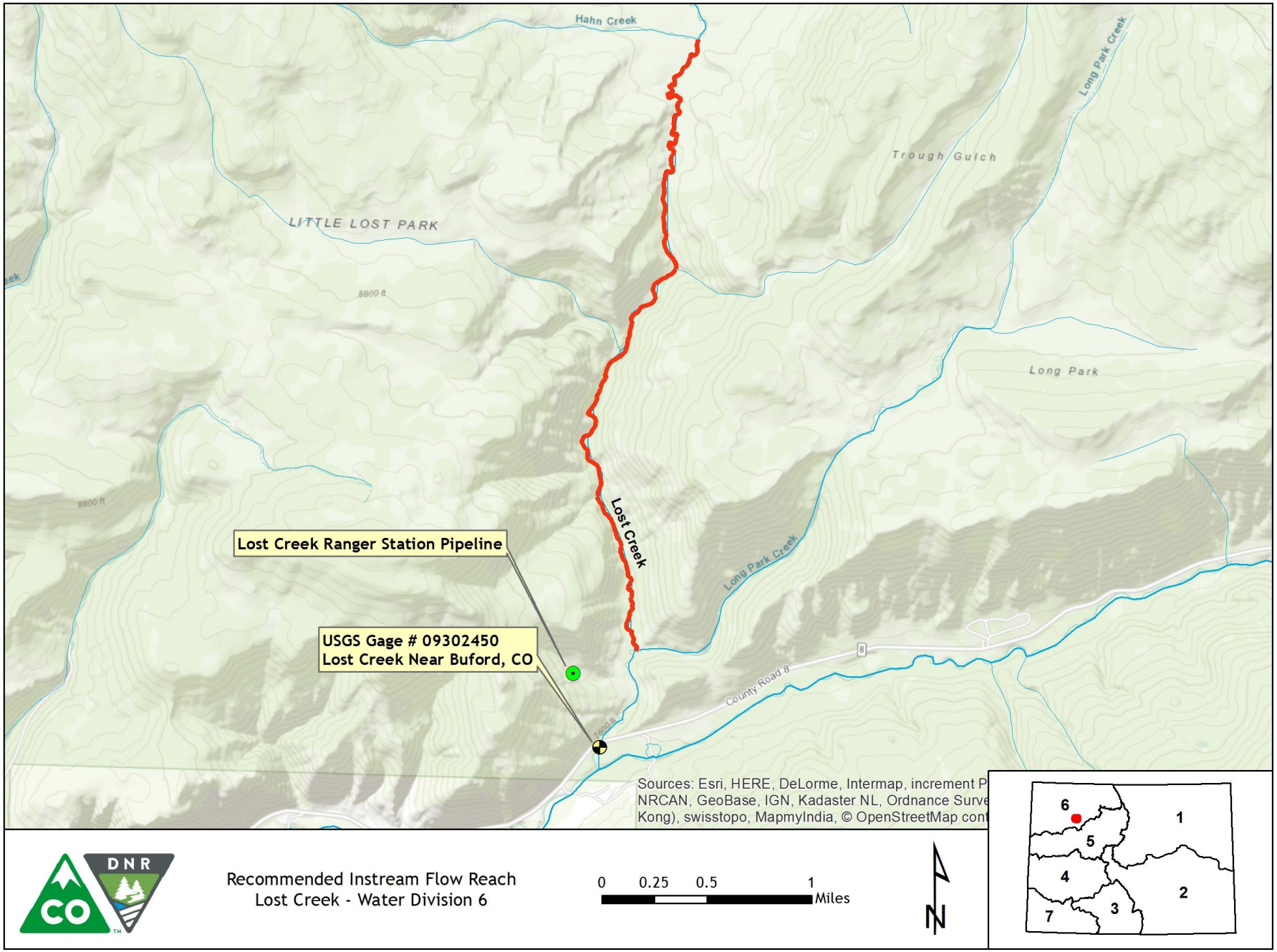
VICINITY MAP



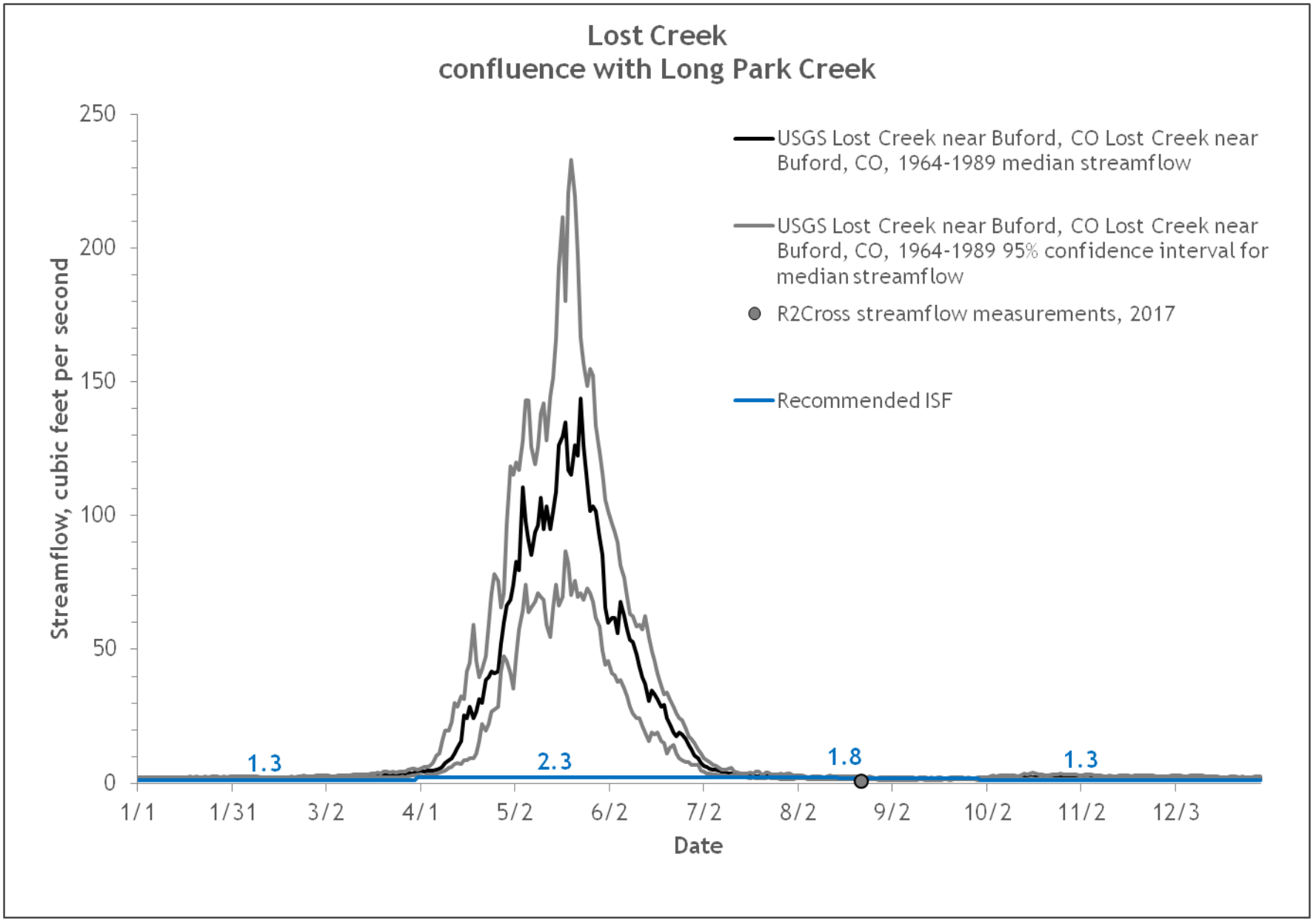
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH