COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Spottlewood Creek
Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	A Point Located at UTM North: 4537937.85	UTM East: 495521.89
LOWER TERMINUS:	A Point Located at UTM North: 4534887.62	UTM East: 498663.70
WATER DIVISION:	1	
WATER DISTRICT:	3	
COUNTY:	Larimer	
WATERSHED:	Cache La Poudre (HUC#: 10190007)	
CWCB ID:	13/1/A-003	
RECOMMENDER	Colorado Parks & Wildlife and City of Fort Collins	
LENGTH:	3.53 miles	
FLOW RECOMMENDATION:	0.1 cfs (1/1 – 12/31)	

SPOTTLEWOOD 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.

Colorado Parks & Wildlife (CPW) and the City of Fort Collins recommended that the CWCB appropriate an ISF water right on a reach of Spottlewood Creek. This reach is located within Larimer County about 24 miles north of the city of Fort Collins (See Vicinity Map). Spottlewood Creek originates in Wyoming and it flows in a southeasterly direction as it drops to an elevation of 5,795 feet where it joins Coal Creek. One hundred percent of the land on the 3.53 mile proposed reach is publicly owned and managed by the City of Fort Collins as the Soapstone Prairie Natural Area (See Land Ownership Map). CPW and the City of Fort Collins recommended this reach of Spottlewood 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.

The Spottlewood Creek drainage contains areas with persistent perennial lakes, perennial stream sections, and intermittent stream sections. Portions of the drainage are likely dry during much of the year and may only have flowing water during spring runoff or storm events. The headwaters of the Spottlewood drainage are within the boundary of the Ogallala or High Plains Aquifer as defined by the U.S. Geological Survey boundaries (USGS, 2009). Most of the drainage appears to be in the White

River Formation or Group (USGS, Geologic Units of Colorado). The primary rock type is sandstone, with claystone and conglomerate.

Hansen and Bentley (2008) conducted fish surveys of Spottlewood Creek in fall of 2008. This survey found mudpuppies, an aquatic salamander; however, no fish species were sampled. Hansen and Bentley (2008) recommended introduction of fish species into Spottlewood Creek. The City of Fort Collins and CPW introduced 1,500 northern redbelly dace in September 2012. The northern redbelly dace is a State endangered fish; only five specimens have been collected in Colorado (CPW, 2014). The City and CPW also introduced 340 plains topminnow in September 2012. See Table 1 for a list of species identified in or near Spottlewood Creek.

Riparian vegetation surrounding Spottlewood Creek includes the Colorado butterfly plant *Gaura neomexicana ssp. Coloradensis*. This species has been listed as threatened under the Endangered Species Act since 2000 (U. S. Fish and Wildlife Service website). According to the U.S. Fish and Wildlife Service, the Colorado butterfly plant is a rare short-lived perennial herbaceous plant found primarily in southeastern Wyoming, northcentral Colorado, and extreme western Nebraska. The Colorado butterfly plant is typically found in wetlands habitats along the meandering stream channels on the high plains.

Insect surveys were conducted on Meadow Springs Ranch and Soapstone Prairie Natural Area in 2009, 2010 and 2011 (Stoaks and Kondratieff, 2011). One site was sampled on Spottlewood Creek near the lower terminus of the proposed ISF reach. Stoaks and Kondratieff (2011) note that flowing springs and streams are unique habitats on the high plans steppe, often with distinct aquatic communities. Further, they stress that these areas are important for conservation because "aquatic insect habitat and species have mostly disappeared on the Great Plains." Thirty-two uncommon insect species were found, with some only known to occur in Colorado on the Meadow Springs Ranch or Soapstone Prairie Natural Area (Stoaks and Kondratieff, 2012 has a full list of species). Aquatic macroinvertebrates were sampled at Spottlewood Creek over 3 years (Stoaks and Kondratieff, 2012). This sampling effort found at least 158 different insect taxa and stated that "the majority of these are lentic or standing water species."

Table 1. List of species identified in or near Spottlewood Creek.

Species Name	Scientific Name	Status (state / federal)
northern red-belly dace	*Phoxinus eos*	State endangered USFS Sensitive Species
plains topminnow	*Fundulus sciadicus*	none
common mudpuppy	*Necturus maxulosus*	none
Colorado butterfly plant	*Gaura neomexicana ssp. coloradensis*	Federally threatened
aquatic macroinvertebrates	*158 taxa (see Stoaks and Kondratieff, 2012)*	unknown

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 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). 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 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). The R2Cross model did not produce a summer flow 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 0.1 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 Spottlewood Creek.

Entity	Date Measured	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW	6/11/2014	0.02	0.0 – 0.1	0.05	Out of range
CPW	6/11/2014	0.11	0.0 – 0.3	0.15	Out of range
			Mean	**0.1**	**NA**

ISF Recommendation

CPW recommends flows of 0.1 cfs (1/1 – 12/31) based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis. This flow amount meets the criteria for average wetted perimeter and average depth in the R2Cross model.

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 Spottlewood Creek has a 15.6 square mile drainage basin. The average elevation of the basin is 7,020 ft and the average precipitation is 17.49 inches. The City of Fort Collins has one absolute surface water right in the drainage tributary to the lower terminus. This water right is 0.007 cfs from a spring high in the basin. Based on aerial photography, there does not appear to be any irrigated lands in the portion of the drainage basin located in Wyoming; however, there are a number of stock ponds.

Available Data

There is not a current streamflow gage on Spottlewood Creek or anywhere in the vicinity of the proposed ISF. StreamStats relationships were not developed for the plains due to the lack of available gage data. CWCB staff installed a weir and pressure transducer that measured stage every 15 minutes. The record starts 5/22/2013 with intermittent recordings through 1/12/2015. Brief periods of ice and an equipment malfunction from 7/17/2014 to 10/22/2014 resulted in the incomplete record.

In addition, staff obtained anecdotal information on streamflow for Spottlewood Creek. Daylan Figgs, the Fort Collins Natural Areas Senior Environmental Planner, has been responsible for managing the Soapstone Prairie Natural Area since April, 2005. Mr. Figgs observed that flows in Spottlewood Creek remain fairly steady in the 0.1 – 0.3 cfs range and that higher flows occur in the spring and in response to storm events. Although he observed that flows decrease during drought periods, he has stated that they typically remained at or above 0.1 cfs. Like Graves Creek, the wetted segment on Spottlewood Creek decreases during extremely dry periods near the downstream terminus. Mr. Figgs further stated that he has not seen Spottlewood Creek without flow. Willie Altenburg, President of the Folsom Grazing Association, has been grazing cattle in the area since 1983. Mr. Altenburg stated that he cannot remember a time when Spottlewood Creek was dry. The presence of numerous springs within the basin that contribute flow to Spottlewood Creek likely explain the fairly constant base flows observed.

Data Analysis

Daily average streamflow was calculated from the streamflow record for each year with data. Due to limited available data, median streamflow could only be calculated for periods when there was more than one streamflow measurement. 95% confidence intervals for median streamflow could not be calculated.

Water Availability Summary

Figure 1 shows daily average streamflow for 2013, 2014, and 2015. The median streamflow is plotted for time periods with more than one streamflow measurement. The majority of the streamflow measurements are above the proposed ISF of 0.1 cfs. However, the pressure transducer recorded flows below 0.1 cfs during May, June, July and part of September of 2013. In 2014, measured streamflow was above 0.1 cfs in May, June, and part of July until the pressure transducer malfunctioned. When measurements resumed in October of 2014 flows were higher than 0.1 cfs through the rest of the year.

CWCB made streamflow measurements during a relatively unusual period of precipitation conditions. The nearest climate station with a long period of record is located in Cheyenne, Wyoming, roughly 20 miles away (Cheyenne, USW00024018, accessed 1/6/2014). This station has nearly 100 years of complete precipitation records. The year preceding installation of the flow measurement system, 2012, had one of the lowest annual precipitation totals on record, with just 5 out of 100 years lower. June, July, and August of 2013 recorded half the average precipitation for those months and just 4 out of 100 years had lower flows during those months. Conversely, September 2013 had the highest monthly total streamflow ever recorded for any month in the 100-year record.

This unusual sequence of drought and flood impacts the hydrology in Spottlewood Creek and adjacent areas. The low flows recorded in May, June, July, and August of 2013 are likely a result of exceptionally low precipitation in 2012 and 2013 prior to September. The higher flows recorded in the latter half of 2013 are similarly affected by the September high flow event, which may have kept flows higher in 2014. Despite this range of precipitation conditions, on a daily basis the Spottlewood Creek measurements are generally between 0.05 and 0.40 cfs. This data and the observations made by Daylan Figgs allow staff to conclude that 0.1 cfs is typically available year-round.

Material Injury

Because the proposed ISF on Spottlewood 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.

