Cottonwood Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
March 15-16, 2023

UPPER TERMINUS:	Hawkins Ditch headgate UTM North: 4267895.51 UTM East: 206860.73
LOWER TERMINUS:	confluence with Roubideau Creek UTM North: 4289842.88 UTM East: 226016.62
WATER DIVISION:	4
WATER DISTRICT:	40
COUNTY:	Delta, Montrose
WATERSHED:	Lower Gunnison
CWCB ID:	18/4/A-006
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	23.33 miles
EXISTING INSTREAM FLOW:	4-06CW166, 3.6 cfs (4/1 – 6/15)
INCREASE INSTREAM FLOW RECOMMENDATION:	ISF protection initiates at 183 cfs and protects all unappropriated streamflow until flow rates recede to the existing 3.6 cfs ISF right. This water right will only be in effect 4/1 - 9/30.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

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 information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

RECOMMENDED ISF REACH

The BLM recommended that the CWCB appropriate an increase to an existing ISF water right on a reach of Cottonwood Creek. Cottonwood Creek is located within Delta and Montrose counties (See Vicinity Map) and is approximately 4.5 miles southwest from the City of Delta. The stream originates on the Uncompahgre Plateau at an elevation of 9,300 feet and flows northeast for 30.8 miles until it reaches the confluence with Roubideau Creek which is a tributary to the Gunnison River. The existing ISF water right on Cottonwood Creek was appropriated in 2006 for 3.6 cfs (4/1-6/15). The proposed reach extends from Hawkins Ditch headgate downstream to the confluence with Roubideau Creek for a total of 23.33 miles. The land on the proposed reach is 76.5% BLM, 9.5% USFS, 7% state, and 7% privately owned (See Land Ownership Map).

BACKGROUND

The BLM found Cottonwood Creek suitable for inclusion in the National Wild and Scenic Rivers System based in part on the presence of rare riparian communities that qualified as outstandingly remarkable values (ORVs; BLM, 2017). An ORV is defined as a river-related value that is unique, rare, or exemplary, when compared to the other streams in the region. This finding was informed by surveys conducted by the Colorado Natural Heritage Program (CNHP)[1] that determined that Cottonwood Creek contained rare plant communities that warranted conservation (Damm and Stevens, 2000; Stephens et al., 1999). On Cottonwood Creek, CNHP identified vulnerable populations of narrowleaf cottonwood and skunkbush sumac that are rarely found in the same habitat.

Although BLM recognized that Cottonwood Creek has some ISF protection, the suitability determination specifically noted that the current lack of flow protection for globally significant

1 The Colorado Natural Heritage Program is Colorado's only comprehensive source of information on the status and location of Colorado's rarest and most threatened species and plant communities. CNHP is a non-academic department of the Warner College of Natural Resources at Colorado State University. It is also a member of the NatureServe Network, "which is an international network of partners that use the same scientific methodology to enable scientists to monitor the status of species and natural plant communities from state, national, and global perspectives."

riparian values was a significant factor driving BLM's suitability determination. The BLM stated that if scientific studies conclude that alternative forms of flow protection are in place and are sufficient to fully protect the flow-related ORVs on Cottonwood Creek, the BLM will determine it is unnecessary to quantify, assert, or adjudicate a federal reserved water right for these segments if they are ultimately designated into the National Wild and Scenic River System.

At the request of the CWCB, BLM developed a concept to preserve the riparian communities of these streams using the ISF program. The proposed ISF is based on protecting high-flow events and the falling limb of the hydrograph which create the conditions necessary for seedlings to survive and sustain the population of the riparian community. This ISF increase would only be active during the primary growing season and only when flows are sufficiently high to provide benefits to the riparian community. At other times, the existing seasonal ISF would continue to provide some flow protection for aquatic habitat.

OUTREACH

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently, more than 1,100 people are subscribed to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Cottonwood Creek was sent to the mailing list in November 2022, March 2022, November 2021, March 2021, November 2020, March 2020, November 2019, March 2019, March 2018, and March 2017. Staff also sent letters in March 2022 to all landowners adjacent to Cottonwood Creek according to the county assessors' website to notify them about the ISF recommendation. A public notice about this recommendation was also published in the Montrose Daily Press on January 8, 2022 and December 21, 2022.

Staff presented information about the ISF program and this recommendation to the Montrose County Board of County Commissioners on October 3, 2017, December 9, 2019, and November 21, 2022 and the Delta County Board of County Commissioners on December 9, 2019. In addition, staff spoke with State Engineer Kevin Rein on June 6, 2017, and with State Engineer Kevin Rein and Deputy State Engineer Tracy Kosloff on October 9, 2020 regarding the administrability of this ISF recommendation. Staff also communicated with Bob Hurford, Division Four Engineer and Luke Reschke, Lead Water Commissioner several times regarding water rights and water use practices on Cottonwood Creek.

NATURAL ENVIRONMENT

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists. Please see BLM's letter of recommendation which includes more detailed information about the plant communities, riparian flow needs, and the importance of protecting the riparian communities.

Riparian Community

Cottonwood Creek starts near Columbine Pass on the Uncompahgre Plateau, it descends through forested lands before carving a gradually deepening canyon. The valley floor contains a wide riparian corridor. CNHP surveys found that Cottonwood Creek supports a healthy riparian plant community that is part of the Rocky Mountain Lower Montane-Foothills Riparian Woodland and Shrubland Ecological System (CNHP website).

Specifically, Cottonwood Creek contains a population of a rare imperiled narrowleaf cottonwood and skunkbush sumac (*Populus angustifolia/Rhus trilobata*) riparian forest (Figure 1). Narrowleaf cottonwoods are members of the willow family that can grow up to 80 feet in height. Skunkbush sumac is a deciduous, flowering shrub, averaging four feet in height. Cottonwood Creek also includes extensive acreage of other non-imperiled riparian communities and species, that were noted by CNHP to be in very good condition such as Fremont cottonwood (*Populus deltoides ssp. Wislizenii*), red osier dogwood (*Cornus sericea*), silver buffaloberry (*Shepherdia argentea*), thin leaf alder (*Alnus incana*), strapleaf willow (*Salix ligulifolia*), and coyote willow (*Salix exigua*) (Damm and Stevens, 2000; Stephens et al., 1999).

