

**Instream Flow Rights in Colorado: anticipated impacts  
from climate change**

**A Thesis**

Presented to

The Faculty of the Environmental Studies

Program

The Colorado College

In Partial Fulfillment of the

Requirements for the Degree

Bachelor's of Arts in

Environmental Policy

By

Anita Klaeser

May 2020

**Eric P. Perramond (1<sup>st</sup> reader)** 

**Michael Angstadt (2<sup>nd</sup> reader)** 

## **Introduction**

The water law system that can be found throughout the west is known as the prior appropriation system and was created in Colorado (Getches 1997, 7). This system is based on the prior appropriation doctrine which says that the first in time is also the first in right. This first come first served system, or Colorado Doctrine as it is also sometimes referred to, was originally created in Colorado when mining attracted Anglo-American pioneers and prospectors to the west. The idea behind prior appropriation was that by only allowing those who would use the water they appropriated for a beneficial use, a water monopoly would be avoided (Schorr, 2012, 104). While the system has worked well for Colorado, in large part because prior indigenous peoples were ignored by, or expelled from, the state, it has not been without problems. The prior appropriation doctrine says that appropriated water must be put to a beneficial use. While beneficial use prevents monopoly and wasted water, it can be difficult to interpret. There are now many different types of beneficial uses including municipal use, agriculture, industrial, commercial. Since 1973, the most recent additions to the list of state-recognized beneficial uses include environmental and recreational purposes. However, in the last two decades, concerns about the impacts of climate change are putting environmental water rights at risk because of their place in the water law system. There will likely be significant declines in the amount of water seasonally available in Colorado

and environmental in-stream flows are likely to be the first affected. In stream flow water rights are rights held by the Colorado Water Conservation Board that are specifically meant to allow water to stay in streams without diversion.

The prior appropriation doctrine also relies on the distinction between consumptive and non-consumptive uses. Non-consumptive uses are those that allow for water to be put back into the flow and diverted downstream. Irrigation, for example, consumes some of the water that is put to its use, but most is not consumed and can be reallocated downstream (Hobbs 2002, 6). This means that the amount of water an appropriator is allowed to *divert* is different from the amount of water they are allowed to *consume*. Water rights holders are not allowed to injure another person's rights even if they have a more senior water right. Senior water rights are those that have the earliest appropriation dates and are therefore given the most priority in the system. The higher the priority the more the water is worth. Throughout the west, water is treated as a private use right. It is viewed in a similar fashion to money, for example the acronym that is used for new types of transport for water is ATM (alternative transfer methods) and another new trend in water is water banking. ATM is "used broadly to describe a host of newer types of approaches to facilitate additional water transfers from rural areas, but in a way that minimizes local impacts or, in some cases, even produces local economic and/or environmental benefits" (Dilling et al. 2019, 3). Water Banking is the process in which "owners of temporarily

unnecessary water can deposit their water in a virtual bank for withdrawal and temporary use by others” (Browning, 2004, 72). The main focus of water issues has mostly been centered around human need rather than focusing on the needs of the river systems themselves. Many of the streams in Colorado have been over appropriated and the environmental impacts of the appropriation system have not always been considered. Human use has always been the top priority for water, but a 1970s amendment has given another meaning to beneficial use in Colorado.

In 1973, The Colorado state legislature decided they needed to “correlate the activities of mankind with some reasonable preservation of the natural environment” (Colorado Water Plan 6-159). With this decision came the creation of the Instream Flow Program. This program allows for water rights to be used solely for the protection of the environment and helps the state follow all endangered species act regulations. Water for this program has to be donated to or acquired by the Colorado Water Conservation Board (CWCB), the only entity that can legally hold an instream flow right (Merriman and Janicki date,1). Prior to the instream flow program, all water appropriators were required to divert their water from its source, water that was not diverted was considered to have not been put to a beneficial use. The instream flow program recognizes that there are benefits to keeping water in stream, especially if they are acquired senior rights (Hobbs 1997, 8). These benefits include protecting the aquatic habitat of endangered fish species, terrestrial habitat that is used by

birds including the endangered whooping crane, and for the benefit of the streambed itself (Zallen 1986, 41). While a lot of the focus of the instream flow program is on streams, the program also benefits lakes in Colorado. Since 1973, the CWCB has gained rights to 8,500 miles of streams and 485 lakes that are included in the instream flow program (Merriman and Janicki date,1). The streams that are included in this program can be seen in Figure 1, which locates these riparian instream flow rights in Colorado. The red lines represent the reaches of stream that are protected through the instream flow program. The location of the instream flows is heavily concentrated in the mountains. There are very few in the eastern part of the state. This is likely due to the fact that there is less water in the east and that almost all of the water in the east was appropriated in the late 1800s and early 1900s for agriculture, leaving little to be appropriated for later 20<sup>th</sup>-21<sup>st</sup> century instream flow purposes. One notable aspect of instream flows is that they are mostly junior water rights and because of that, they cannot cause any injury to senior rights and have to comply with interstate compacts. This makes it difficult to appropriate instream flows in some areas, such as the Rio Grande basin for example, because of the need to comply with the Rio Grande compact. The same is true on the eastern plain of Colorado due to obligations to Nebraska and Kansas for the Platte and the Arkansas, respectively.

Figure 1: Streams Included in Colorado's Instream Flow Program.  
Colorado Cattlemen's Association  
<https://www.agwaternet.org/InStreamFlowMap.aspx>

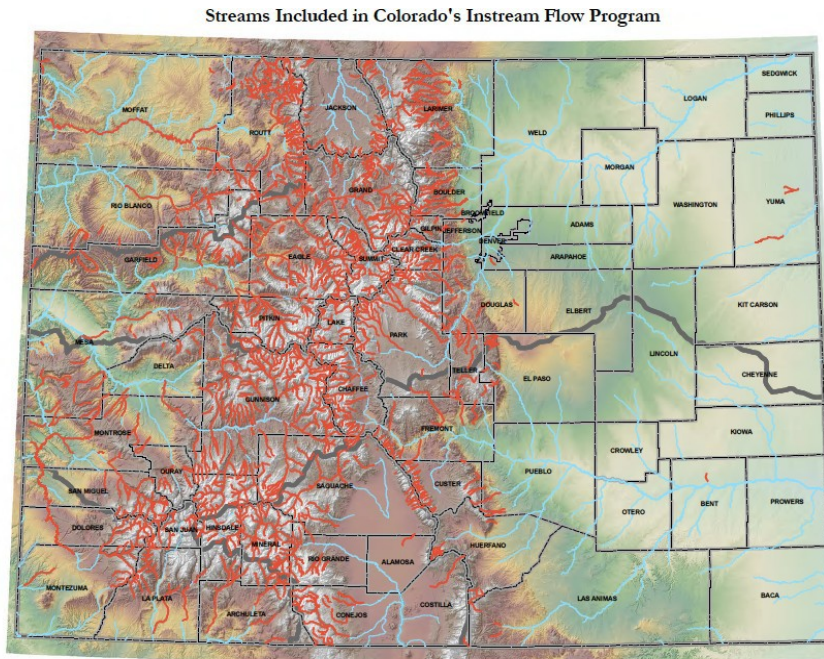


Figure 2 is a map of all of the lakes that have instream flow rights in Colorado. Lakes in the instream flow program are a smaller portion than the stream section. There are around 500 lake instream flows and around 1800 stream instream flow rights. The lakes have a similar spatial pattern to the streams seen in figure 1. There are very few lakes marked on the eastern side of the state. This is due to a higher quantity of lakes available in the mountains than on the plains. Another important thing to note on this map is that many of the lakes fall on or near

division boundaries. The lakes occur near the continental divide, as storage impoundments and reservoirs for diversions, canals, and tunnels to transfer water between watersheds. It is important to look at this map in conjunction with figure 1 to get more detail on the instream flows of lakes. Figure 3 shows the cumulative amount of water protected in lakes by instream flow rights by division. The water is measured in acre feet. The map is separated by water court division and the darker areas represent divisions with a larger amount of protected lake water. The San Juan/Dolores division has the greatest number of lake water with 27,638 acre feet and the South Platte has the least with 5592 acre Feet. It is interesting to note that the South Platte is one of the largest divisions and the San Juan/Dolores is one of the smallest. This is most likely a sign of how much unappropriated lake water each division had when the instream flow program began in 1973. It is also important to look at this map in conjunction with figure 2. In figure 2, we saw that many of the lakes are on or near division boundaries. For example, the Arkansas division has more protected lake water than the Rio Grande division, by about 5000 acre feet, even though the general trend is for eastern divisions to have less protected water. when you look at figure 2, however, you may notice that almost all of the lakes protected in that division are on the division line. There is still little water protected in the eastern part of the sate even if the Arkansas division technically has more protected lake water than the Rio Grande.

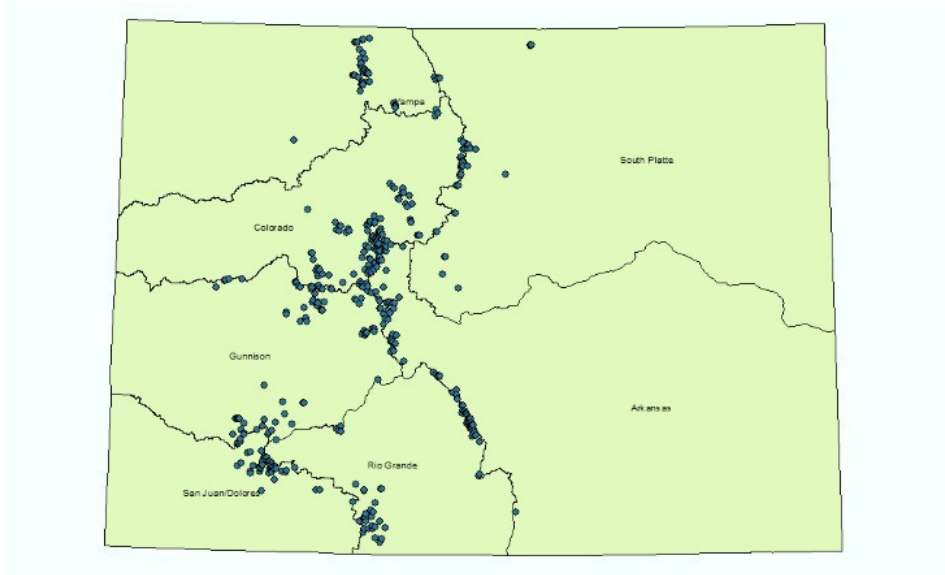


Figure 2: Location of ISF lakes

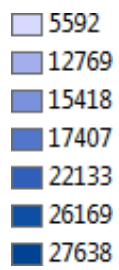
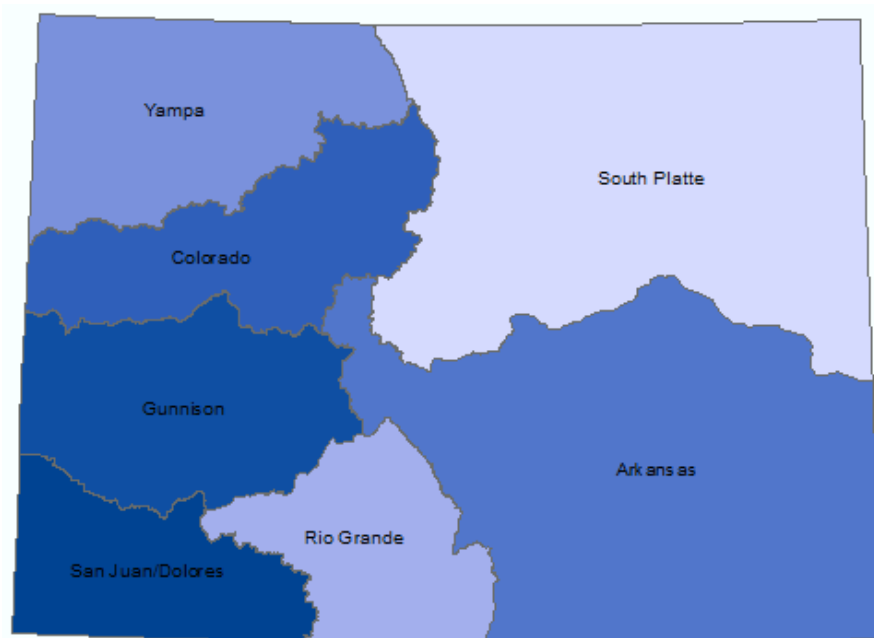


Figure 3: total amount of instream flows in lakes by division measured in Acre Feet





Water projects in Colorado have to consult with the USFWS and consider the Endangered Species Act (ESA) for any project that have a federal nexus. This consultation in some cases has restricted what a project could or could not do with their water. The Endangered Species Act must be followed even if it harms a water right, but if it does the water right owner is to be compensated for the alteration (Hobbs 2002, 11). The ESA and the instream flow program have similar priorities, environment and biodiversity. While prioritizing the environment over human use has not always been a popular idea, in recent years' social values have shifted to care more for environmental issues, especially with the increased knowledge of climate change (Tarlock 2006, 55). The form, quantity and seasonal timing of water in Colorado is changing and to ensure the health of our environment and ourselves, we must also adapt.

Since 2002, Colorado has seen some of their worst recorded droughts. In 2019 there has been much more rain and a significantly larger snowpack than past years, but one good year does not mean the drought is over. While many people are concerned about human water use during a drought, we need to also be focused on the damage that is being done to the ecosystem. In an article published by the American water works association, the results from a report done by the Environmental Protection Agency are given stating that, "42% of the nation's stream length was in poor biological condition, compared with the baseline least-disturbed reference sites. Another 25% was deemed in fair biological condition" (Grigg, 2012,51).

Keeping our water resources in good condition is important both for human consumptive use as well as complying with interstate compacts and the ESA.

Instream flow rights have both physical and legal protection. The physical protection is through processes to measure the flows and make sure that they are not being reallocated in a different stretch of the river, including gages to measure flow in certain stretches of the river as well as placing calls on junior rights. Legal protection takes the form of reviewing other applications for water rights that would potentially injure the instream flow and filing oppositions in the water court if they do (Merriman and Janicki,2). There are also systems in place, such as the Watershed Flow Evaluation Tool, to make sure that the best management scenarios for these flows are put into action (Kendy et al., 2012, 26). There is always more to discover about how the instream flow program works and what impacts it is having on the environment and species in Colorado. Colorado has drafted a water plan that hopes to lead to a “strong environment” and instream flows are an important part of making that happen (Colorado Water Plan).`

### **What is Beneficial Use?**

The term “Beneficial Use” is used often when discussing water rights in the prior appropriation system. Beneficial use is ingrained in the Colorado’s water system. The state constitution has a provision that states that the right to divert water if it is put to a beneficial use will never be denied. Because

the system is based on private property rights, this provision has encouraged wasting water on low value uses to acquire rights (Schorr 2012, 105). At the time when the prior appropriation system was established, there was a fear that water in the west would be monopolized. To avoid a monopoly, water rights were only given to people who were actively using the water.

Speculators would not be able to get water rights if they were not able to prove that the water was going to be put to a beneficial use (Pisani 1996, 14). Hobbs provides a list of what a beneficial use might be including irrigation, industrial, municipal, and power generation. He also provides a list of the “ever-evolving” uses including instream flows, and fish and wildlife culture that have not always been considered a beneficial use (1997, 8). One of the ways that a water rights holder could prove beneficial use is through the diversion of their water. Diverting water became a requirement for a use to be considered beneficial.

Diversion of water can be complicated. The amount of water that a right holder has the right to divert is not necessarily the amount of water that they are allowed to consume. Their consumptive water rights determine how much water they are allowed to consume, but because of inefficiencies in diversion methods and natural impacts like evaporation, the amount of water they can divert may be larger. Any water that is diverted and not part of a person’s consumptive use right is expected to return to the flow and be available for appropriation downstream. If an upstream rights holder consumes more than their consumptive right and does not put water back

into the stream flow they could be held accountable for injuring another right holder (Schorr 2012, 107). The “No-Injury” rule is important when determining a new water right or changing the use of an existing right.

Accordingly, when proposing a new appropriation, a potential right holder must be able to prove that not only will the water be put to a beneficial use, but that the use of the water will not harm any existing senior water rights.

An injury to a water right usually takes the form of senior rights holders not getting all of their appropriated water. A right holder must also prove both of these things if they are trying to change the use of their existing right.

That is why water transfers can be so costly. To change the use of a water right, the holder must go through the authorities, in Colorado this is the state engineer and get approval for the transfer. To get approval there must be proof that there will be no injury, getting this proof requires hydrological, legal counsel and engineering research. Sometimes these proceedings can involve the whole basin, making it difficult to make a deal with other rights holders. When a deal is made it is usually because the change of use would create enough revenue for the right holder to be able to compensate injured parties (Schorr 2012, 108).

Yet, what counts as a beneficial use has been continuously evolving (Hobbs, 2002). Diversion is no longer required for a use to be considered beneficial. Changing social values since the 1970s throughout the United States have started to prioritize the needs of the environment and wildlife. While these attitudes have not gotten rid of the desire to get economic

benefit from our natural resources, they have allowed for adaptation in our systems. Leaving water in the stream is now considered to be a beneficial use. The purpose of leaving the water in stream can vary from protecting endangered species habitat, to recreation and aesthetics. Not every state recognizes the same beneficial uses of leaving water instream. Table 1 shows what uses each state has designated as beneficial for instream flow purposes. It includes ten categories: Fish, other aquatic organisms, wildlife, recreation, aesthetics, environmental protection, navigation, channel maintenance and water quality. Of the states that recognize instream flows as a beneficial use, California recognizes the most uses of instream flows. California recognizes 8 of the 10 options. The two that they do not recognize are channel maintenance and environmental protection. Wyoming only recognizes one use, fish. Their program is centered around fish and according to Reed Benson has not made any progress since its inception. While Colorado has a successful instream flow program, it only recognizes 4 of the 10 uses. The four that it recognizes are fish, other aquatic organisms, riparian areas and environmental protection. It is important to note that even though Colorado does not recognize all of the uses as beneficial for instream flow uses, they do have a separate type of water right for recreational uses called Recreational In-Channel Diversions (RICD). This table does not tell the whole story for all protected waters in these states, it is solely focused on instream flow uses. New Mexico is a special case in this table, it has 4 beneficial uses marked on the table, but

there have not been any approved instream flow rights for these uses because they do not have a formal instream flow program.

RICD was enacted by the Colorado State Legislature in 2002 but, recreational flows had been awarded to local governments since a 1992 Colorado Supreme Court vs. Fort Collins court decision. In 1992, Fort Collins wanted to obtain a right on the Cache La Poudre River for wildlife, fish and recreation. These uses were already considered beneficial uses but for the water right to be legitimate, the water would have to be diverted for use. The supreme court ruled that because the water was being controlled by structures it was a legitimate right. In 2002, the legislature decided to make the RICD statute because these types of rights had become more popular. A RICD flow must be “diverted, captured, controlled and placed to beneficial use between specific points defined by physical control structures”. RICD rights are held by local governments rather than by the CWCB like instream flow rights. The CWCB has some role in the process of holding hearings and the water court process for RICD rights. The CWCB wanted to have more of a role in the process but, the legislature gave the majority of the power to the local governments. In 2006 there were a few updates made to the statute. The updates made it harder to obtain RICDs, harder to defend RICDs against new appropriations and calls for water as well as making RICDs for “nonmotorized boating” only (Benson, 2006).

Table 1: Beneficial Use of Instream Flow by State. Carney, Shasha. July 2015. "Decades down the Road: An Analysis of Instream Flow Programs in Colorado and the Western United States". 1-50.

State	Fish	Other aquatic organisms	Wildlife	Riparian areas	Recreation	Aesthetics	Environmental protection	Navigation	Channel maintenance	Water quality
Alaska	•		•	•	•			•		•
Arizona	•		•		•					
California	•	•	•	•	•	•		•		•
Colorado	•	•		•			•			
Idaho	•	•	•		•	•		•		•
Kansas	•	•	•		•	•				•
Montana	•		•		•					• <sup>7</sup>
Nebraska	•		•		•					• <sup>8</sup>
Nevada	•		•		•					
New Mexico <sup>9</sup>	○		○		○		○			
North Dakota										
Oklahoma										
Oregon	•		•	•	•	•				•
South Dakota <sup>10</sup>	•		•	•		•				
Texas				•	•	•		•	•	•
Utah	•				•		•			
Washington	•		•		•	•				•
Wyoming	•									

One recent example of an instream flow being used for multiple purposes is Tucson, Arizona. On June 24, 2019 Tucson Water changed the location of where they return repurposed water into the Santa Cruz River. The new location allows for reclaimed water to flow through the city on a stretch of the river that held importance to residents and local tribes. Reclaimed water is treated so that it is safe for all purposes besides drinking. The new stream flow will provide habitat for species and more recreation activities, as well as, improving the aesthetic value of the downtown area. The water will probably only flow for about a mile, but

the flow is being celebrated by many groups (Brocius 2019). Now that non-consumptive uses of water are being considered beneficial uses, it is critical to understand how these rights are acquired, measured and protected.

The Shoshone hydroelectric plant in Glenwood Springs, Colorado, is one example of non-consumptive water rights. The energy plant has been in existence since the early 1900s and has senior water rights because of its early creation. In the summer and when river flows are low, the Shoshone plant is still able to take its full amount of water while junior users, including trans mountain diversions that bring water to Denver, have to rely on reservoirs to get their allotted water. The interesting part about this water right is that the Shoshone plant does not consume their water. The water is used to generate electricity and is then put back into the river. The water that is returned to the flow is critical in protecting the endangered fish species of the Colorado river, as well as, helping the rafting industry to be successful. In 2007, there was a threat to this critical streamflow. One of the plant's major water lines ruptured and the plant needed to be shut down for repairs. During the shutdown, the allocated water would not be used and therefore could be diverted for use elsewhere, taking away from the return flows that benefited the river. Luckily because 2006 and 2007 were wet winters and because there was an established relationship of trust, the water interests involved were able to collaborate to make sure that the river flow would not face detrimental impacts because of the shutdown (Reiter et al.



2008). The Shoshone water right has provided Glenwood Springs with critical streamflow that has aided the environment and rafting industry. If the plant had not had a senior non-consumptive right, the water left instream would have been diverted by downstream users for many years before the environment and recreation were recognized as beneficial instream flow uses. With the change of recognition of beneficial use, stakeholders are able to work together to make sure the environment continues to benefit even when the water right itself is threatened. Collaboration between uses and acceptance of beneficial uses is critical to keeping water in stream. If all of the water in any stretch of river was diverted for consumptive uses the state would lose economic value and the states biodiversity would be threatened.

### **Water Courts and Their Role in the Acquisition of Instream Flows**

The water court system is unique to Colorado. In 1969 the Water Rights Determination and Administration Act was passed with created seven individual water divisions (Burr 2019, 1). Each of the seven divisions has their own water court system to deal with issues pertaining to water rights. Each court has a chief water judge, water referee, water clerk and some have an alternative water judge. Water court judges are designated by supreme court justices and are chosen from district court judges. The referee is appointed by the judge. Water courts have jurisdiction over the determination of water rights, uses of water resources and all other water matters. A study done by the Colorado State Court Administrator's office in

2008 gives some details about how water courts work. The study found that 83% of cases were resolved by referees which means the case is either dismissed or results in an unopposed referee order that is signed by the judge. The other 17% of cases are resolved by the judge. 72% of water court cases take less than a year to resolve, but some cases can take multiple years. When the study was completed, it was found that 70% of cases were unopposed, but that opposition was on the rise. When a case faces opposition it will take longer to resolve. Usually less than 1% of cases go to trial.

Water courts play a role in the acquisition of instream flow rights because they determine whether or not a new right or a change of use will harm other rights holders. The majority of instream flow rights are new acquisitions by the CWCB, so the courts must determine if the new acquisition is harmless to other rights and must look through any opposition to the new right. In cases when a right is donated or sold to the CWCB, the court must determine if the change of use of that right is harmless to other users or not. When a water right is sold or donated to the CWCB, a contract is created between the two parties. These contracts have a section dedicated to what water court proceedings the CWCB must take. Figure 4, for example, shows a contract between the CWCB and Nancy Hoelzen, who donated her water rights on Hot Spring Creek for instream flow purposes on Hot Spring Creek and the Elk River. The contract is split into five sections: Recitals, conveyance of the water rights, water court proceedings,

miscellaneous provisions and enforcement. The recitals section describes each length of stream that is a part of the donation and what the intended purpose of that water is. The conveyance of the water rights section gives the timeline in which the water rights will be given to the Colorado Water Conservation Board. Next, the water court proceedings section describes how the CWCB will be in charge of getting the use of the water changed in the court system. Miscellaneous provisions include that the agreement is binding to all heirs of those signing and that no one may sign the contract without their consent. The enforcement sections explain each party's role in enforcing the contract and their duty to the other in the case of failure to abide by the contract.

Figure 4: Contract Between CWCB and Nancy Hoelzen

AGREEMENT FOR THE DONATION OF WATER RIGHTS

This agreement, made this <sup>15<sup>th</sup></sup> day of August, 1997 by and between the State of Colorado for the use and benefit of the Department of Natural Resources, Colorado Water Conservation Board ("Board"), and Mrs. Nancy E. Hoelzen, Kent, Washington.

RECITALS

A. Section 37-92-102(3), C.R.S (1990 and Supp. 1996) authorizes the Board to acquire by contractual agreement such interests in water as the Board determines may be required for minimum stream flows to preserve the natural environment to a reasonable degree.

B. Under said Section 37-92-102(3), no entity other than the Board shall be granted a decree adjudicating a right to water for instream flow uses.

C. The Board is the owner of an instream flow ("ISF") water right on Hot Spring Creek extending from the headwaters to the National Forest boundary for 2 cubic feet per second ("c.f.s.") as decreed in Case No. 77W1335.

D. The Board intends to appropriate an instream flow right on the lower segment of Hot Spring Creek from the National Forest boundary to the confluence of Hot Spring Creek and the Elk River.

E. Mrs. Hoelzen is the owner of approximately 2.06732 c.f.s. of H.E. Turner Ditch water rights and approximately 0.88583 c.f.s. of O'Neal Ditch water rights ("the Water Rights"). Both ditches divert water from Hot Spring Creek in Routt County.

F. Mrs. Hoelzen intends to transfer ownership of the Water Rights to the Board for the maintenance of instream flows on Hot Spring Creek and the Elk River.

G. The Water Rights are decreed for purposes other than instream flow use. The Board's use of these rights for instream flow purposes will require Water Court approval of changes in use of the Water Rights.

H. The Board intends to accept the Water Rights from Mrs. Hoelzen and to file an application with the Division 6 Water Court for a change of use of the Water Rights to instream flow uses.

NOW THEREFORE, in consideration of the mutual and dependent covenants contained herein, the parties agree as follows:

CONVEYANCE OF THE WATER RIGHTS

1. Mrs. Nancy Hoelzen shall convey by quitclaim deed to the Board her interest in the following Water Rights:

- (a) H.E. Turner Ditch: 2.06732 c.f.s. out of 2.33 c.f.s. total decreed, Priority No. 55 decreed by the Water Court for Water Division 6 in Civil Action 3926 on May 30, 1972, appropriation date July 31, 1965.
- (b) O'Neal Ditch: 0.88583 c.f.s. out of 1 c.f.s. total decreed, Priority No. 55a decreed by the Water Court for Water Division 6 in Civil Action 3926 on May 30, 1972, appropriation date July 31, 1965.

2. Within thirty days after the execution of this agreement, Mrs. Hoelzen shall convey the Water Rights to the Board by a deed in substantially the same form as the attached Exhibit A, shall record said deed with the Routt County Clerk and Recorder, and shall provide a copy of the recorded deed to the Board.

WATER COURT PROCEEDINGS

3. Within a reasonable time period after receiving title to the Water Rights, the Board shall file an application with the Water Court seeking to change the decrees for the Water Rights to instream flow uses for exclusive use by the Board.

4. The Board may, at its sole discretion, cause the application under Paragraph 3 above to be dismissed at any time before the Court issues a final decree. If the application is dismissed for any reason or is denied in whole or in part, or if the decree of the Court is conditioned in such manner as to prevent this Agreement from being completely fulfilled, then the Board may sell or donate all or a portion of the Water Rights to whomever it chooses, subject only to the written approval of Mrs. Hoelzen.

MISCELLANEOUS PROVISIONS

5. This Agreement shall not be assignable by either party without the written consent of the other.

6. This Agreement shall be binding upon the heirs, successors and assigns of the parties hereto.

ENFORCEMENT

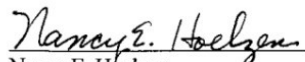
7. Pursuant to Section 37-92-102(3), C.R.S. (1990 and Supp. 1996), the terms of this Agreement shall be enforceable by each party as a water matter in the District Court for Water Division No. 6; provided, however, that before commencing any action for enforcement of this Agreement, the party alleging a breach shall notify the other party in writing of the alleged breach

and the parties shall make a good-faith effort to resolve their differences through informal consultation.

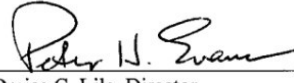
8. Specific performance of this Agreement shall be the exclusive remedy for failure of either party to comply with any provision of this Agreement.

DATED this 15<sup>th</sup> day of August, 1997.

NANCY E. HOELZEN

  
Nancy E. Hoelzen

COLORADO WATER CONSERVATION BOARD

By:   
for Daries C. Lile, Director  
Colorado Water Conservation Board  
1313 Sherman Street, Room 721  
Denver, Colorado 80203

This donation of water rights is important for the ISF program because the water rights have more seniority than new appropriations. The appropriation date of these rights dates to 1965 which is before the ISF program began giving them seniority to most ISF flow rights. This contract follows a similar outline to other water right donations and acquisitions. These types of rights are critical because of their seniority. Water right contracts are an important aspect of the role water courts play in the program because they determine who is in charge of interacting with the courts and when they will need to file for a change of use for the water right. Changing the use of the water right is the only way to make the water able to stay in stream permanently without risk of others diverting the way.

Having a specialized court system leads to quicker decisions and ensures legal coherence and uniform decisions. In the case of environmental courts, like the water court system, also increase the relevance of the subject and

shows the importance of water issues. Judges in these specialized courts are able to reach decisions sooner because they are knowledgeable on the subject and do not need to be educated on the issues as much as a general judge. As mentioned previously, the speed of these cases varies and some may last for long periods of time, but in general the specialization speeds up the process as a whole. Water cases require a lot of technical knowledge and have complex legal doctrines making the specialized court system especially useful issues (Casado-Pérez 2019, 591-606).

### **How Instream Flows Are Measured**

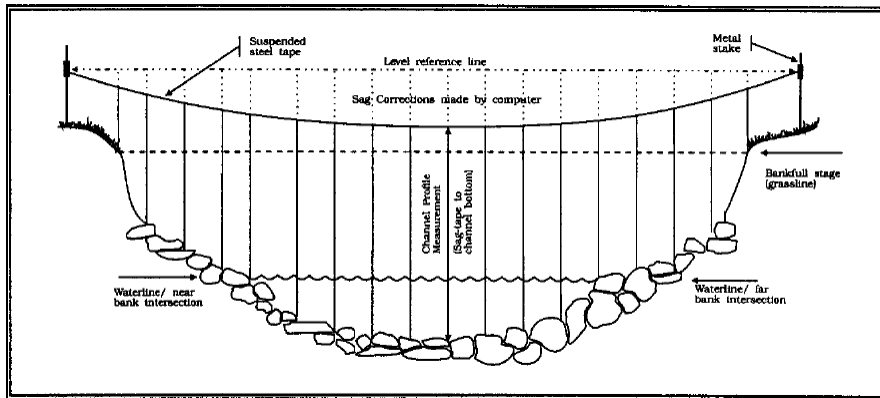
The way that stream flows are measured is important to the instream flow program because it provides information about what amount of flow a stream needs to remain perennial. There is technically instream flows in all rivers, but most, and in some cases all, of that water has been appropriated, leaving some sections dry. The purpose of the instream flow program is to maintain and, in some cases, improve the health of the river, to do this it is necessary to know what the flow of the river would be with and without a specified instream flow right. When a stretch of stream is recommended to the CWCB for appropriation or acquisition as an instream flow right, it can be measured using any methodology as long as it is supported by science.

One of the ways that instream flows are measured is using R2CROSS. Espergen (1996,2) describes how the R2CROSS program works in his article “Development of Instream Flow Recommendations in Colorado

Using R2CROSS". R2CROSS is a computer program that allows for stream flows to be measured in a time and labor efficient manner. Before an instream flow right can be appropriated the CWCB must determine that the amount of water appropriated would protect the environment to a reasonable degree, that there is an environment to protect and that the appropriation would not harm other users. The CWCB uses technical data to prove these factors in their final recommendations (1996,2). These data are collected when visiting the stream and usually consists of fish and invertebrate samples as well as channel geometry and stream discharge. To use the R2CROSS method these data need to be collected in a riffle stream habitat. A riffle is controlled by channel geometry and is critical to the fish and invertebrate success in the river. Riffles are critical because a small reduction in stream flow could have greater impacts on the depth of the stream. The equipment that is used to make stream measurements with R2CROSS include steel survey tape, spring tension scale, cross section stakes and multiple other pieces (1996, 3). Figure 5 shows what a typical cross section looks like when using the R2CROSS method of measuring instream flows. This method is the most common method for measuring instream flows because it is scientifically reliable. This figure shows the tools that are needed and the way that the measurement is set up. The full method includes more parts, but this figure shows the basics of what the measurement process would look like in stream.



Figure 5: Typical Stream Cross Section. Espergen, Gregory D. 1996. "Development of Instream Flow Recommendations in Colorado Using R2CROSS". 1-20.



There is a standardized field form that is used to record all data and includes sections such as “Location Information”, “Supplemental Data” and “Channel Profile Data”. All the collected data are then calculated with Manning’s equation (1997, 5). Manning’s equation has calculations that include water velocity, upper and lower stream flow limits and water slope. These data create the biologic recommendation that is the basis for determining if the streamflow will meet the criteria for appropriating an instream flow (1997,11).

On top of the R2CROSS system, the CWCB has technologies in place to make sure that stream flow levels are monitored. The first of these technologies does not require any sort of special equipment, it is based on the “eyes and ears” of people who see the streams on a regular basis. If someone notices that the stream flow appears to be low, they can call the CWCB to check on it. Another technology that is used is gages. There are three types of gages in place, ones that

need to be read by agencies and ones that are connected to satellites and provide real time information. The third type of gage is called a “flow alert system”. This gage sends an alert to the water right holder via email or phone call when levels drop below the correct flow. The CWCB is also working to develop new technologies to better monitor instream flows. The first of which is a dye dilution method. This would be used to better monitor flows in the winter, due to the cold weather the standard gages can freeze and ice in the river can alter the results. Using the dye dilution method, dye would be released into the stream and then downstream the dye would be re-measured to see how much it diluted allowing for an estimation of the streamflow. The other technology that is being developed is a decision support system that would use the geographic information system (GIS) and include any relevant information on stream flows so that users could see alerts when stream flows had been interrupted. It is important to have different types of monitoring systems to make sure that the unique circumstances of each instream flow can be accurately monitored (Carney, 2015).

### **Interstate Compacts and How They Impact Instream Flow Rights.**

As the Headwaters state, Colorado has many interstate compacts regarding water. These compacts determine how much water from each interstate river Colorado is allowed to keep each year and how much must

be delivered to downstream states. One of the most well-known compacts is the Colorado River Compact of 1922. This compact allocated 7.5 million AF of water to the Upper Basin States (Colorado, Utah, New Mexico and Wyoming). Of that amount, Colorado is allotted 3.9 million AF. However, they will not always receive the full allotment.

When the Colorado River Compact was signed the Colorado River was going through a high flow period that has not been seen in many years. The compact did not account for the high flow at that time and so the upper basin states are required to deliver 7.5 million AF to the lower basin no matter the flow levels. This means that Colorado and the other upper basin states are running on a deficit. The rest of the interstate compacts that Colorado is a part of have similar issues.

Colorado has a specific amount of water they must deliver no matter how much there is in total. It is important for Colorado to meet all these requirements so that they do not face a compact call. A compact call could lead to expensive legal actions. These compacts can impact instream flow rights because they have a higher priority in the system. Instream flow rights will not receive their water unless the compacts have been met. If Colorado's deficit continues to grow, then instream flows will suffer more losses.

The priority systems rules who will get their water and when, interstate compacts have the highest priority in the system because expensive legal battles could ensue if these agreements were not met. Not only do the people

of Colorado suffer losses at the hands of these compacts, the environment suffers too. Once the water leaves the state, it is no longer protected under the state's laws and so the instream flow program does not cross the borders with the water.

### **What Happens Downstream of an Instream Flow**

An instream flow right protects a specified amount of water for a certain stretch of a river or lake. Yet water that is protected with the instream flow right is no longer protected when it moves past the boundaries of the right. Downstream of an instream flow right, the water is able to be appropriated by other users and used to make compact agreements. Because the majority of the instream flow rights in Colorado are new appropriations and therefore junior rights, there is a possibility that the water that is meant to be protected will not even reach the stretch of river it is meant to be in. New appropriations cannot harm any senior water rights. Instream flow rights generally have to wait for many other users to get their water before the water can be left in stream. While Colorado's program is successful and has over two thousand instream flow rights, there are still sections of these protected rivers that are dry. Some Colorado water users oppose instream flow rights close to the state border because they fear the water would then be able to be used by the other downstream states and that Colorado users would lose access to that water.

While it would be nice if instream flows could be protected throughout

multiple states, the only time that happens is when there is federal protection of a fish species under the Endangered Species Act.

The Instream flow program only protects water when it is in the designated stretch included in the ISF right, once the water flows past that section the water is used to fulfill other rights. The ISF program does not provide continuous protection of water, but it plays an integral role in keeping water in stream. The program will continue to evolve when changes are needed and are able to be made, there have already been multiple states to include more water in the program.

### **Trends in Instream Flows: Years and Type of Right**

Since the inception of the Instream Flow Program, there have been about 1849 stream and 497 lake rights added to the program. Within the first decade of its existence about 800 instream flow stream rights were created. Since then, the amount of rights brought into the program each year has slowed. This is likely due to the fact that when the program began there were many streams that had already been determined to be a good fit for the program. So when the law passed there was already a list of rights to be added. This allowed for the high number of instream flow rights created in the first decade. In the past decade there have been about 150 new appropriations. Progress has slowed since the introduction of the program, but any additional water rights can benefit the program, especially if they are acquired senior water rights.

There is a large difference between the number of rights that have been new appropriations by the CWCB and those that have been acquired. Only 165 of the 1849 stream flow rights and 15 of the 497 lake rights have been acquired. While acquired rights are few in number, they can have a large impact on the program because they are likely to be senior in priority than new appropriations. The flow amount of instream flow rights varies. About half of the rights have a minimum flow year-round while the other half is seasonal. Year-round rights are able to provide continuous flow in their area, but that should not diminish the importance of seasonal rights. Any amount of water for any amount of time is beneficial to the success of the program. There has been a change in how many rights are added to the program each year and there have been efforts to increase the amount of water donated, but no matter what trends we see, the program's success is still notable.

### **Opposition to the Instream Flow Program**

Colorado's Instream Flow program has a lot of support, but there is also opposition to the program. The main point of opposition to the program is the fear that it will take water away from other users. Mark Squillace, a law professor at the University of Colorado Law School, presents another opposition. He is not against instream flows, just the program that is in place.

His argument is that the public interest standards that are supposed to be a

part of western water are not being applied and if they were an instream flow program would not be necessary. The Colorado constitution states that “The water of every natural stream, not heretofore appropriated...is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the state” (Squillace 2019, 21). This language seems to recognize the purpose of the public interest, but the state has disavowed the obligation to the public interest in the allocation of water and instead has made water a private property right. Squillace says that the state should deny or condition the appropriation of water rights to protect the public’s water, including instream flows. This idea is practiced in states like Washington and California. Even with the instream flow program in Colorado, many of the rivers are still dry.

### **Stream Flow Protection in Other Western States**

Colorado is not the only western state protecting the integrity of rivers and streams. Most of the other western states that use the prior appropriation system have their own protocol for protecting the stream flows of their rivers. Table 2 shows which western states legally recognize instream flows as a beneficial use. These protocols vary in their degree of protection. Some states, such as Idaho and Oregon have been protecting their streams dating back to the 1920s. New Mexico, on the other hand has been described as the “last holdout state” (Covell et al. 2016, 367). Many of the stream flow protections found in the west are based on state water codes or water plans.

Some states allow for a change of use of a water right or for the creation of a non- consumptive water right, while others do not. One of the major challenges facing the creation of instream flow protections is proving that leaving water instream is a beneficial use. Each state has their own water code or water plan that describes what a beneficial use is. Many states have similar ideas to Colorado, requiring that a beneficial use be consumptive and require a diversion from the stream (Covell et al. 2016, 355). Table 2 which states qualify instream flows as a beneficial use and which states have a special status for instream flow rights. The table includes 18 states, of which only two, North Dakota and Oklahoma, do not legally recognize instream flows as a beneficial use. Nevada, New Mexico, North Dakota, Oklahoma and South Dakota do not have a special status for instream flow rights. While many states recognize instream flows as a beneficial use and have a special status for ISF rights, their individual programs have variability.



Table 2: Which States Legally Recognize Instream Flows as a Beneficial Use. Carney, Shasha. July 2015. "Decades down the Road: An Analysis of Instream Flow Programs in Colorado and the Western United States". 1-50.

State	ISF Legally Recognized as a Beneficial Use	Special Status Exists for ISF Water Rights
Alaska	Yes	Yes
Arizona	Yes	Yes
California	Yes	Yes
Colorado	Yes	Yes
Idaho	Yes	Yes
Kansas	Yes	Yes
Montana	Yes	Yes
Nebraska	Yes	Yes
Nevada	Yes	No
New Mexico	Yes	No
North Dakota	No	No
Oklahoma	No	No
Oregon	Yes	Yes
South Dakota	Yes	No
Texas <sup>6</sup>	Yes	Yes
Utah	Yes	Yes
Washington	Yes	Yes
Wyoming	Yes	Yes

Some states give exclusive authority to hold instream flow rights to a government entity, while others allow individual rights holders to have instream flow rights. In Utah, eNGOs like Trout Unlimited, can hold rights as well (Covell et al. 2016, 366). Colorado is one of the states that has given instream flow rights authority to a government entity, the Colorado Water Conservation Board. Along with a difference in right holder, there are also differences in how instream flow rights are obtained. Some states allow for unappropriated water to be appropriated for an instream right, while other states only allow a change of designated use. Table 3 explains who each state allows to appropriate instream flow rights and who can change the use of an existing right for instream flow purposes. Kansas goes about the acquiring of instream flows in a unique way, instead of allowing for the creation of new rights or a change of use, the state engineer holds water from appropriation allowing it to stay instream unappropriated (Covell et al.

2016, 364). There is a lot of overlap in the way that western states protect their water resources, but the differences in the systems show the variability between the state governments. Table 3 summarizes which agencies have the power to appropriate instream flow rights and who has the power to transfer water rights for instream flow purposes in each state. In California and Utah, the appropriation of new instream flow rights is not allowed, while they do allow the transfer of water rights to ISF. In Alaska anyone is allowed to appropriate a new instream flow right, but the transfer of rights is not allowed. In Colorado, the Colorado Water Conservation Board has exclusive authority of instream flow rights, they are the only entity that can appropriate new rights and any transfer of water rights but be transferred into their authority.

Some states, like Colorado, have a more structured program, while others are less structured and allow for most people to create instream flows on their own. Understanding how each state operates around instream flows is important to understanding the success, or lack thereof, of these ISF programs.

Table 3: Who Can Appropriate and Transfer Instream Flow Rights by State. Carney, Shasha. July 2015. "Decades down the Road: An Analysis of Instream Flow Programs in Colorado and the Western United States". 1-50.

State	Who Can Appropriate ISF Water Rights	Who Can Transfer Existing Water Rights to ISF Use
Alaska	Any local, state or federal government agency and any private person or organization	Not allowed
Arizona	Any person, the state of Arizona or a political subdivisions thereof (including, but not limited, to counties, incorporated cities, towns, and irrigation, power, electrical, agricultural improvement, drainage, and flood control districts)	The state and political subdivisions of the state (private individuals can retain the right but lose the original priority date)
California	Not allowed	Any water right holder can transfer a right to ISF purposes if established criteria are met
Colorado	Colorado Water Conservation Board	Any person, including government entities or organizations, can transfer rights to the CWCB for conversion to ISF
Idaho	Idaho Department of Water Resources (IDWR)	The U.S. Bureau of Reclamation can lease water from Idaho's water bank for use in the Snake River system. <sup>16</sup>
Kansas	Legislature	The state (through the Division of Water Resources)
Montana	Federal and state agencies and any political subdivision of the state	Any public or private entity can lease for ISF purposes
Nebraska	Natural Resource Districts (NRDs) and Nebraska Game and Parks Commission (GPC)	Any water right holder can lease to the GPC Commission or NRDs for up to 30 years at a time
Nevada	Any "person" including individuals, organizations, corporations, government agencies, etc.	Same as appropriations
New Mexico	Not allowed	Same as other water right transfers
North Dakota	Not allowed	Not allowed
Oklahoma	Not allowed	Not allowed
Oregon	Department of Fish and Wildlife, Department of Environmental Quality, State Parks and Recreation Department can apply for new water rights, then held in trust by the Water Resources Department	Any entity can purchase, lease or receive ISF as a gift but converted ISF use must be held in trust by the Water Resources Department
South Dakota	Not explicitly determined. So far, Division of Wildlife, Game, Fish and Parks, private organization and U.S. Fish and Wildlife Service granted permits or transfers of use.	Not explicitly determined. So far, Division of Wildlife, Game, Fish and Parks, private organization and U.S. Fish and Wildlife Service granted permits or transfers of use.
Texas	Not allowed (desired instream flow levels are set through basin studies, see footnote 4)	Any individual or entity with an existing water right can transfer to ISF. Rights can be donated to Texas Water Trust of the Texas Water Development Board in perpetuity or for a given number of years.
Utah	Not allowed	Division of Wildlife Resources (DWR) and Division of Parks and Recreation (DPR)
Washington	Department of Ecology	Individuals can donate rights, which are then held by the Department of Ecology
Wyoming	State of Wyoming (initiated by the Game & Fish Department; Water Development Commission applies to the State Engineer's Office)	Anyone can give as a gift or voluntary transfer to the state (Game & Fish Department acts as petitioner, administered by the State Engineer and the Board of Control)

Some states that have made significant progress in protecting their states water resources while others have not made much progress at all. States like Colorado and Oregon are at the top of the pack in terms of instream flow programs. They both have over a thousand, or in Colorado two thousand, instream flow rights segments, which is more than every other state combined

(Carney, 2015). Reed Benson writes about the progress that has been made in Colorado's program in comparison to the lack of progress in Wyoming. Colorado has created multiple new statutes to amend the original program and improve the benefits. These include the 2002 statute that allowed the CWCB to acquire senior water rights not just appropriate new rights and allocated state funds to do so. There was another amendment to the program in 2003 that allowed water users to loan water to the CWCB for instream purposes for up to 120 days, at first this only applied to users in areas that were experiencing a drought emergency, but it is now open to all users. Wyoming has not made any changes to their program over the years, and new proposed statutes failed in recent years (Benson, 2006). Although Colorado's program is more successful than other states, it is not without flaws.

### **How Climate Change Will Effect Instream Flows in Colorado**

The Colorado River Basin (CRB) has the highest number of instream flow lake and stream rights (see figures 6 and 7), but in terms of overall appropriated water it ranks 4<sup>th</sup> with 1.9 million AF appropriated each year. The basins with the most appropriated water are the Arkansas, South Platte and Gunnison River Basins (see table 4). The Arkansas and South Platte River Basins are in the eastern portion of the state which is home to the major urban areas of the state. Because the major urban areas like Denver and Colorado Springs are the most populous cities in Colorado the large

amount of appropriated water in those basins lines up with the municipal needs of the basins. They are also the basins that cover the most land. The Colorado River Basin is in the western portion of the state and so has a smaller population to support and more unappropriated water that was able to be claimed for the Instream Flow Program.

Figure 5: Number of ISF Lake Rights by Basin Figure 7: Number of ISF Stream Rights by Basin

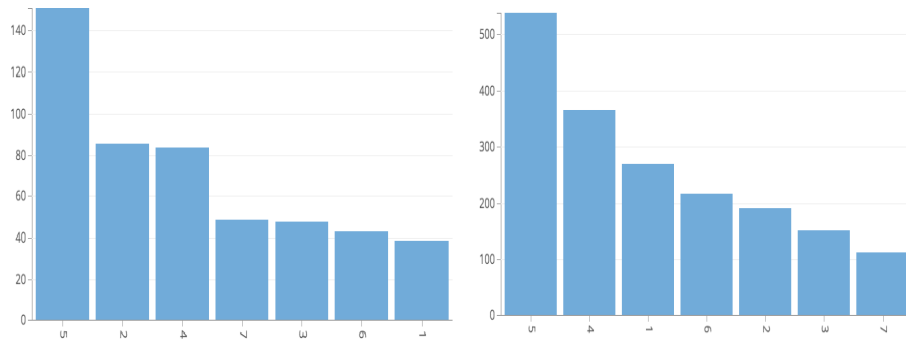


Table 4: Total Appropriated Water by Basin

Basin	Total Appropriated Water in AF
South Platte River Basin (Division 1)	4,137,371.2 AF
Arkansas River Basin (Division 2)	5,475,043.8 AF
Rio Grande River Basin (Division 3)	495,905.15 AF
Gunnison River Basin (Division 4)	2,065,227.68 AF
Colorado River Basin (Division 5)	1,970,437.6 AF
White River Basin (Division 6)	303,661.8 AF
San Juan River Basin (Division 7)	876,718.2 AF
Total	15,324,293.9 AF

The San Juan River Basin (SJR) has the least amount of instream flow stream rights and the 4<sup>th</sup> highest number of instream flow lake rights. It falls in 5<sup>th</sup> for overall appropriated water.

The SJR is in the southwest corner of the state. Almost all of the lakes with instream flow rights in the basin are on or near the border of the Rio Grande and Gunnison Basins. Many of the instream flow stream rights also fall on those borders with their also being a portion of them towards the middle of the basin. The SJR does not feed populous areas like the Arkansas and South Platte do and so, similarly to the Colorado River Basin, the demand for water is lower.

The predicted reductions in streamflow that can be seen in the tables below show how the river basins in Colorado will be affected by climate change and drought. When looking at the Colorado River Basin (table 5), the predicted reductions are high with some predictions getting up to 25% which would have a major impact on the Basin because of the high demand for Colorado River water both within Colorado and throughout the west. The Colorado River Compact has serious guidelines that determine how much water Colorado can take from the river each year. The CRB has the highest number of instream flow rights for both lakes and streams.

This will be a positive for the basin when reductions occur. Even though the instream flow rights are likely to be some of the first to be affected and not receive their allotment of water due to being low in seniority, the number of

rights means that there will likely still be some instream flows left.

However, for basins with a smaller amount of instream flow rights this may not hold true. The SJRB (table 6) does not have nearly as many instream flow rights as the CRB and because they are also made up of mostly junior rights, they are likely to lose a lot of their instream flow protection. This will be especially true if the reductions meet the predicted 50%.

The basins that have the least amount of instream flow rights will likely be more impacted than those with many as flow reductions continue but, even basins like the CRB will feel the effect because of more senior rights having priority in the system.

Table 5: Estimated Flow Reductions in the Colorado River Basin

Estimated Reduction Rate Colorado River Basin (5)	ISF rights on Lakes	Full-year ISF rights on rivers
0%	22,133 AF	31,200 CFS
8%	20,362.36 AF	28,704 CFS
11%	19,698.37 AF	27,768 CFS
17%	18,370.39 AF	25,896 CFS
25%	16,599.75 AF	23,400 CFS

Table 6: Estimated Flow Reductions in the San Juan River Basin

Estimated Reduction Rate San Juan River Basin (7)	ISF rights on Lakes	Full-year ISF rights on rivers
0%	27, 638 AF	374.1 CFS
6%	25,979.72 AF	351.65 CFS
11%	24,597.82 AF	332.95 CFS
15%	23,492.3 AF	317.99 CFS
50%	13, 819 AF	187.05 CFS

The lack of priority that instream flow rights have will become especially apparent if there is a drought. If reductions in flow reach the predicted amounts, visible reductions could be seen. The instream flow program has created visible improvements in some places. One example of this is Boulder creek. Boulder creek which is now a healthy stream running through downtown Boulder used to be almost completely dry. The city of Boulder donated instream flow rights for the creek and with that water it came to life. If access to these water rights is taken away due to drought and lack of seniority these creeks may dry up again.



## **Discussion**

Water rights in Colorado have been fought over since they were in existence. The fight is only becoming more complicated with the addition of factors like climate change and drought. Colorado's first come first served system has met most people's needs in the past, but the needs of the environment have not always been considered. If we choose to account for the needs of all people and the environment when thinking about the allotment of water rights throughout the state, we will be unable to satisfy every need. Because Colorado is the headwaters state and is subject to multiple interstate river compacts, we are usually running on a deficit. This means that we have less water than what we have allotted to all rights holders. To make this matter worse, most environmental instream flow rights have low priority in the system which means they will be the first to be cut off from their water source leaving rivers and streams with the threat of becoming dry.

This system is ingrained into the laws of the state. For the first century of Colorado water law, leaving water instream was not considered a beneficial use and therefore could not be a reason to hold a water right on water. This meant that for all those years, people were able to divert as much water as the courts deemed beneficial without any consideration of the effects on the environment. In 1973, the instream flow program created a new type of water right was created to allow for water to

be left in stream with the hope of reducing the likelihood of Colorado's rivers running dry. As discussed throughout this paper, because the instream flow program was not started until 1973 most of the water rights under it have a very low priority in the system. While this has always been a downfall of the program the increased threat of drought due to climate change will make this detail even more important. Reductions in stream flow are predicted to be high throughout the state, with some basins suffering more than others. If we continue with business as usual, then the instream flow program will likely not be enough to keep our rivers from drying up. If Colorado's rivers that add to their aesthetic beauty, tourist industry and biodiversity are to stay intact then there will need to be changes made to the water law system.

Changing water law in Colorado is a big task. It has been set in stone for centuries and many people are not willing to give up or negotiate the water rights they have, especially those with more senior rights. On top of that, the many interstate compacts play a major role in the water rights system in the state and would be extremely difficult to renegotiate because all western states are facing drying conditions and want to keep as much water in their states as possible. The water court system is also designed to work with the current laws and if the laws were to be changed the court set up may need to be changed as well. Although these are all big obstacles to overcome, the risk of losing stream flows throughout the state is worth the

time it will take. One of Colorado's main industries is tourism which would not survive if the natural beauty of the state were to be disrupted because of a lack of streamflow. On top of tourism and the economy, it is also important to recognize the harm losing streamflow would place on the ecological systems throughout the state. Losing streamflow has great consequence and we should take any and all precautions possible to reduce the risk.

## **Conclusion**

Colorado's water right system is complicated and based on laws created now over a century old. There are now many more updated doctrines involved in Colorado's water law

including interstate compacts and updates to older laws. One of the newest updates to the water law system was the in stream flow program in 1973. This program allows for the CWCB to purchase, acquire and accept donations of water rights with the intention that the water be left in stream without diversion. It took changes in the law requiring diversion to make this program possible. The program has been updated throughout its tenure. The program has provided great improvements to many streams and has surely contributed to the natural beauty and ecology of the state. However, the program is not without flaws; the biggest of which is that most of the active instream flow rights are very junior in the priority system causing them to receive water last during times of drought. While it would be beneficial for the state to update its water laws to ensure that in stream

flows will not be lost with the threat of drought due to climate change, it will be no easy feat. The water law system in Colorado is based on priority, those who diverted and used it in a beneficial way first have the right to that water. The in stream flow program would benefit greatly from the donations of high priority water rights, but not many people with high priority rights are willing to give them up. Water is power in the western United States and not many people want to give up their power. The predictions in reductions of streamflow throughout the state are disconcerting. Climate change is likely to have major impacts on Colorado snowpack and watersheds, and both state agencies and water users should be prepared. Colorado's rivers and streams are over appropriated and as a state we will need to make sure that we are making the most of the resources we have without jeopardizing our natural environment or tourist economy.

### **Bibliography**

Bennett, Katrina E. et al. 2018, "Climate Driven Disturbances in The San Juan River Sub-Basin of The Colorado River". *Hydrology and Earth System Sciences*, vol.22, 709-725.

Benson, Reed. 2006, "Adequate Progress", or Rivers Left Behind? Developments in Colorado and Wyoming Instream Flow Laws Since 2000". *Environmental Law*, vol. 36, 1283-1310.

Brocius, Ariana. June 24, 2019. "Tucson Reviving a Stretch of the Santa

Cruz River”. Arizona Public Media. <https://www.azpm.org>.

Browning, Michael F. 2004. “Private Means to Enhance Public Streams”. *The Colorado Lawyer*,

Vol. 33.

Burr, Carolyn. 2019. “The Water Court Team: An Introduction to the Roles of clients, engineers, and Attorneys in the Water Court Process”. *Denver Water Law Review*.

Carney, Shasha. July 2015. “Decades down the Road: An Analysis of Instream Flow Programs in Colorado and the Western United States”. 1-50. Colorado Water Conservation Board

Casado-Pérez, Vanessa. 2019. “Specialization Trend: Water Courts”.

*Environmental Law*, 18-53. Castle, Anne J. June 2015. “SLIDES: The Colorado River: Innovation in the Face of Scarcity”. *Innovations in Managing Western Water: New Approaches for Balancing Environmental, Social and Economic Outcomes (Martz Summer Conference, June 11-12)*

Covell, Cynthia F. et al. 2016. “Update to a Survey of Instream Flow Programs in the Western United States.” *Water Law Review*, vol. 20, 355-268

Dilling, Lisa et al. 2019. “Savior of Rural Landscapes or Solomon’s Choice?

Colorado’s Experiment with Alternative Transfer Methods for Water

(ATMs)”. *Water Security*, vol. 6. Espergen, Gregory D. 1996. “Development

of Instream Flow Recommendations in Colorado Using R2CROSS”. 1-20.

Foster, Lauren M. et al. 2016. “Energy Budget Increases Reduce Mean

Streamflow More than Snow-Rain Transitions: Using Integrated Modeling

- to Isolate Climate Change Impacts on Rocky Mountain Hydrology”.  
*Environmental Research Letters*, Vol. 11, 1-10.
- Getches, David H. 1997. “Water Law in a Nutshell”. *West Publishing co.*
- Grigg, Neil s. Oct. 2012. “Water Utility Leadership and Its Key Role  
in Protecting Aquatic Ecosystems.” *American Water Works  
Association*, vol. 104, 50-51
- Hobbs, Gregory J. 1997. “Colorado Water Law: An Historical Overview.”  
*Water Law Review*, vol. 1. 1-25
- Hobbs, Gregory J. 2002 “Priority: The Most Misunderstood Stick in the Bundle.”.  
*Environmental Law*, 1-12
- Kendy, Eloise, et al. May 2012. “A PRACTICAL GUIDE TO  
ENVIRONMENTAL FLOWS FOR POLICY AND  
PLANNING.” 26-28
- Kopytkovskiy, M., Geza, M., and McCray, J.E. April 2015. “Climate-change  
Impacts on Water Resources and Hydropower Potential in the Upper  
Colorado River Basin”. *Journal of Hydrology: Regional Studies*,  
vol.3, 473-492.
- Merriman, Dan, and Anne M Janicki. “COLORADO’S INSTREAM  
FLOW PROGRAM— HOW IT WORKS AND WHY IT’S  
GOOD FOR COLORADO.”
- Pisani, Donald J. 1996. *Water, Land, and Law in the West*. Lawrence  
(KS): University Press of Kansas.
- Reiter, Joe, Ris, Lauren and Kenney, Doug. March 14, 2008.

“Shoshone Power Plant Breakdown”. Red Lodge Clearinghouse.

<http://www.rlch.org>

Schorr, David. *Colorado Doctrine*. 2014. New Haven (CT): Yale University Press.

Sittler, John. 2017. “Save Some for the Fishes: Analyzing the St. Jude’s Co. Decision and What it Means for Beneficial Use in Colorado”. *University of Colorado Law Review*, vol. 88.

Solander, Kurt C. et al. 2017. “Shifts in Historical Streamflow Extremes in Colorado River Basin”. *Journal of Hydrology: Regional Studies*, vol. 12, 363-377.

Squillace, Mark. 2018. “Restoring the Public Interest in Western Water Law”. *Utah Law Review*, 2-54.

Tarlock, Dan. 2006 “General Stream Adjudications: A Good Public Investment?” May. *Journal of Contemporary Water Research and Education*. 52-61

Udall, Bradley and Overpeck, Jonathan. 2017. “The Twenty-First Century Colorado River Hot Drought and Implications for The Future” *Water Resources Research*, vol. 53, 2404- 2418.

Zallen, Margot. 1986. “Evolution of ESA Consultations on Western Water Projects.” *Natural Resources & Environment*, vol. 2,41-42, 70-71