CPW, Natural Diversity Information Source, accessed 1/5/2014, http://ndis.nrel.colostate.edu/wildlifespx.asp?SpCode=010036

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

Hansen, A.G., and K.T. Bentley, 2008, Inventory of fishes inhabiting Spottlewood, Graves, and Sand Creeks on Meadow Springs Ranch and Soapstone Prairie Natural Area, Lamar County, CO., Report prepared for the City of Fork Collins, and the Aquatic Research Section and Species Conservation Sections of the Colorado Division of Wildlife.

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.

Stoaks, R.D., and B.C. Kondratieff, 2011, Interim report on insect survey of Soapstone Prairie Natural Area, Larimer, Co. and Meadow Springs Ranch, Weld, Co., Colorado. Department of Bioagricultural Sciences and Pest Management, Colorado State University.

Stoaks, R.D., and B.C. Kondratieff, 2012, Final report on insect survey of Soapstone Prairie Natural Area, Larimer, Co., Colorado. Department of Bioagricultural Sciences and Pest Management, Colorado State University.

U. S. Fish and Wildlife Service, Colorado Butterfly Plant, accessed 1/1/2015, http://www.fws.gov/mountain-prairie/species/plants/cobutterfly/.

USGS, 2009, Digital map of aquifer boundary for the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, accessed 12/31/2014 at http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds543.xml

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.

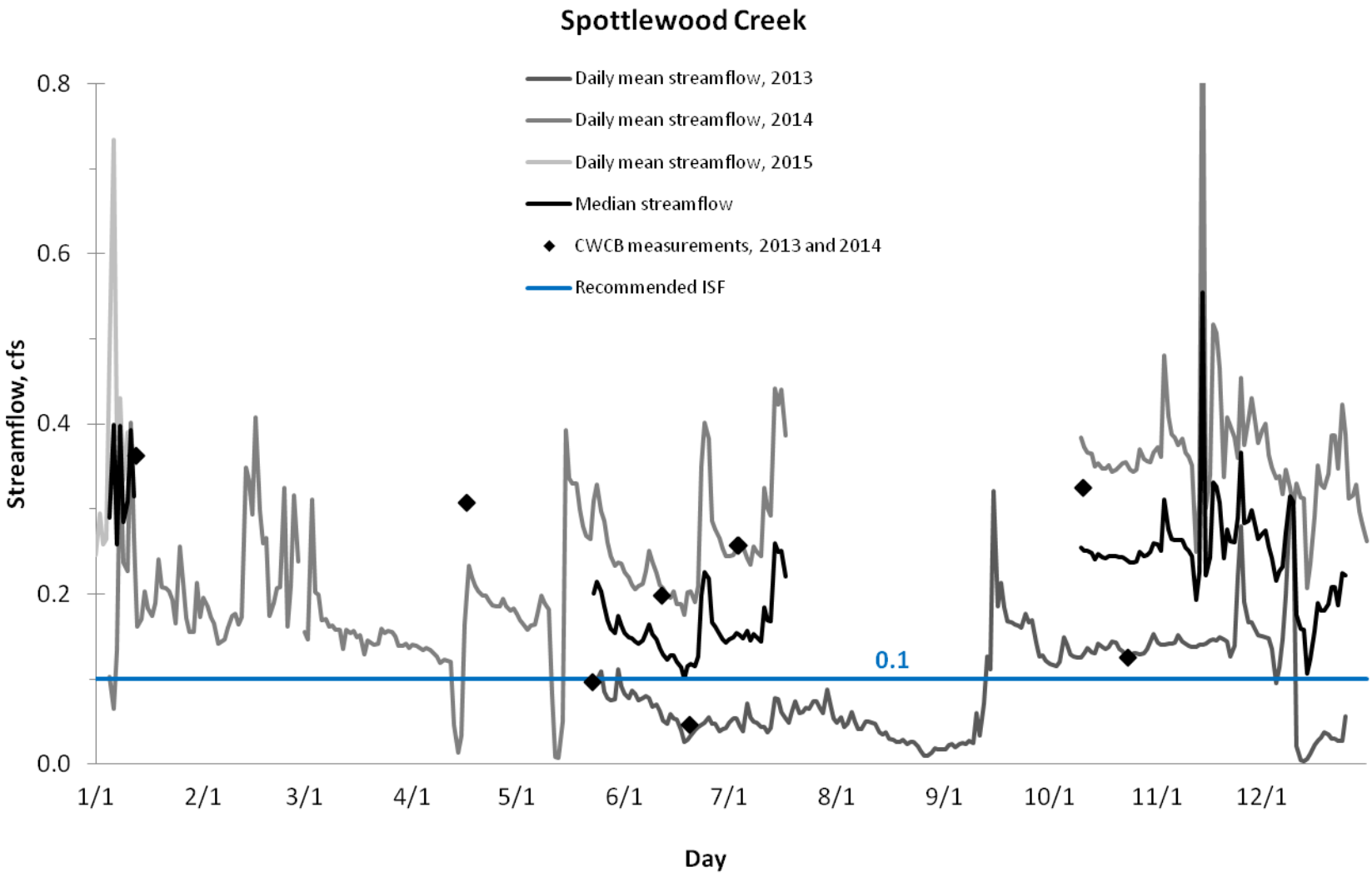
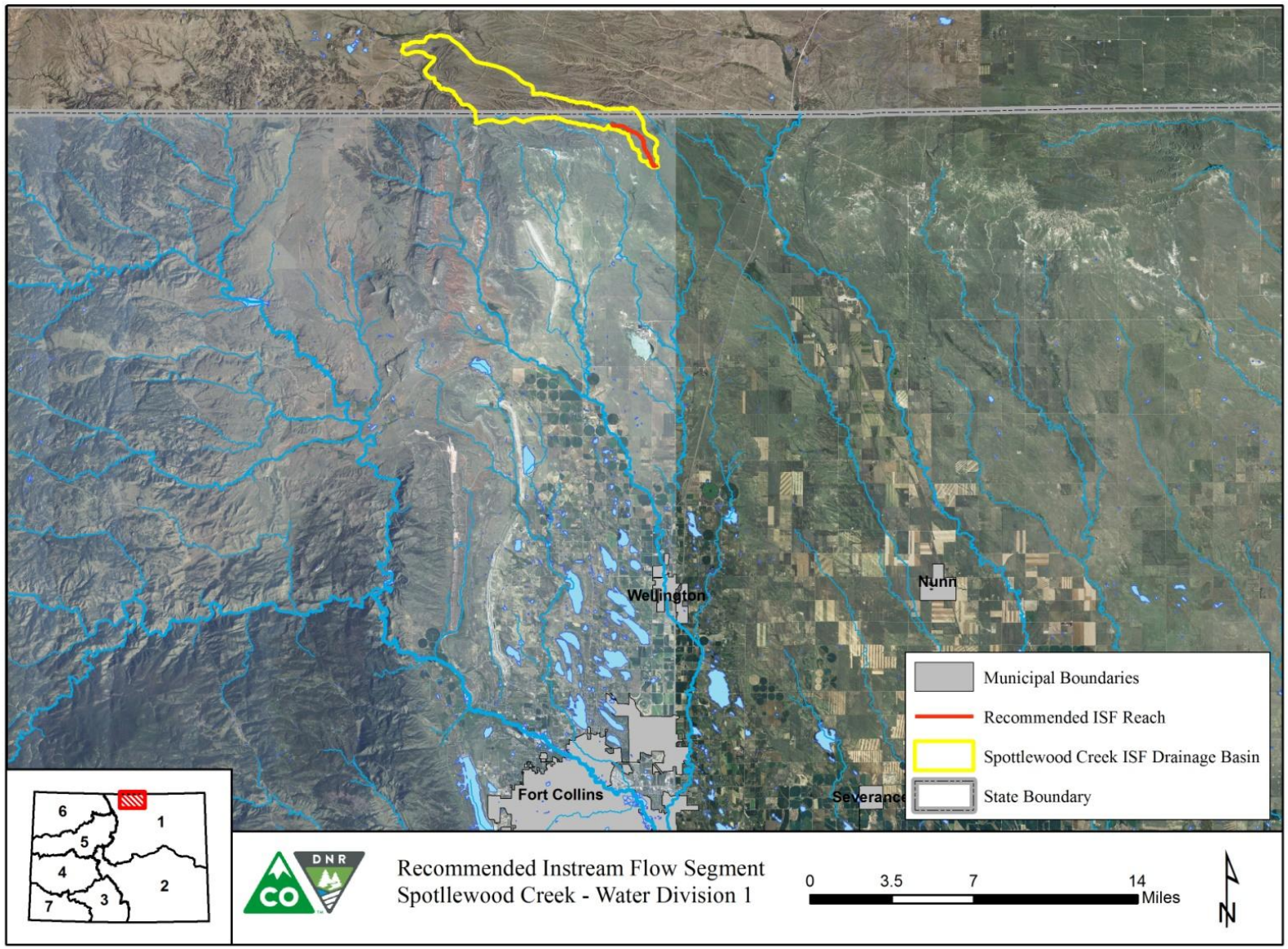
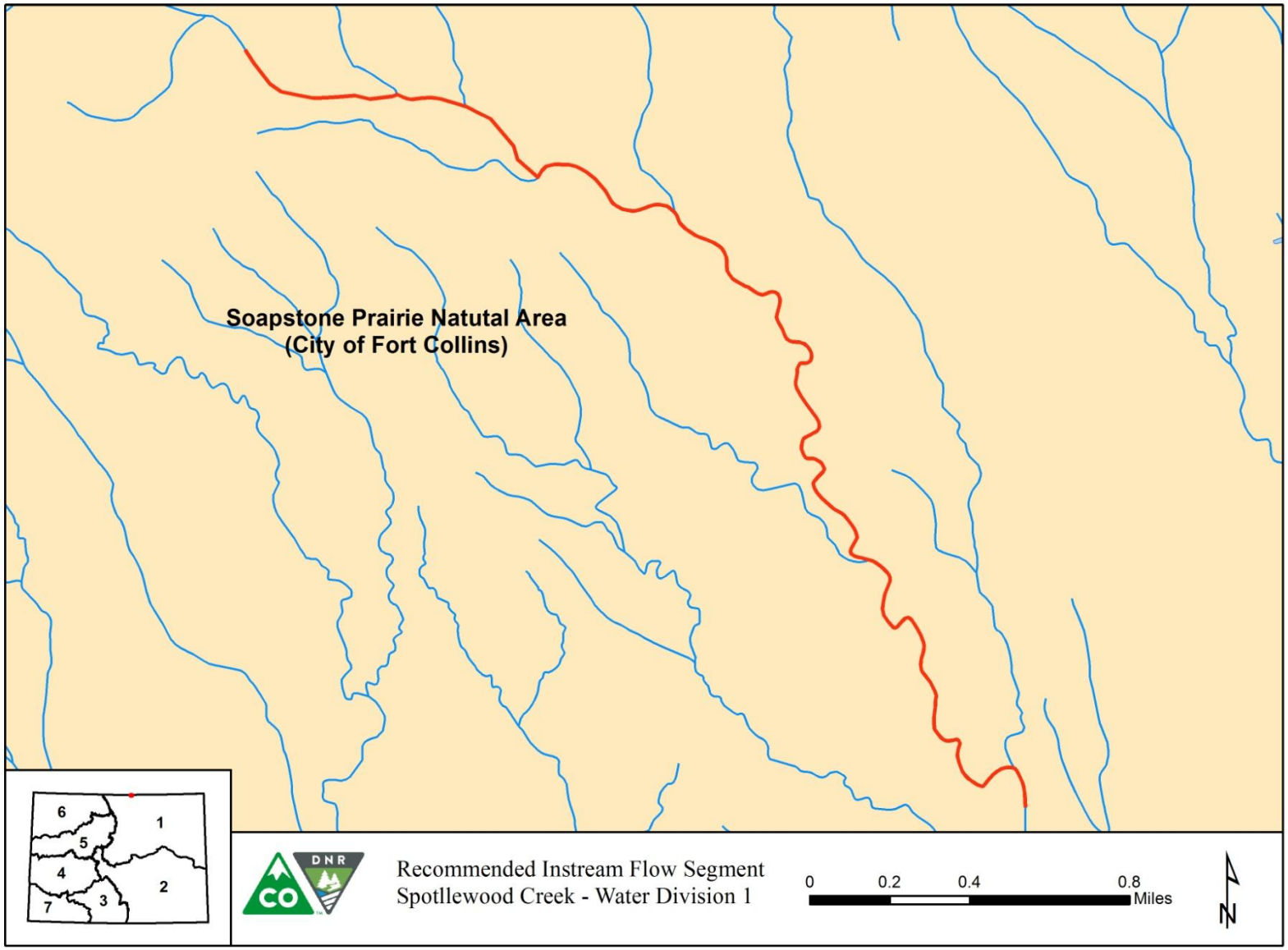


Figure 1. Complete hydrograph showing streamflow data and the proposed ISF rate on Spottlewood Creek

Vicinity Map



Land Use Map


Soapstone Prairie Natutal Area
(City of Fort Collins)
6
1
5
4
2
7
3
CO
DNR
Recommended Instream Flow Segment
Spotllewood Creek - Water Division 1
0
0.2
0.4
0.8
Miles
N

Water Rights Map