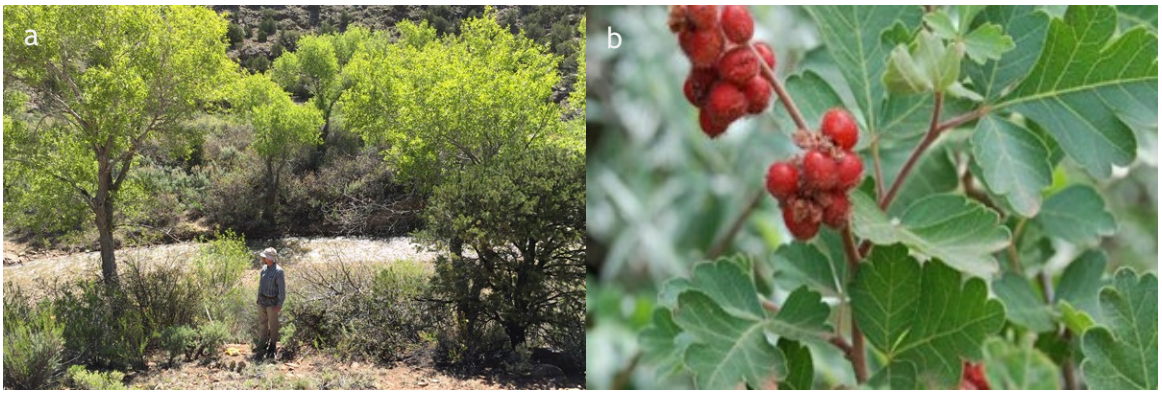


Figure 1. Images of species in the Cottonwood Creek riparian area. a) narrowleaf cottonwood and b) skunkbush sumac

The combination of narrowleaf cottonwood and skunkbush sumac is rated by CNHP as both globally and state vulnerable, which is defined as being at moderate risk of extinction with 21 to 100 occurrences of these communities in the world (Damm and Stevens, 2000). Even though the populations of narrowleaf cottonwood and skunkbush sumac are widely distributed, these species are rarely found growing in the same location because of their different habitat needs which are rarely met simultaneously.

CNHP included Cottonwood Creek as one of 25 wetland and riparian sites within Ouray and eastern Montrose counties that most merit conservation efforts and as one of four areas of local significance based on its ecosystem functions and values (Stephens et al.,1999). Both CNHP and BLM found Cottonwood Creek to have high biodiversity with the riparian community in good condition, few non-native species, and minimal anthropogenic disturbance. CNHP ranked Cottonwood Creek biodiversity as having high significance with an excellent example of good occurrences or state rate species.

CNHP designated the Cottonwood Creek watershed as a Potential Conservation Area (PCA) because highly functioning riparian areas with an intact assemblage of historic native species are so rare in the Uncompahgre River basin. PCAs focus on capturing the ecological processes necessary for the continued existence of plants or plant communities with natural heritage significance. PCAs are meant to be used for conservation planning purposes but have no legal status. CHNP states that, “the Cottonwood Creek Conservation PCA merits special status, such as designation as a BLM Area of Critical Environmental Concern (ACEC) or Research Natural Area.” (Damm and Stevens, 2000)

Riparian communities are important because they provide many critical hydrologic, watershed, and ecosystem functions (Stephens et al., 1999). Hydrologically, riparian areas can help mitigate the impacts of floods by reducing water velocity and attenuating peak flows. They also stabilize streambanks and prevent erosion and unraveling of the channel during high-flow events. Heavily vegetated riparian corridors provide biogeochemical functions of filtering out sediment and toxins. Riparian communities directly support wildlife by providing diverse habitat types including forest, dense scrub, and shrub. In semi-arid regions of the western United States, an estimated 80% of mammals, birds, reptiles, and amphibians use riparian areas and wetlands for habitat throughout the year or as migratory rest stops (Somers and Floyd-Hanna, 1996). The riparian corridor also provides shade to reduce water temperatures and organic matter which provides habitat and food for the aquatic ecosystem.

Preserving the riparian corridor in Cottonwood Creek is warranted to preserve a rare riparian community that provides important functions including maintaining overall system resiliency. This riparian community is uniquely adapted to the Uncompaghre Plateau which includes extremes of high and low streamflow conditions in a semi-arid region. These diverse riparian communities of native species are well adapted to their location and are better able to withstand environmental stresses and catastrophic events. When a watershed is more resilient, it is better able to rebound following disturbances such as severe storms, flooding, landslides, mudslides, and wildfires. Resiliency also mitigates the impact of those disturbances on the surrounding communities, which improves outcomes for both people and ecosystems.

Native Fish

Although not the primary basis for the proposed ISF, Cottonwood Creek also provides important habitat for the three-species: Flannelmouth Suckers (*Catostomus latipinnis*), Bluehead Suckers (*Catostomus discobolus*), and Roundtail Chubs (*Gila robusta*). These species are identified by the state of Colorado as Species of Greatest Conservation Need and by the BLM as sensitive species. They are also subject to a multi-state conservation agreement designed to prevent a listing of the species under the Endangered Species Act (Utah DNR, 2006).

CPW has conducted extensive research on Cottonwood Creek and the Roubideau Creek basin including monitoring streamflow, fish sampling, and fish tracking to determine movement patterns and spawning site selection. CPW found that upwards of 25,000 fish use the Roubideau Creek drainage to spawn annually, with thousands of fish using tributaries such as Cottonwood Creek. Individual fish have very high annual spawning tributary fidelity in this area, with up to 77% of individuals returning to the drainage multiple years in a row (Thompson and Hooley-Underwood, 2019).

High-flow events are also important for the three-species. These species are cued to spawn when streamflow in the tributaries increases during runoff. A gradual receding flow after the spring peak supports the development of eggs, hatching, larvae development, provides habitat for juvenile fish to grow and mature, and allows adult fish to move back into larger river systems before they become stranded. These findings highlight the importance of Cottonwood Creek for the three-species, especially because few other accessible and flowing tributary networks remain.

ISF QUANTIFICATION

BLM staff, in conjunction with CWCB, evaluated the flow needs of the riparian communities and examined several methods to quantify the flow rates necessary to preserve the species.

Flow Needs of Riparian Communities

The BLM conducted a review of scientific literature to identify the flow regime needed to support the vulnerable narrowleaf cottonwood and skunkbush sumac riparian community (See BLM's recommendation letter for additional details). Considerable research has been conducted on the hydrologic conditions necessary for establishment and persistence of cottonwood trees. Those studies conclude that the persistence of cottonwood trees as part of a riparian community is highly dependent on infrequent flood or high-flow events (Cooper et al, 1999). High-flow events create disturbed areas and wet sediment deposits where cottonwood can germinate by seed, root, or branch fragment propagation (Scott et al., 1997).

Like cottonwood trees, skunkbush sumac also reproduces by seed and root sprouts, but the dominant form of reproduction is sprouting. Sprouting occurs more frequently in response to large disturbance events such as floods. However, unlike cottonwood trees, skunkbush sumac needs well-drained soils and will not tolerate long-duration high-flow events or high-water tables for long durations. BLM believes that the sandstone-based soils along Cottonwood Creek and the general short duration of high-flow events allows these species to survive and grow interspersed with the narrowleaf cottonwoods.

In addition to high-flow events, research also concludes that slowly receding flow rates after the event are important for maintaining water levels in the alluvial aquifer. This allows the roots of new seedlings to grow and remain in contact with the receding groundwater levels in riparian soils (Mahoney and Rood, 1998). Baseflows, which occur in later summer, fall, and winter, also maintain water levels in the alluvial aquifer, supporting deep-rooted cottonwoods and willows, which both require constant access to groundwater to prevent dieback of upper branches or mortality.

Because high-flow events are critical to long-term reproduction and success of the riparian community, BLM focused on identifying the flow rate that would start to access the riparian community. BLM identified that bankfull, which is typically the elevation where streams start to access the floodplain and inundate riparian vegetation, was an appropriate threshold necessary to preserve the riparian community. When streamflow is at bankfull conditions or above, important processes required for the long-term survival of the plants can occur, including creating areas where wet sediment is deposited, dispersal of seeds and branches, depositing nutrients on the floodplain, and recharge of the alluvial aquifer.

Hydraulic Modeling

BLM staff explored using the U.S. Forest Service's WinXSPRO model to identify the flow rate necessary to preserve the riparian communities. After evaluating the model, BLM and CWCB staff determined that the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) would produce more reliable results. HEC-RAS is widely used throughout the United States for hydraulic modeling of floods. This model uses multiple cross-sections to perform more advanced calculations than approaches that rely on single cross-sections. It is also capable of producing maps that illustrate the portions of the channel

inundated at different flows. BLM and CWCB staff concluded that results from the HEC-RAS model were more appropriate and accurate for modeling high flows.

CWCB staff hired AECOM, an outside engineering firm, at the beginning of 2021 to collect detailed survey information and develop hydraulic models for the sites in each of the four proposed ISF reaches. CWCB Staff, BLM staff, and the AECOM surveyor selected a reach on Cottonwood Creek six miles upstream from the lower terminus. This site was selected based on the presence of the riparian species of interest and channel characteristics that were conducive to modeling efforts. In each selected site, AECOM surveyed cross-sections to measure channel geometry and floodplain topography. Bankfull indicators were identified by CWCB and BLM staff at each cross-section. In addition to elevation data, the AECOM surveyor also measured the location of debris piles deposited by exceptionally large and infrequent flow events. A total of eight cross-sections were surveyed on the selected reach of Cottonwood Creek.

AECOM then developed a hydraulic model for each reach using HEC-RAS version 5.0.7 (AECOM, 2021). Manning's n values were selected based on aerial imagery and photos collected during the field survey which showed the nature of the channel, bed material, and vegetation. These values were selected in accordance with Table 3-1 in the HEC-RAS 5.0.1 Reference Manual. On Cottonwood, the Manning's n value in the channel was set to 0.045, the values in the floodplain were set to between 0.055 and 0.07. Using an iterative process, discharge values for the minimum bankfull elevation and the minimum and maximum flood debris elevations were determined in each reach. The selected discharge minimized the difference between the modeled water surface elevation and the surveyed bankfull elevations.

For Cottonwood Creek, AECOM determined that the surveyed bankfull indicators correspond to a flow of 183 cfs (Table 1). The lower elevation flood debris corresponds to a streamflow of 974 cfs and the maximum elevation of the debris corresponds to a streamflow of 1247 cfs.

Table 1. HEC-RAS modeling results for Cottonwood Creek.

Parameter	Discharge (cfs)
Bankfull	183
Minimum elevation of flood debris	974
Maximum elevation of flood debris	1,247

ISF Recommendation

This recommended ISF water right is specifically structured to protect the high-flow component of the hydrologic regime that is critical to the persistence of riparian communities. This water right also protects the receding limb of the hydrograph. Protecting bankfull flows and the receding limbs of the hydrograph will provide the conditions necessary for reproduction and maintenance of the riparian communities. The BLM recommends the following flows based on modeling analyses and the biological needs of the riparian communities:

> When the flow rate reaches 183.0 cfs (bankfull flow), all flow in the creek should be protected until the flow rate recedes to 3.6 cfs, which is the flow rate associated with the existing ISF right from April 1 to June 15. If the threshold of 183.0 cfs is met outside of the April 1 to June 15 period associated with the

current CWCB water right, then flows should also be protected as they recede down to a 3.6 cfs flow rate.

BLM recommends that the proposed water right be in effect only during the April 1 to September 30 period, if the flow rate threshold is met. This time frame corresponds to the portion of the year when the riparian community is actively growing and reproducing, and when most high flow events occur due to snowmelt runoff and monsoonal thunderstorms. During years in which streamflow does not reach the proposed threshold, this instream flow water right for high-flow events would not be in effect.

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.

Water Availability Methodology

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that Staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) 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 to estimate a selected basin's streamflow statistics including flood discharge and frequency characteristics (Capesius and Stephens, 2009). 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.

Unlike other ISF water rights, this ISF will only be in effect when the bankfull threshold is reached and only during a limited portion of the year. This proposed ISF is not structured to occur year-round and is not expected to occur every year or even in most years. Therefore, median flow is not assessed in this analysis because the high-flow events necessary for the riparian community are not anticipated to occur on a median basis. Instead, the water availability analysis for Cottonwood Creek provides information about the known hydrology in the area, the available streamflow data for Cottonwood Creek, and the potential characteristics of these high-flow events.

Basin Characteristics

The drainage basin of the proposed ISF on Cottonwood Creek is 46.8 square miles, with an average elevation of 7,210 feet and average annual precipitation of 16.09 inches (See the Hydrologic Features Map). Hydrology throughout the Uncompahgre Plateau demonstrates a relatively early snowmelt runoff pattern that is also influenced by monsoon and late-season storms. This results in high-flow events that can occur between early spring and early summer due to snowmelt and high-flow events that can occur between summer and late fall due to rain events. A nearby gage, Roubideau Creek at mouth near Delta, CO gage (USGS 09150500, period of record 1939 to 1953 and 1976 to 1983), shows that most annual peaks occur in May but can occur as late as October (Figure 2).

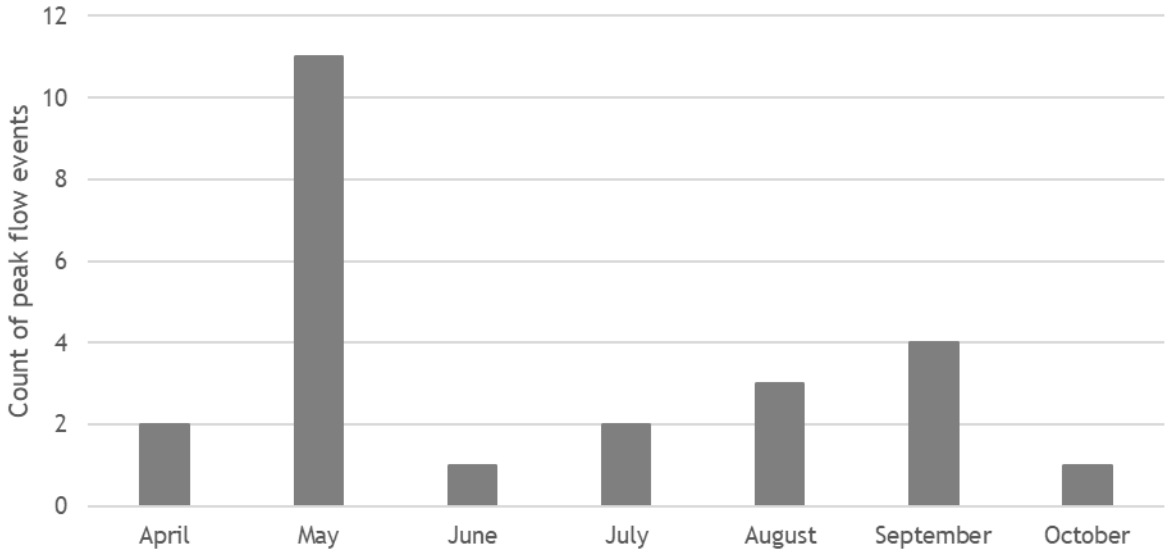


Figure 2. Number of times the peak occurred each month at the Roubideau Creek at mouth near Delta, CO peak flow gage data from 1939-1953 and 1976-1983.

Snowmelt runoff typically produces the high-flow event with the longest duration, which can last weeks to months. Rain events have the potential to produce very high flows but are typically short-duration events. Streamflow in this region can be highly variable, some years may have substantial flows while other years have little to no measurable flow.

Existing Water Uses

There are several water rights in the basin tributary to the proposed ISF on Cottonwood Creek. There are five active surface water diversions upstream from the proposed lower terminus. The sum of decreed surface water diversions is 84 cfs, with maximum recorded diversions totaling 44 cfs for all diversions. The largest of the five, the Hawkins Ditch (WDID 4001437, 31 cfs, appropriated in 1947), is located approximately 230 feet downstream of the proposed upper terminus. There are also 219 acre-feet in active storage rights and 0.066 cfs for two springs. None of these water rights are known to completely dry up Cottonwood Creek. Some diversions import or export water into the Cottonwood Creek basin. The Everlasting Ditch (WDID 4001435, 27 cfs, appropriated 1901) irrigates lands in both the Cottonwood Creek drainage basin and the adjacent drainage basin, Monitor Creek. In addition, the David Brother's Ditch (WDID 4001428, 2 cfs, appropriated in 1951, 10 cfs, appropriated in 1959) diverts water from the adjacent Dry Fork Escalante Creek which is used to irrigate lands in the Cottonwood Creek basin via the North

Fork Ditch (WDID 4001325, 3 cfs, appropriated in 1925, 10 cfs, appropriates in 1959) approximately 3.5 miles upstream of the upper terminus. Hydrology is altered by water use within the basin.

Data Collection and Analysis
A number of different sources of information were used to assess hydrology in Cottonwood Creek. Each source will be presented in subsections for clarity.

Representative gage analysis
There are no current or historic streamflow gages on Cottonwood Creek. No representative gages on nearby streams were identified due to a general lack of gages in the region and the high level of water use in the nearest streams with gages.

CPW Cottonwood Creek gage
Colorado Parks and Wildlife (CPW) CPW installs a temporary streamflow gage on Cottonwood Creek annually to monitor spring flows in conjunction with research on spawning movements of native sucker species. This gage (termed the CPW Cottonwood gage) is located about 0.1 miles upstream from the proposed lower terminus on Cottonwood Creek. The CPW gage is operated seasonally, typically from early spring in March or April through June or early July when the spawning migration is completed, and flows drop. The gage has operated most years from 2015 to present. The gage was not operated through late summer, fall, or winter and therefore does not record information from flow events during these portions of the year. As such, though they are assumed to exist and understood to be short in duration, there are no recorded late summer and early fall monsoon events in the CPW gage record. Streamflow measurements collected to maintain this gage as well as other measurements made by CPW and CWCB are included in the hydrograph. Staff then used the available data to develop a rating curve to determine streamflow during the gaged portions of the years with data.

During the time of data collection, the seasonal gage has collected a range of flows and events (See Complete and Detailed Hydrographs). The seasonal gage was not installed and no data was recorded in Cottonwood Creek during 2018 and 2021 due to extremely low flows and short flow durations from extreme drought conditions. In 2016, 2019, and 2022 the seasonal gage recorded several high-flow events. All other years show varied flow throughout the spring and early summer.

The CPW gage is affected by within basin diversions and diversions that both export and import water from the system. For a summary, please see existing water uses section above. Given that the impacts of diversions are reflected in gage records, no further adjustments were made to assess the impact on water available for the overbank thresholds on the instream flow reach.

Climate Conditions
The CPW Cottonwood Creek gage record period (2015-2022) was compared to a longer-term climate record for context. The nearest climate station with a relatively long record is at Columbine Pass (USS0008L02S, 1986 to 2022) located in the headwaters of Potter Creek, approximately 18 miles southwest from the proposed lower terminus. Figure 3 shows cumulative snow water equivalent (SWE) totals for 2015-2022 in comparison to the 30-year average (downloaded from the Colorado River Basin Forecast Center on 2/9/2023). Peak SWE in 2018 was the lowest on record, 2015, 2020 and 2021 were below average, 2016 was about average,

and 2017, 2019, and 2022 were above average. This information demonstrates a range of precipitation in the area during the CPW Cottonwood Creek gage record.

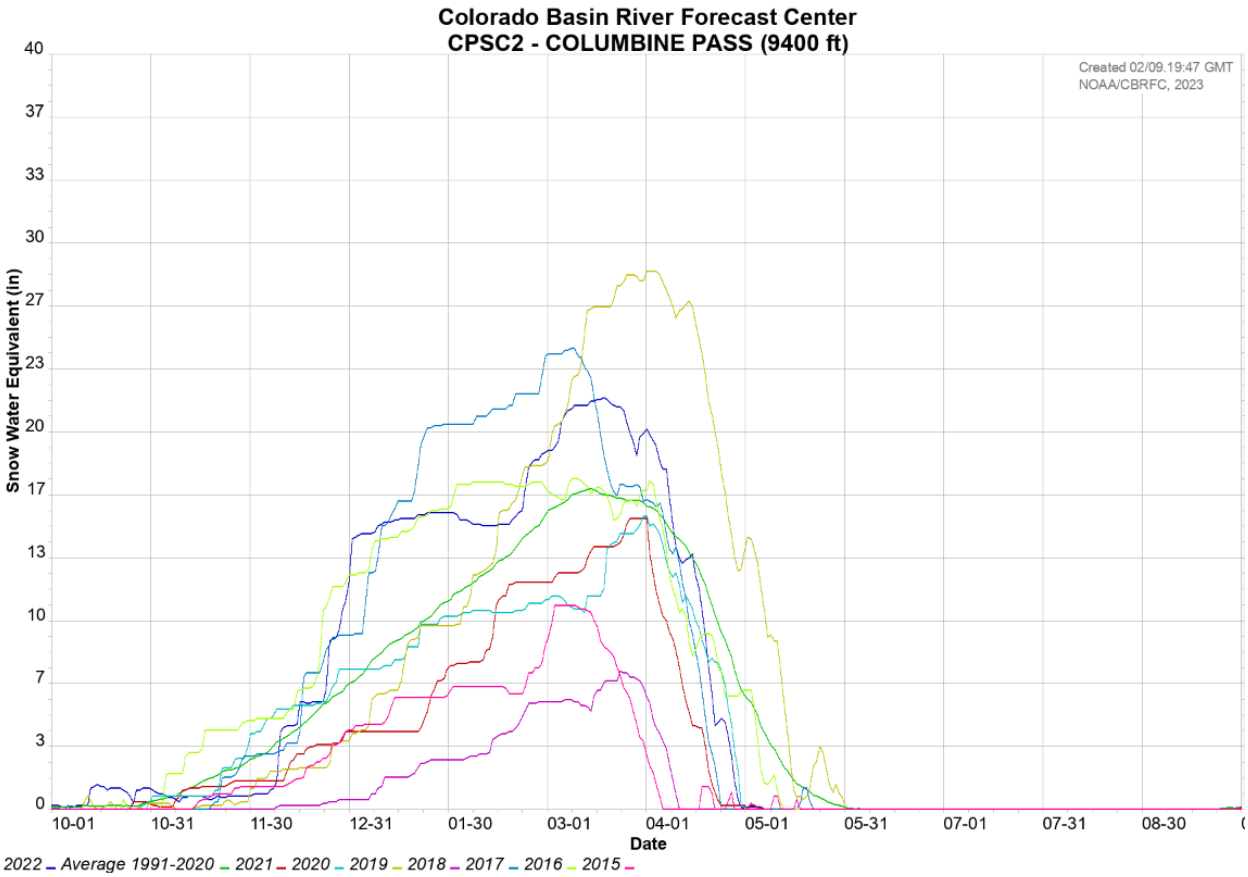


Figure 3. Cumulative SWE for 2014 to 2022 and median SWE from 1991 to 2020 downloaded from the Colorado River Basin Forecast Center on 12/19/2022. Source: NOAA Colorado Basin River Forecast Center

Staff also evaluated streamflow gages to better understand potential streamflow given that persistent low soil moisture in recent years has impacted how much snowfall becomes streamflow. The Dallas Creek gage and San Miguel gages (USGS 09147000 Dallas Creek near Ridgway and USGS 0917700 San Miguel River at Uravan) were selected because they were reasonably close to the Uncompaghre Plateau. The gages are not impacted by large reservoirs; however, they are in different basins and have significant water uses. Years with complete data (provisional or approved data, filling missing data in 2022 with the long-term average) from 1992 to 2022 was used to calculate annual water volumes and basic percentiles. Data from these gages show that 2019 was very wet (greater than 75th percentile); 2015 was wet to dry (greater than 50th percentile for the San Miguel and greater than the 75th percentile for Dallas Creek, 2016 and 2017 was wet or wettest (greater than the 50th percentile for the San Miguel River and greater than 75th percentile for Dallas Creek); 2018, 2020, 2021, and 2022 were in the driest category (less then 25th percentile). 2018 and 2020 were exceptionally dry with annual water volumes less than the 10th percentile. Therefore, the CPW Cottonwood Creek gage

data contains a range of year types, but many years in the record are likely to reflect dry or exceptionally dry conditions.

High-Flow Characteristics

The ISF recommendation is based on the importance of high-flow events that help to maintain the rare riparian community on Cottonwood Creek. Based on the available information from the CPW gage, riparian flows would have been achieved in three of the six years the gage operated, with three separate events as shown in the Complete Hydrograph, the Detailed Hydrographs and Table 2. All three events lasted multiple days until flows receded to the existing ISF rate of 3.6 cfs. The highest daily average flow recorded at the CPW gage was 210 cfs and the highest instantaneous flow (based on a 30-minute interval reading) was 286 cfs.

Table 2. Duration and maximum streamflow for high-flow events that reached the bankfull threshold or higher in Cottonwood Creek (2015-2022).

Start Date	End Date	Duration (time)	Maximum flow (cfs)	Data Source
5/7/2016	5/27/2016	21 days	278	CPW gage
4/30/2019	6/17/2019	49 days	286	CPW gage
4/20/2022	5/20/2022	29 days	201	CPW gage

The USGS StreamStats model estimates several different peak flow statistics based on regional regression analysis using available streamflow data (Table 3). These estimates provide information about the potential frequency of high-flow events, but these estimates likely have high uncertainty due to the lack of streamflow gages in the region that can be used to inform the models. Nevertheless, these estimates suggest that the riparian threshold of 183 cfs could occur at the frequency of a 2-year peak flood event.

Table 3. StreamStats estimates of area-averaged high-flow events on Cottonwood Creek.

Peak Flow Statistic	Estimated Flow (cfs)
2 Year Peak Flood	217
5 Year Peak Flood	416
10 Year Peak Flood	584
25 Year Peak Flood	863
100 Year Peak Flood	1,350

Historical High-Flow Event Estimates

AECOM also surveyed the location of large piles of woody debris deposited by previous very infrequent high-flow events on the floodplain of the modeled stream site. The HEC-RAS model was used to estimate the flow necessary to reach the locations of the debris piles. This modeling work estimated that a flow of 974 cfs would reach the minimum elevation of the debris and a flow of 1,247 cfs would reach the high elevation of the debris. BLM estimated that some of the debris piles were deposited within the last ten years and BLM staff are aware of a very high-flow event that occurred in 2008 (Jedd Sondergard, BLM staff personal communication 4/6/2021). The observation of large piles of debris on the floodplain demonstrates that very high-flow events do occur and that these events can inundate large portions of the floodplain.

Water Availability Summary
The hydrographs of the available gage data, along with the AECOM estimates of high-flow events, and StreamStats estimates of peak flow events provide information about hydrology on Cottonwood Creek. These data demonstrate that high-flow events above the bankfull threshold of 183 cfs have occurred on Cottonwood Creek, although they do not occur in every year. Staff concludes that water is available for the appropriation as structured.

MATERIAL INJURY
As a new junior water right, the proposed ISF on Cottonwood Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

ADDITIONAL INFORMATION

Citations

AECOM, 2021, Cottonwood, Monitor, and Potter Creek's survey and hydraulics. Memo to CWCB.

Bureau of Land Management. 2017. Record of decision and approved resource management plan for Dominguez-Escalante National Conservation Area.

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

Colorado Natural Heritage Program, Rocky Mountain lower montane-foothills riparian woodland and shrubland. https://cnhp.colostate.edu/projects/ecological-systems-of-colorado/details/?elementID=365200

Cooper D.J., Merritt, D.M., Anderson, D.C. and Chimner, R.A, 1999, Factors controlling the establishment of Fremont cottonwood seedlings on the Upper Green River, USA. Regulated Rivers: Research and Management, 15:419-440.

Damm, M., and J. Stevens, 2000, Assessment of riparian vegetation and wildlife habitat structure: North Fork of the Gunnison tributaries and lower Gunnison tributaries. Colorado Natural Heritage Program.

Mahoney, J.M. and S.B. Rood, 1998, Streamflow requirements for cottonwood seedling recruitment- an integrative model. Wetlands, 18; 634-645.

Scott, M.L., Auble, G.T., and Friedman, J.M.,1997, Flood dependency of cottonwood establishment along the Missouri River, Montana, USA. Ecological Applications, 7:677-690.

Somers, P. and L. Floyd-Hanna, 1996, Wetlands and riparian habitats, and rivers. In Blair, R., ed. pp. 175-192. The western San Juan Mountains: their geology, ecology, and human history. University Press of Colorado, Niwot, CO.

Stephens, T., D. Culver, J. Zoern, and P. Lyon, 1999, A natural heritage assessment of wetlands and riparian areas in Uncompahgre River basin: Eastern Montrose and Ouray Counties Volume II. Colorado Natural Heritage Program.

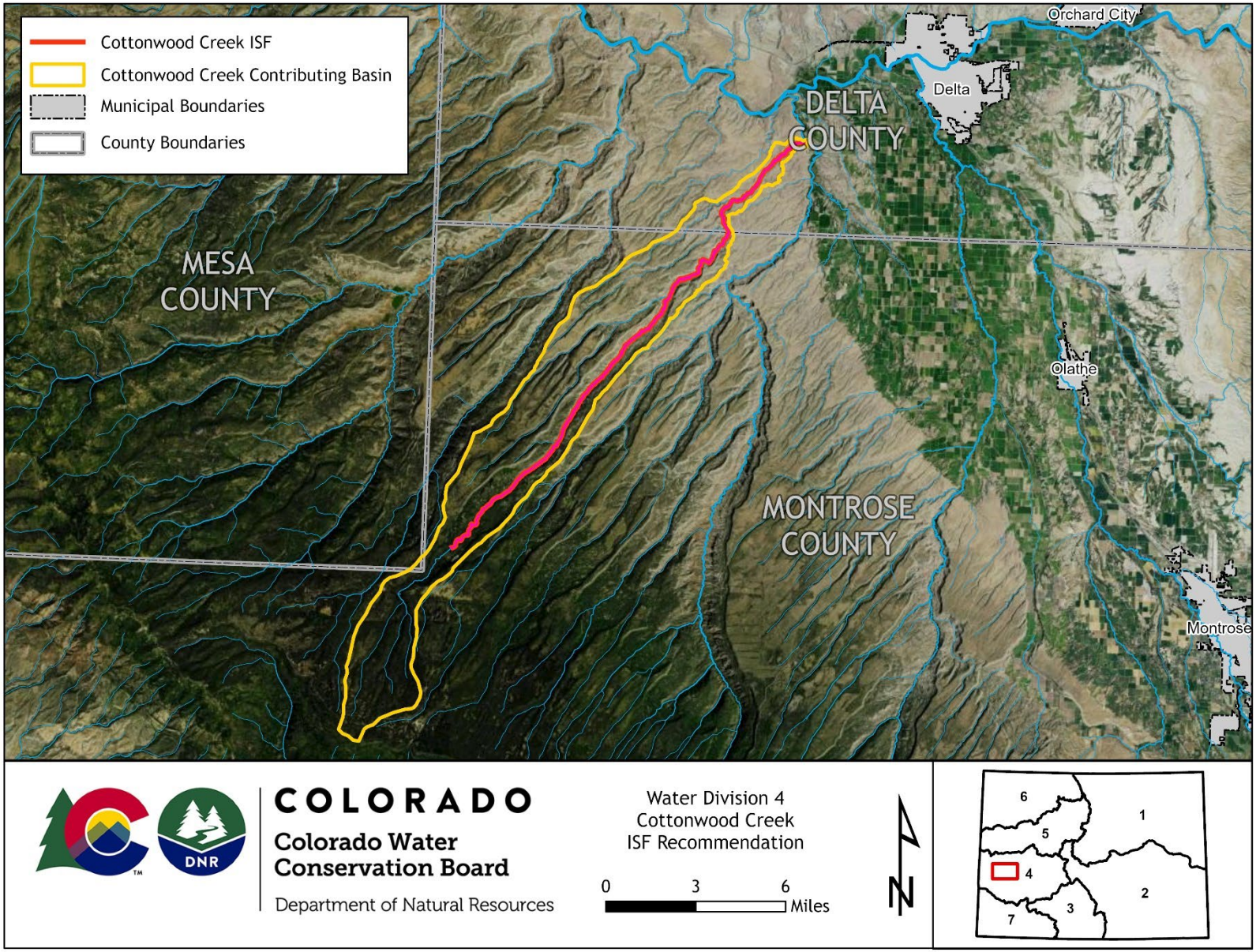
Thompson, K.G., and Z.E. Hooley-Underwood, 2019, Present distribution of three Colorado River basin native non-game fishes, and their use of tributaries. Technical publication No. 52, Colorado Parks and Wildlife Aquatic Research Section.

Utah Department of Natural Resources, Division of Wildlife Resources, 2006, Range-wide conservation agreement and strategy for Roundtail Chub *Gila robusta*, Bluehead Sucker *Catostomus discobolus*, and Flannelmouth Sucker *Catostomus latipinnis*.

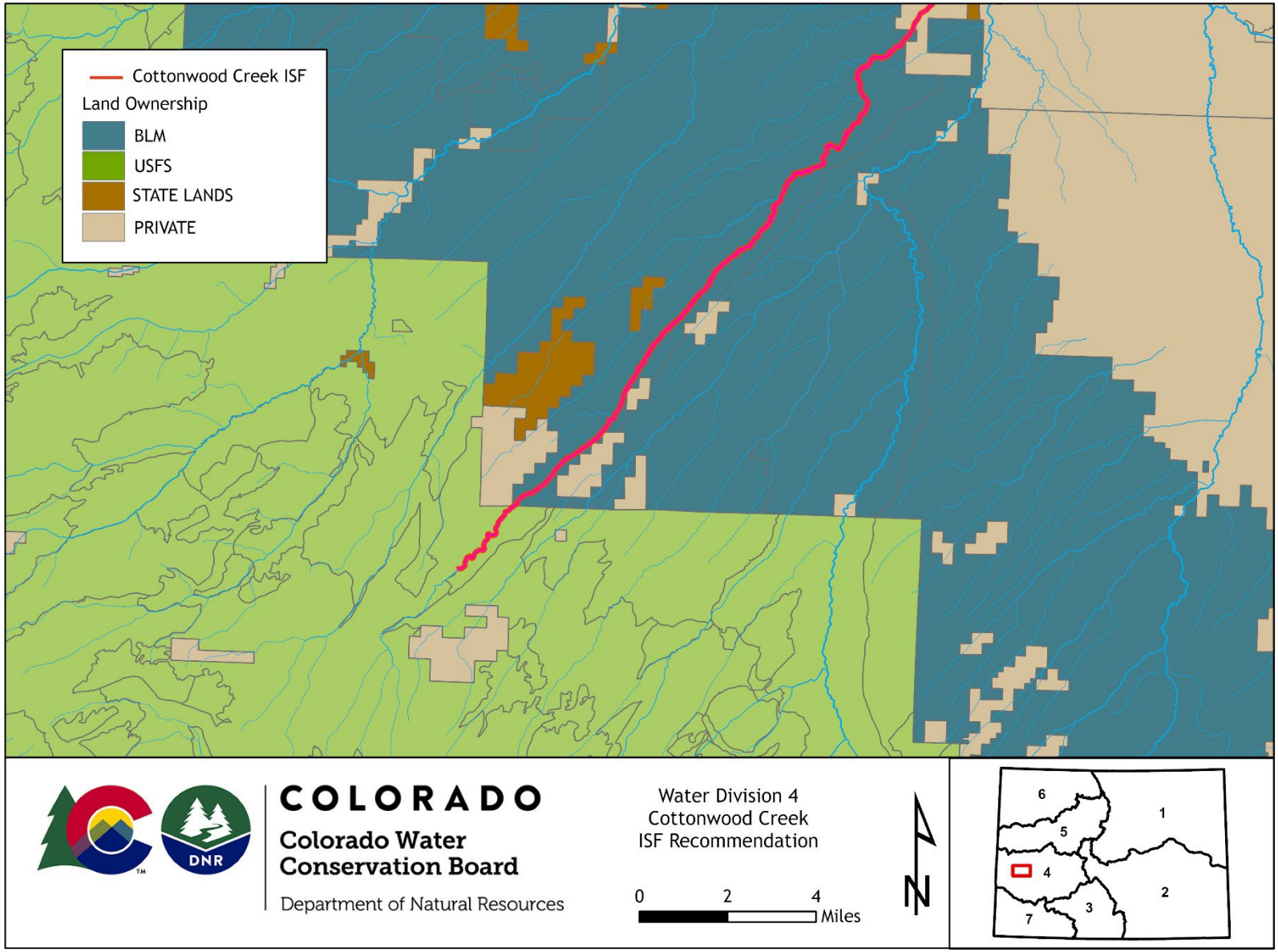
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

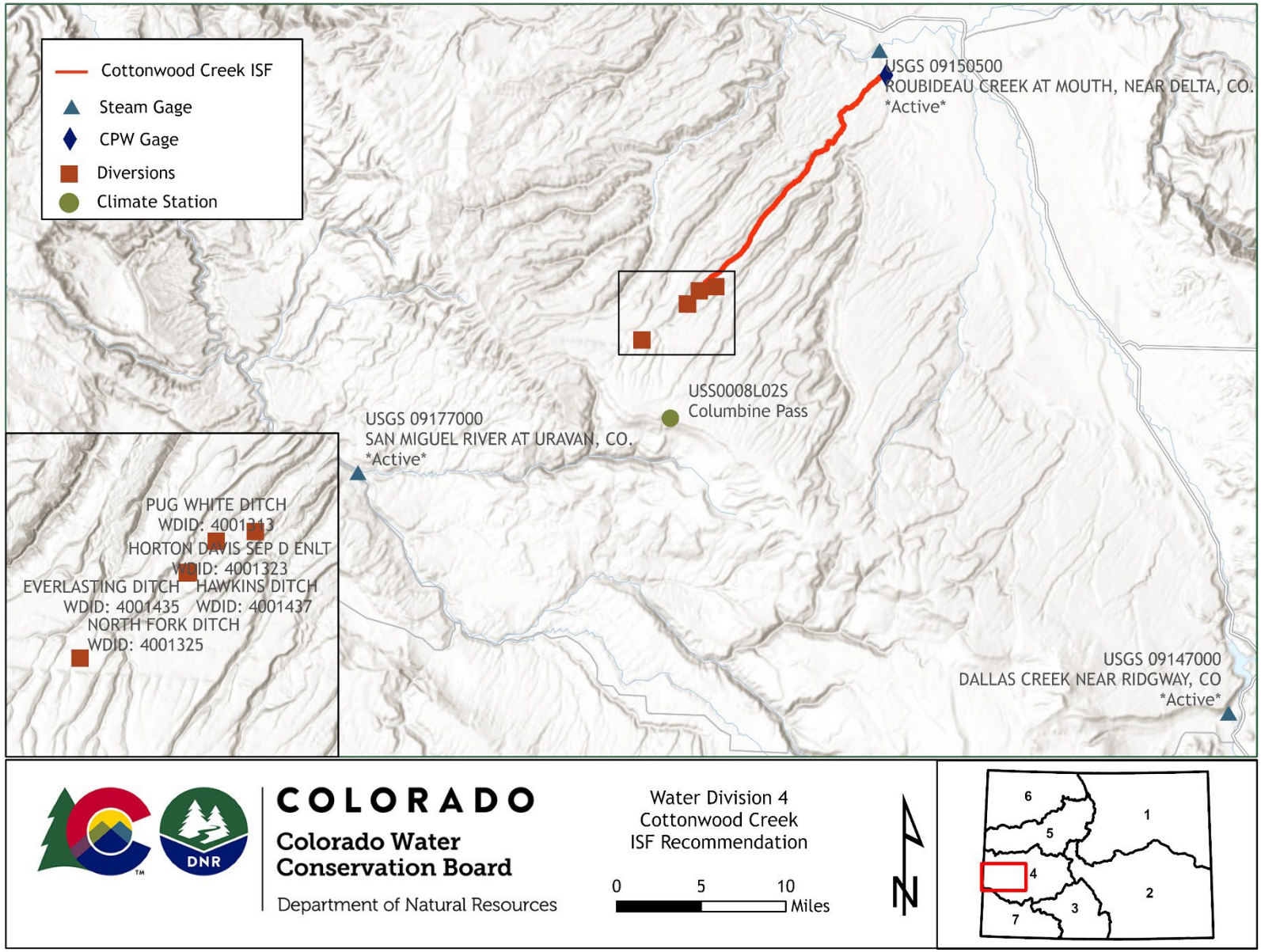
VICINITY MAP



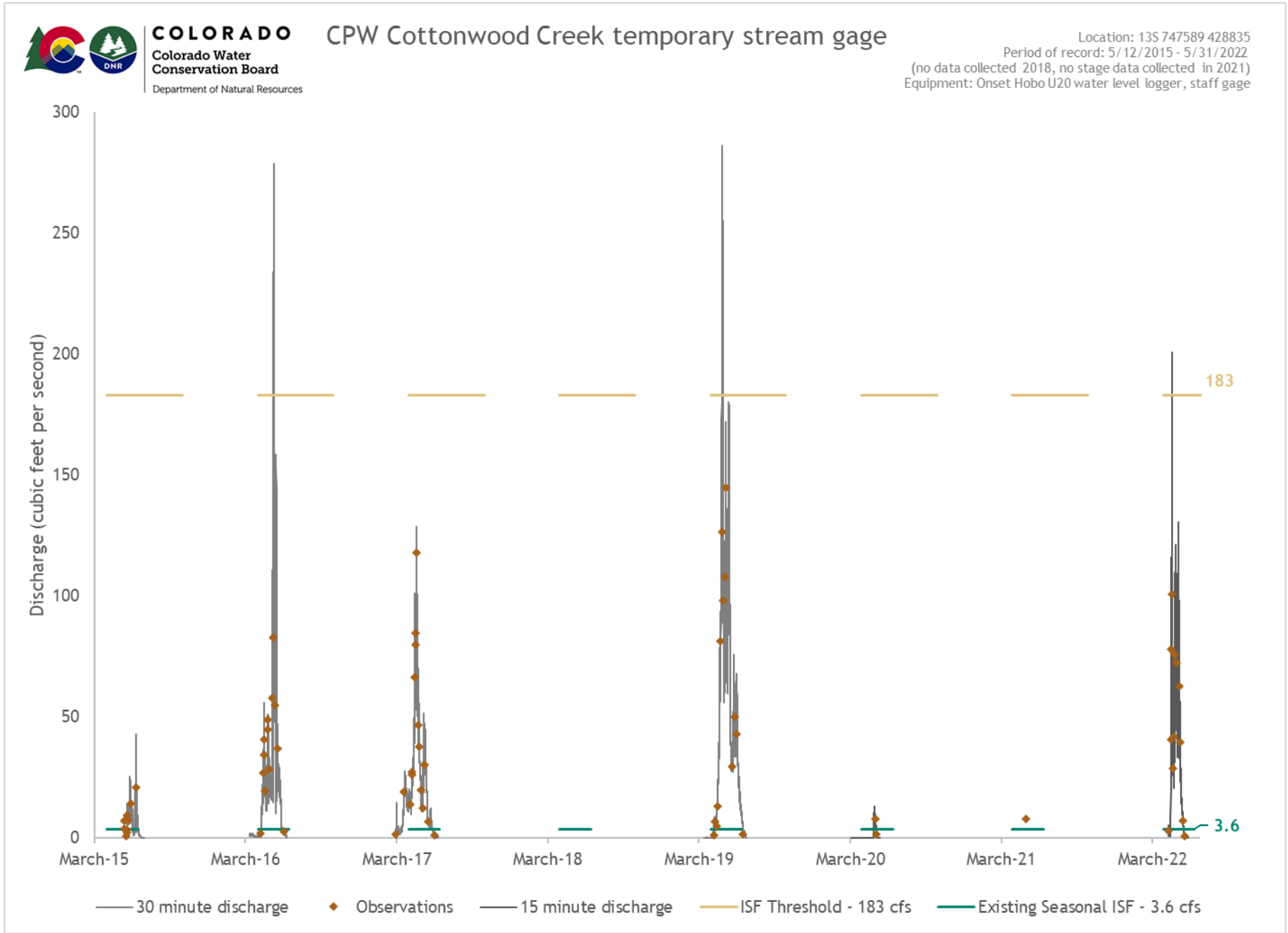
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPHS