COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Schaefer Creek
Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the Vicinity of UTM North: 4302917.13 UTM East: 304350.23
LOWER TERMINUS:	Confluence Grouse Spring Creek at UTM North: 4310081.09 UTM East: 302311.39
WATER DIVISION:	4
WATER DISTRICT:	40
COUNTY:	Gunnison
WATERSHED:	North Fork Gunnison (HUC#: 14020004)
CWCB ID:	15/4/A-006
RECOMMENDER	U.S. Forest Service
LENGTH:	5.92 miles
FLOW RECOMMENDATION:	1.7 cfs (12/1 – 4/15) 4.6 cfs (4/16 – 7/31) 2.9 cfs (8/1 – 11/30)

SCHAEFER 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. 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 United States Forest Service (USFS) recommended that the CWCB appropriate an ISF water right on a reach of Schaefer Creek. This reach is located within Gunnison County about 16 miles east of the town of Paonia (See Vicinity Map). Schaefer Creek originates on the north flank of East Beckwith Mountain at an elevation of 10,740 feet. It flows in a northwesterly direction as it drops to an elevation of 7,240 feet where it joins Grouse Spring Creek to form Snowshoe Creek. The proposed reach extends from the headwaters downstream to the confluence with Grouse Spring Creek. Eighty-eight percent of the land on the 5.92 mile proposed reach is publicly owned and managed by the USFS (See Land Ownership Map). USFS recommended this reach of Schaefer 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/2015ProposedISFAppropriations.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.

USFS personnel sampled the fish community in Schaefer Creek on November 8, 2012. Sampling revealed populations of both Colorado River cutthroat trout (CRCT) and non-native brown trout (*Salmo trutta*). Several age classes of cutthroat trout were collected during sampling, suggesting the population is self-sustaining. All but one brown trout were less than 100 mm total length. USFS personnel concluded cutthroat trout are year-round occupants of Schaefer Creek, while brown trout probably come upstream from Snowshoe Creek and Coal Creek to spawn and return to downstream habitats for

most of the year. The brown trout in the sample were likely young-of-year that will eventually move downstream.

The presence of brown trout could impact CRCT in Schaefer Creek through competition for food and habitat resources. Although brown trout cannot hybridize with CRCT and do not typically exhibit the invasive tendencies of the western North American populations of brook trout (*Salvelinus fontinalis*), it would still be preferable to remove brown trout from the system. In 2012, personnel from the Grand Mesa, Uncompahgre and Gunnison National Forests (GMUG) worked to stabilize a bridge located where Forest Road 913 crosses Schaefer Creek, as the foundation became unstable after spring run-off. The bridge is likely to have to be replaced in the next five years. A new bridge will integrate a fish passage barrier to prevent adult brown trout from spawning in the most upstream sections of Schaefer Creek. GMUG fisheries personnel believe that, because the size structure of brown trout sampled in 2012 suggested the habitat was used primarily for spawning, brown trout will extirpate themselves from upper Schaefer Creek. Installing a barrier and securing an instream flow water right are the two actions most likely to provide long-term benefits to the CRCT in Schaefer Creek.

GMUG personnel collected tissue samples from 32 CRCT for genetic analysis. Testing revealed 96 percent of the genetic composition of the population was that of greenback, or GB-lineage Colorado River cutthroat trout. Populations having greater than 90 percent native CRCT genes are classified as conservation populations by the USFS and Colorado Parks and Wildlife. These populations are of the greatest conservation significance on the GMUG NF and are managed to maximize the probability of long-term persistence.

Table 1. List of species identified in Schaefer Creek.

Species Name	Scientific Name	Status
brown trout	*Salvelinus fontinalis*	none
native cutthroat trout	*Oncorhynchus clarkii**	State Species of Special Concern Federal Sensitive Species

**Identification of subspecies / lineage of native cutthroat trout in Colorado is ongoing through genetic testing and research.*

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

USFS 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 and surveys of channel geometry at a transect and of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic invertebrates (Nehring, 1979). USFS 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 its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

Data Analysis

R2Cross data was collected at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a summer flow of 4.6 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a winter flow of 2.91 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date Measured	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
USFS	8/5/2013	5.8	2.3 – 14.5	2.9	Out of range
USFS	9/25/2013	7.7	3.1 – 19.3	Out of range	4.6
			Mean	**2.9**	**4.6**

ISF Recommendation

The USFS recommends flows of 1.7 cfs (12/1 – 4/15), 4.6 cfs (4/16 – 7/31), and 2.9 cfs (8/1 – 11/30) based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

The summer flow of 4.6 cfs is recommended for the snowmelt runoff period. This recommendation is driven by the percent wetted perimeter in Schaefer Creek. The winter flow rate of 2.9 cfs was not available based on staff's water availability analysis. USFS reduced the winter rate to 1.7 cfs, which maintains an average velocity of 1.0 ft/second and average depth of 0.18 ft.

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 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.

Basin Characteristics

The proposed ISF on Schaefer Creek has a 7.97 square mile drainage basin. The average elevation of the basin is 9,620 ft and the average precipitation is 33.47 inches. There are four absolute water rights with records. The Beckwith Diversion (appropriation date 1948. 7.66 cfs absolute) is the lowest diversion on Schaefer Creek with records. This diversion has records from 1970 to present. Norris Diversion (appropriation date 1947, 15.0 cfs absolute) is located further upstream and is somewhat senior. The other two diversions (Dawes Dom PL and Pillips Ditch No. 1) have a total of 0.25 cfs in decreed diversions. Compared to the volume of water during the spring runoff, these water rights have relatively minor impacts on the hydrology of Schaefer Creek.

Available Data

There is not a current or historic streamflow gage on Schaefer Creek. The closest gage identified was the historic Ruby Anthracite Creek near Floresta gage (USGS 09132000). The gage has two short periods of record, from 1938 to 1943 and from 1954 to 1958. The gage was located in a drainage to the east of Schaefer Creek. Ruby Anthracite Creek gage had a 20.6 square mile drainage basin. The average elevation of the basin is 10,300 ft and the average precipitation is 36.82 inches. Ruby Anthracite drains the eastern edge of Beckwith Mountain as well as the southern portions of the Ruby Mountain Range. There is a total of 2.617 cfs in absolute decreed water rights in the drainage basin tributary to the historic gage. None of these water rights have diversion records. Compared to the volume of water during the spring runoff, these water rights have relatively minor impact on the hydrology of Ruby Anthracite Creek.

The only other available information about streamflow on Schaefer Creek comes from discussions with the lead Water Commissioner for District 40, Steve Tuck. According to Mr. Tuck, spring runoff starts around May 1 and the peak flow of about 100 cfs typically occurs between the first of June and the middle of June. Streamflow is back to baseflows by the middle of July and baseflows of 4 to 5 cfs are available for the rest of the year. The diversions located in the Schaefer Creek drainage basin are relatively junior water rights that are typically curtailed by the North Fork of the Gunnison River call by early July. Consequently, the original ISF rates proposed by the USFS (2.44 cfs for winter and 4.54 cfs for summer) appear to be reasonable to Mr. Tuck.

CWCB staff made three streamflow spot measurements in addition to the two measurements made by USFS during their R2Cross data collection efforts.

Data Analysis

Due to the short period of record available for the Ruby Anthracite Creek gage, staff took additional steps to evaluate the record. Staff examined other gages in the region in an attempt to find a gage that could be used to extend the record through regression analysis. However, none of the gages evaluated produced a reasonable regression coefficient and none were found suitable for regression extension.

Staff also examined streamflow gages and climate stations and found that the Crested Butte climate station (Crested Butte, Station ID USC00051959, downloaded 12/22/2014) has a long, nearly continuous period of record and is located about 17 miles from the lower terminus. The average annual precipitation at the Crested Butte station for the period of record (1910 to 2014) is 23.3 inches. During the 7 complete water years the Ruby Anthracite gage operated (1939 to 1942 and 1955-1957), only one year had above average precipitation at the Crested Butte station, four were below average, and two were within one standard deviation of the average. Therefore, the Ruby Anthracite Creek gage record likely represents below average streamflow conditions and could underestimate the amount of water typically available in the Schaefer Creek drainage.

The Ruby Anthracite Creek gage was analyzed using the period of record (1938 to 1958) available through HydroBase on 12/21/2014. The gage record was scaled by 0.352 to the lower terminus on Schaefer Creek using the area-precipitation method. The area-precipitation method estimates streamflow based on the ratio of the precipitation weighted drainage area at the lower terminus location to that of the gage location. Median streamflow was calculated using the adjusted Ruby Anthracite Creek gage record. 95% confidence intervals were not calculated due to the short period of record at the Ruby Anthracite gage.

Water Availability Summary

The hydrographs (Figure 1 and Figure 2) show StreamStats results and the median streamflow calculated from the scaled gage record. StreamStats results were included to provide additional information due to the short period of record at the gage. The proposed ISF summer rate is below median gage data for all but 1 day at the end of July; however, the proposed winter rates are generally higher than the median gage data. The proposed ISF rates are below the StreamStats estimates at all times, with the exception of late April. Based on the combination of gage data and Streamstats, staff concludes that water is available for appropriation on Schaefer Creek.

Material Injury

Because the proposed ISF on Schaefer 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. (2014), 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.

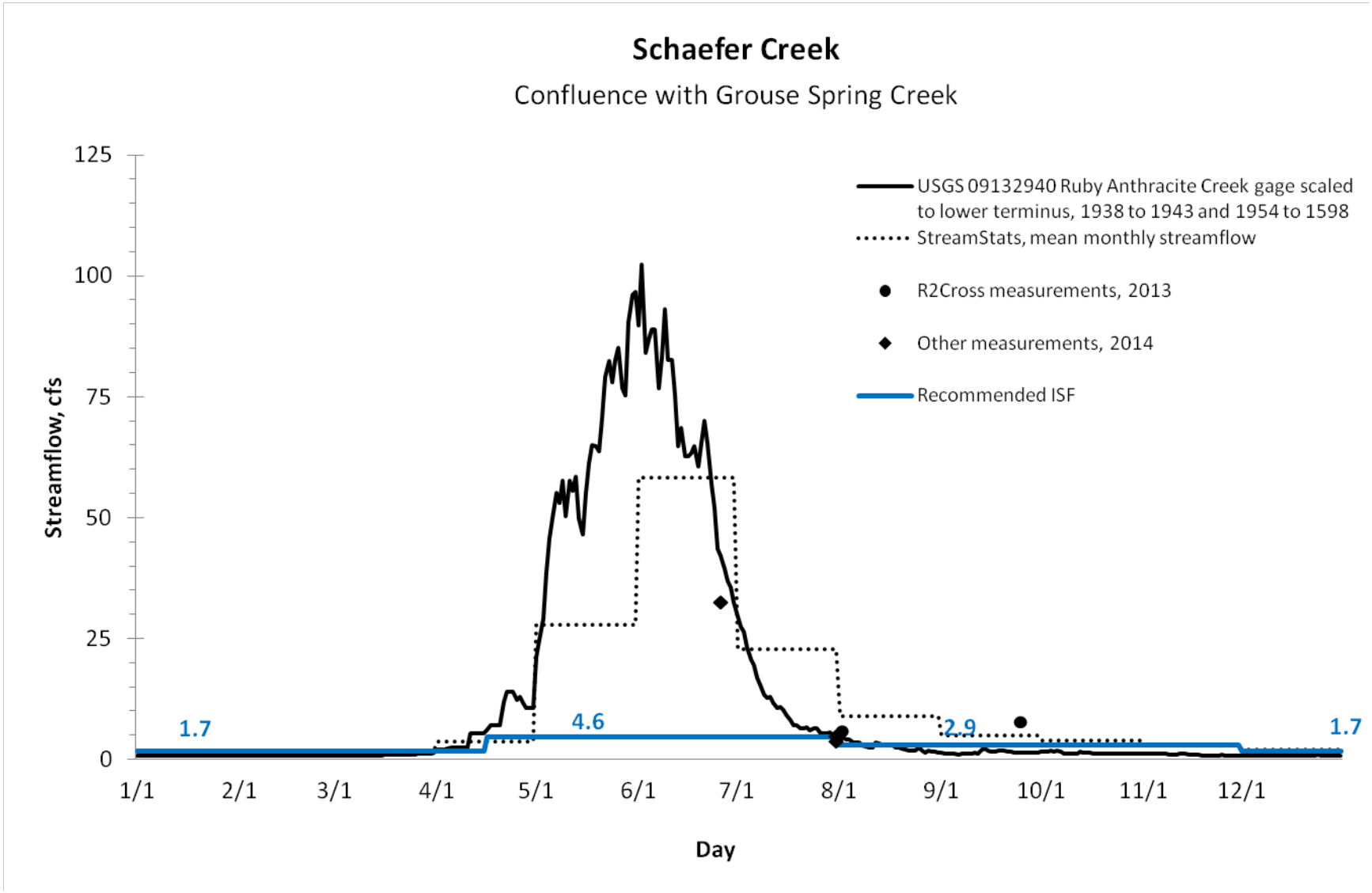


Figure 1. Complete hydrograph showing streamflow data and the proposed ISF rate on Schaeffer Creek.

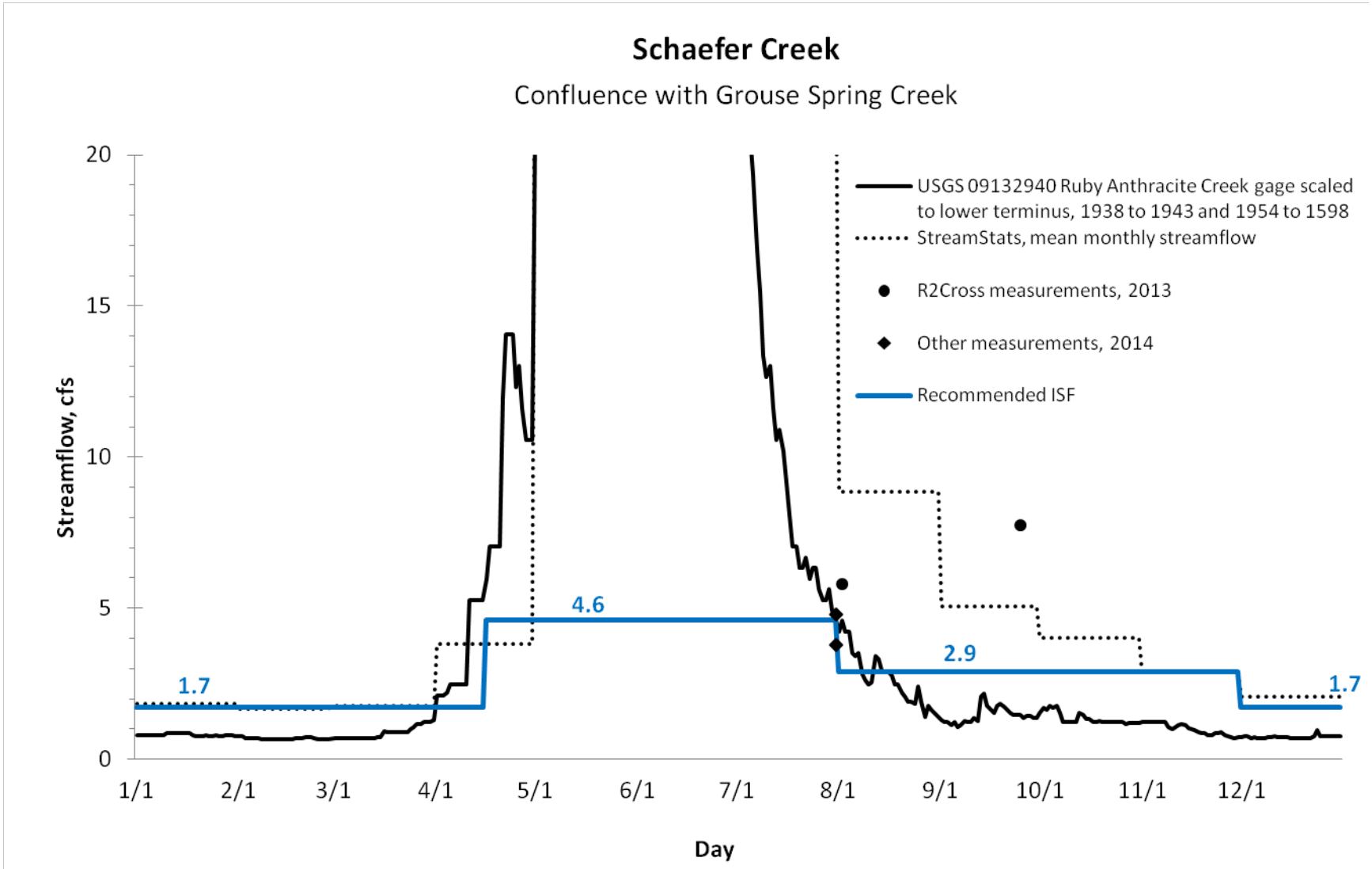
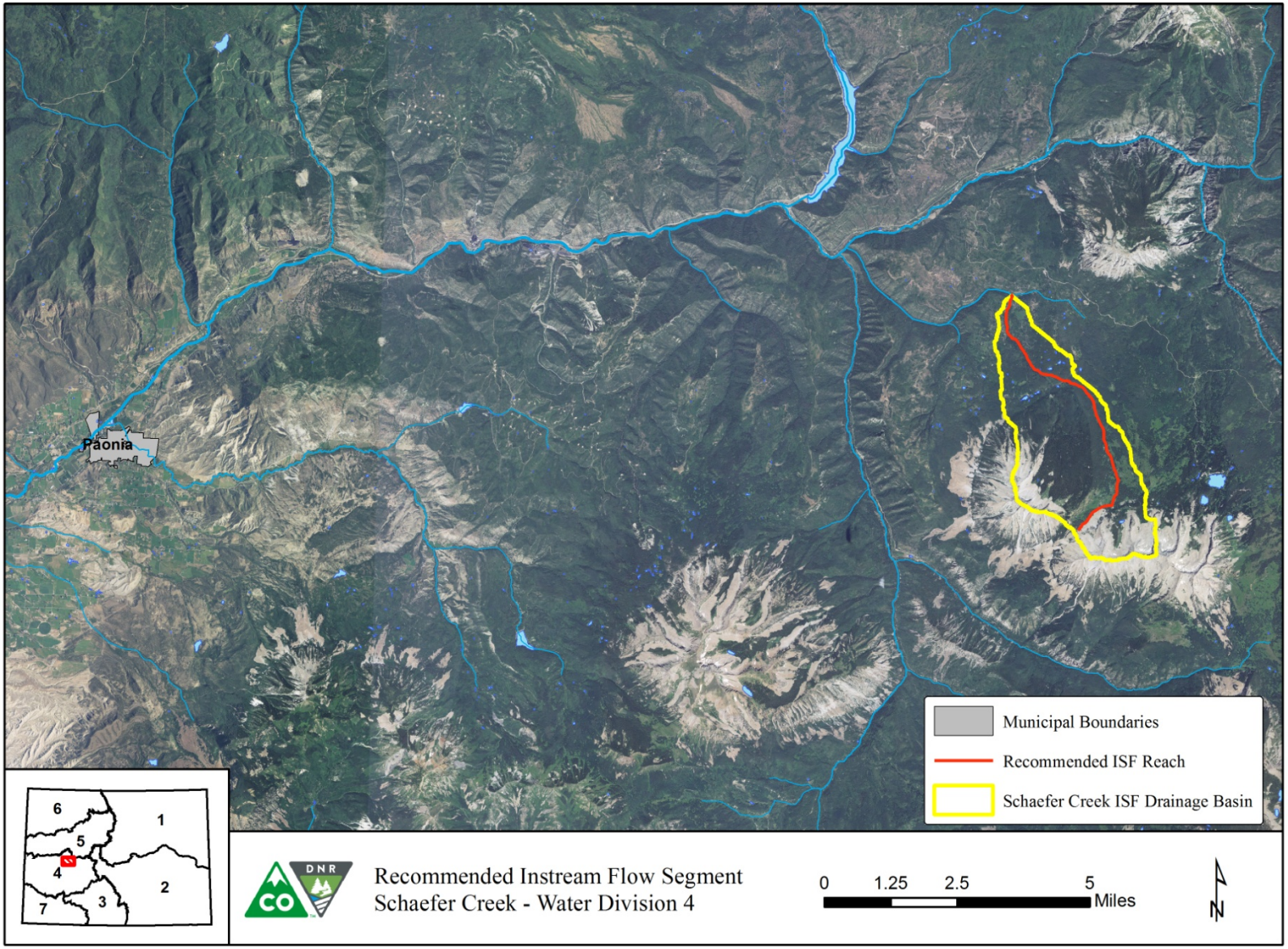
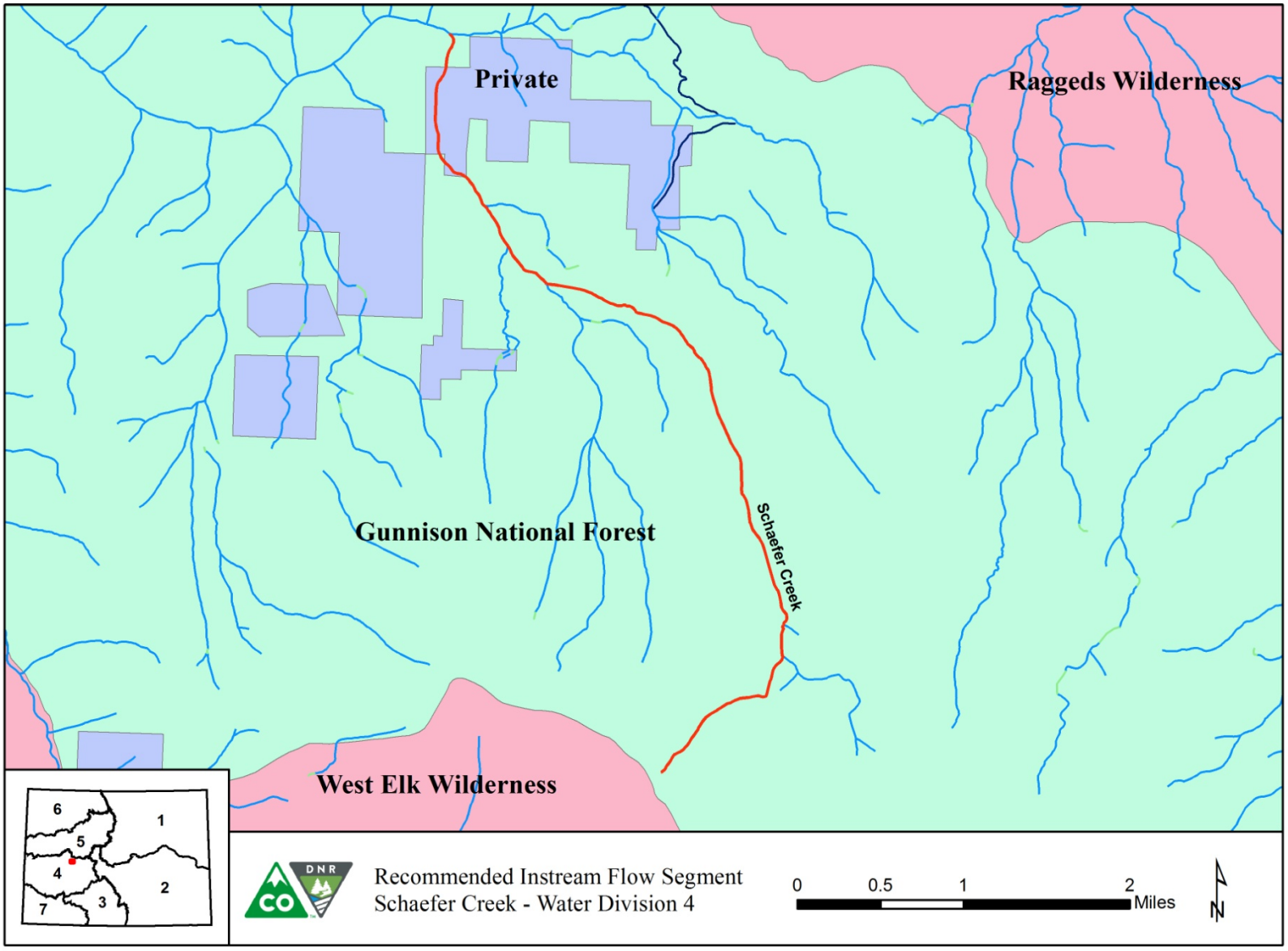


Figure 2. Detailed hydrograph showing streamflow data and the proposed ISF rate on Schaeffer Creek.

Vicinity Map



Land Use Map


Private
Raggeds Wilderness
Gunnison National Forest
Schaefer Creek
West Elk Wilderness
6
1
5
4
2
7
3
DNR
CO
Recommended Instream Flow Segment
Schaefer Creek - Water Division 4
0
0.5
1
2
Miles
N

Water Rights Map