

5. Water Demand by Sector (previously Chapter 3)

Introduction

Colorado's Water Plan identifies the challenges associated with managing Colorado's important water resources. To assess the road ahead, it is essential to understand the many ways that water is used throughout the state and how these uses are connected. As municipal and industrial needs expand, pressure on agriculture, the environment, and water-based recreation increases. As the state's population and associated municipal supply needs increase, more people will want to enjoy the year-round outdoor opportunities which Colorado's natural environment has to offer; Coloradans will continue to increase their consumption of a wide variety of locally-grown agricultural products provided by ranches and farms across the state. This chapter provides an overview of Colorado's current and projected municipal, industrial, agricultural, environmental, and recreational uses.

5.1 Overview

Water use in Colorado is calculated in acre-feet. An acre-foot is the amount of water that it takes to cover one acre to a depth of one foot. An acre is about the size of a football field, including both end zones. The total amount of water currently consumed, on average, statewide is over five million acre-feet per year (Harding, 2014).

Water in Colorado is often used multiple times, as this sequence demonstrates: 1) water is diverted for a given use, 2) the plant, person, or process consumes a portion of the water, 3) the unused portion of water makes its way back to the river (referred to as "return flows"), 4) the return flows are subsequently used by other water users downstream, and the cycle repeats. Colorado diverts approximately 15.3 million acre feet of water annually for uses around the state, but an average of only 5.3 million acre feet is consumed (USGS, 2005). In Colorado the majority of consumptive use is agricultural, followed by municipalities, and then by large industries (Figure 5.1-1; USGS, 2005).

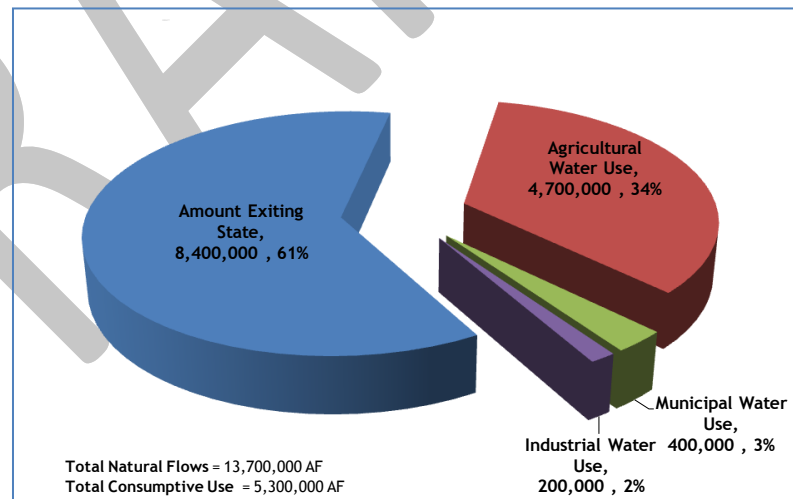


Figure 5.1-1: Statewide Water Use CWCB, 2010; C). WCB, 2014

In addition to meeting the requirements of communities and food production, water is necessary to support aquatic and riparian dependent species, as well as rafting, fishing, camping, and other water-based recreational activities.

5.2: Overview of Municipal and Industrial Needs

Municipal Needs

Most communities throughout the state are projected to continue to grow. As a whole, the state's population is expected to nearly double by 2050, with some communities growing moderately while others are expected to triple in size (SWSI, CWCB, 2010). As population rises, so too will municipal water needs, although these projections of future water needs may be adjusted as social values change.

Colorado is growing for two primary reasons. Coloradans are having children and those children tend to stay in state and become students and working adults. With the birth rate exceeding the death rate, roughly half of the state's growth comes from residents born in Colorado (SWSI, CWCB, 2010). Secondly, Colorado is a desirable place to live. A diverse and healthy economy, combined with vibrant, culturally-rich communities and attractive locations, draw people and businesses to Colorado (SWSI, CWCB, 2010).

The state's population growth cannot be controlled, but the manner in which it grows can be influenced. Colorado's population growth is closely tied to a healthy economy, which is necessary for continued employment of Colorado's current and future citizens. Furthermore, some growth is needed in employment sectors where Colorado does not currently have a sufficient work force. For instance, with a growing aging population, more people will need medical care. To serve this population, the state of Colorado will need additional health workers, some of whom may come from out-of-state (SWSI, CWCB, 2010).

The scale of municipal water use is also important. The amount of municipal water use is small when compared to the amount of economic value that Colorado's cities and towns provide in jobs, goods, and services. For instance, 97.6 percent of Colorado's jobs are based in cities and towns (e.g., public administration, educational and healthcare services, professional management, retail trade, etc.) ([U.S. Census Bureau, 2012](#)).

Climate change could also increase municipal needs. As temperatures rise, outdoor landscapes must adapt to longer growing seasons, higher temperatures, and higher evapotranspiration. The effects of climate change are expected to increase total annual municipal diversions by as much as eight percent (Harding, 2014). In the event that Colorado experiences a future that consists of strong growth in population and evident effects of climate change¹, an additional 1 million acre-feet per year beyond 2008 levels of demand may be needed by 2050. However, if Colorado experiences weak population growth, matched with historical temperature conditions, the additional annual demand beyond 2008 levels are approximately 600,000 acre feet (CWCB, 2010; CWCB, 2011).

¹ This scenario is also known as the "hot growth" scenario in IBCC scenario planning work, which has hot and dry climate matched with high population growth.

There is considerable variability across the state regarding the degree to which climate change could impact municipal demands. This is due to differences in the amount of outdoor irrigation, potential temperature increases, and potential changes in precipitation patterns throughout the state (Harding, 2014). Increases in demand from climate change do not take into account potential decreases in municipal supply due to hydrological changes, which could further exacerbate future municipal needs.

While climate change has the potential to intensify municipal needs, water conservation and other demand management practices have the potential to attenuate them. Each person's daily needs decline as households gradually replace high water use appliances and fixtures with low water use ones, such as toilets, dish washers, and washing machines. This natural replacement is expected to decrease municipal water diversions by as much as 150,000 acre feet per year (SWSI, CWCB, 2010). Colorado may experience these savings sooner than expected due to recent adoption of Senate Bill 14-103. The "fixtures bill," as it is known, allows retailers in Colorado to sell for only water wise fixtures to be sold by retailers in Colorado. In addition, municipal water providers can implement active conservation measures to further reduce household demands. Active conservation measures implemented by water providers can further reduce demands. Conservation and other demand management practices are further explored in sections 6.1, 6.3, and 6.5.

Looking forward, additional technical work is necessary, to better inform the statewide discussion. The SWSI 2010 technical analysis should be updated to take into account the length and severity of the recent economic recession. In general, Colorado's population projections have decreased since 2007(DOLA, 2014).

In spite of the recent economic recession, Colorado's population is still projected to reach between 8.3 and 9.2 million people by 2050 (DOLA, 2014). The CWCB is in the process of applying new water use data to future population projections for low, medium, and high scenarios. This data will result in updated population projections, and will be available by early 2015.

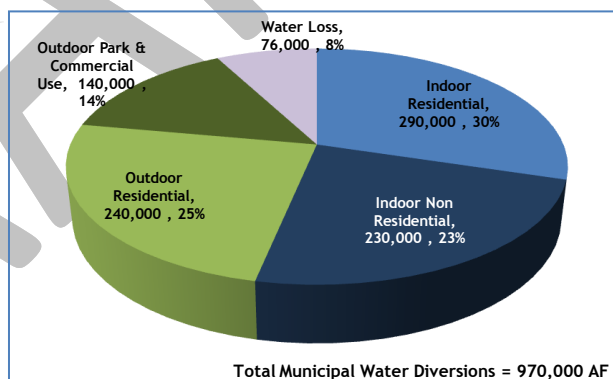


Figure 5.1-2: Statewide Municipal Use Patterns (SWSI, CWCB, 2010).

Colorado's current municipal use is estimated to be approximately 970,000 acre-feet annually (SWSI, CWCB, 2010). This use is split between indoor use, outdoor use, and water loss in distribution systems. These numbers can be further divided between residential, parks, and commercial uses. Statewide, Colorado uses 53% indoors, 39% outdoors, and 8% due to water loss (Figure 5.1-2).

Large Industry

Colorado's large industries are an important part of Colorado's economy. Breweries, snowmaking, energy and mining extraction, power generation, and a multitude of other industries annually

require approximately 200,000 acre-feet of water today. Projections indicate that future large industry needs could increase by 50,000 to 130,000 acre-feet per year (SWSI, CWCB, 2010).

Additional analyses of industrial needs will be incorporated into future water planning efforts, regarding the use associated with energy and extraction. Through statewide and basin-wide planning efforts, existing data will be confirmed and future uses updated. For instance, the Colorado and Yampa/White/Green Basin Roundtables conducted an Energy Needs Study and have asked the CWCB to incorporate this work into future statewide planning efforts (Colorado and Yampa/White/Green Basin Roundtables, 2014).

5.2 Overview of Agricultural Needs

Agriculture is also a critical part of Colorado's economy, and the sector employs more than 100,000 citizens statewide (USDA, Census of Agriculture, 2007). Agribusiness contributes approximately \$16 billion to the state economy each year (ibid). At the local level, agricultural and tourism provide as many as half of the jobs available in several counties (Colorado Department of Agriculture, 2012; Coley/Forest, Inc, 2011). The sustainability of many rural communities is closely linked to the health of the agricultural economy (CDA, 2012).

Statewide, agriculture consumes the most water. Current use estimates are approximately 4.7 million acre-feet of consumptive use on an average annual basis (SWSI, CWCB, 2010). However, taking into account crop irrigation requirements, current agricultural crops could use an additional 2 million acre feet under ideal conditions (SWSI, CWCB, 2010). It is important to note, however, that some water shortages are due to management decisions made by farmers in addition to physically or legally limited water supplies. It is not expected that every agricultural shortage can or should be met in the future.

In the future, irrigated acres statewide are expected to decline for a variety of reasons:

- Many municipalities turn to agricultural water rights as an affordable, reliable source of water and purchase them from willing sellers.
- Urban areas expand onto irrigated farmlands, thus urbanizing those agricultural lands.
- Due to aquifer sustainability and some compact-related issues, the South Platte, Republican, and Rio Grande Basins have reduced, or are in the process of reducing, irrigated acreage (SWSI, CWCB, 2010).

Statewide, irrigated acres could decrease from 3.5 million irrigated acres to 2.7 million acres (SWSI, CWCB, 2010). The potential impact is most pronounced in the South Platte basin, which could lose as many as 35% of the irrigated acres in the basin (South Platte and Metro Basin Roundtables, 2014).

In addition to potential decreases in irrigated acres, agricultural producers could be further impacted by climate change. Depending on location, higher temperatures in the future could increase water demands on the lands still in production. (SWSI, CWCB, 2010; Harding, 2014).

Looking towards the future, Basin Roundtables have examined future agricultural water needs; while six basins expect decreases in irrigated acres, two basins and some expect increases in agricultural irrigation acreage. As part of the Basin Implementation Plans, Basin Roundtables aim

to reduce expected shortages, even under conditions of reduced agricultural acreage, and in a few cases meet additional expected agricultural needs. Section 6.5 further explores projects and methods to achieve that goal. Table 5.2-1 provides a brief summary of agricultural needs, as identified in the Basin Implementation Plans.

Basin	Identified Agricultural Goals
Arkansas	Increase amount of agricultural augmentation water
Colorado	Reduce agricultural shortages
Gunnison	Reduce agricultural shortages by approximately 17,000 acre-feet
Metro/South Platte	Reduce agricultural shortages
North Platte	Add an additional 28,000 acres of irrigated farmland; continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies
Rio Grande	Manage water use to sustain optimal agricultural economy throughout the Basin's communities
Southwest	Reduce agricultural shortages by implementing at least 10 projects
Yampa/White/Green	Add an additional 14,000 acres of irrigated farmland; reduce agricultural shortages

Table 5.2-1: Summary of agricultural goals indicated in the Basin Implementation Plans

5.3: Overview of Environmental and Recreational Needs

Environmental health and recreational opportunities represent important aspects of Colorado's identity and economy. Just as Colorado farming communities largely depend on agriculture, some headwater communities rely largely on tourism. In the headwater counties on the Western Slope, 48% of jobs are related to tourism, compared to 8% statewide (Coley/Forest, Inc, 2011). Outdoor recreation in Colorado generates \$13.2 billion in consumer spending and \$994 million in state and local tax revenue (Outdoor Industry Association, *The Outdoor Recreation Economy*, 2012).

Environmental and recreational attributes are not solely based on the amount of water needed. Water supply is critical, but so is aquatic and riparian habitat, water quality, bank stability, access to the stream, and habitat connectivity. Therefore, environmental and recreational needs are often represented in number of stream miles or acres of wetland, featuring important attributes which need protection. A collaborative effort between CWCB and the Basin Roundtables, as part of SWSI 2010, identified 33,000 miles of streams in Colorado as having important attributes and selected as "focus areas" (CWCB, 2010; CWCB, 2013). Figure 5.3-1 shows all of the important areas identified by the Basin Roundtables.

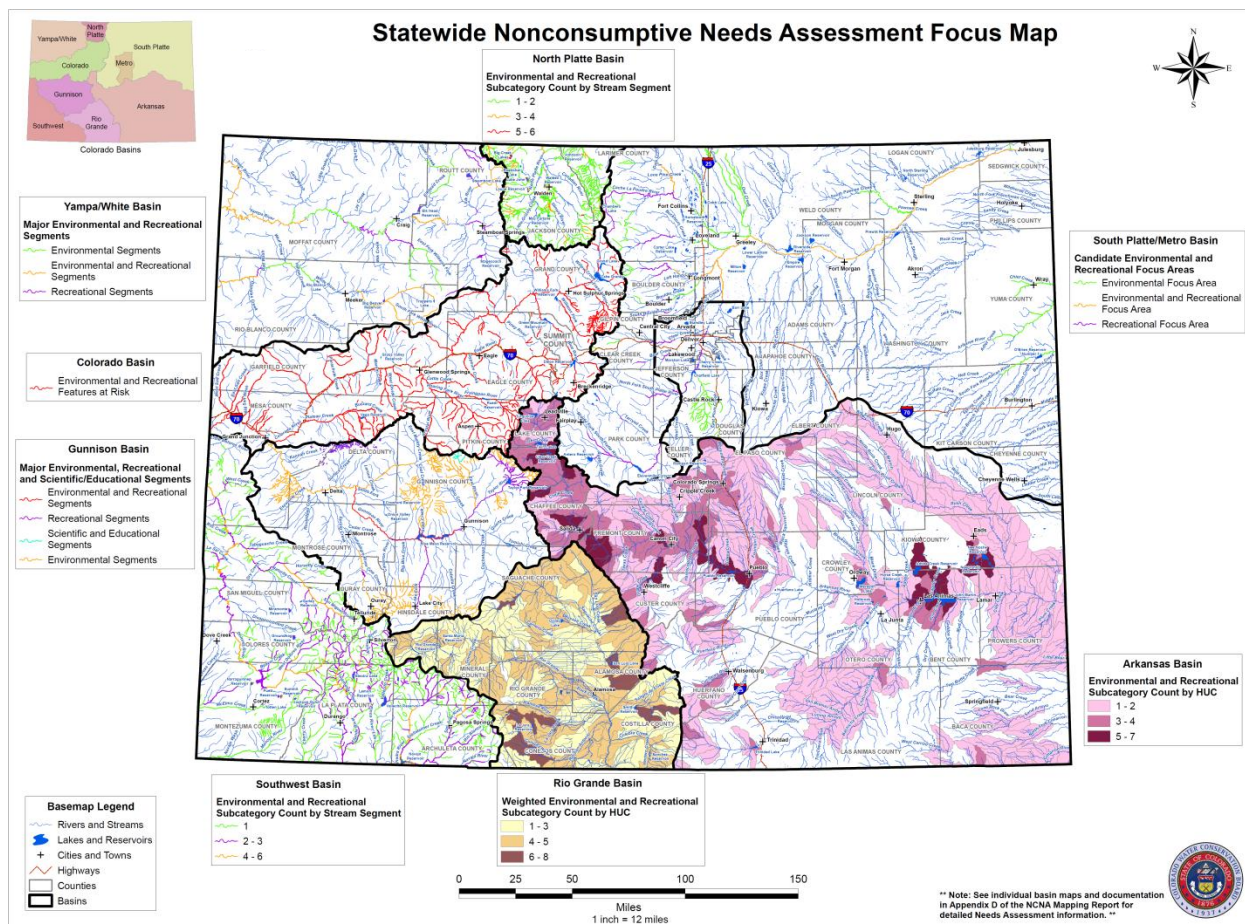


Figure 5.3-1: Statewide Environmental and Recreational Needs (SWSI, CWCB, 2010)

This information can be further broken down by attribute. For instance:

- 3,300 stream miles of Colorado River and greenback cutthroat trout habitat were identified in focus areas across the state.
- 8,600 stream miles of warm-water fish habitat were identified in focus areas. These reaches include endangered, threatened, or imperiled fish species.
- 18,800 stream miles of significant riparian areas and wetlands were identified. These include occurrences of exemplary plant communities as well as rare plant communities.

The number of water rights appropriated for instream flows, natural lake levels, and recreational in-channel diversions, demonstrate the existing needs for the environment and recreation:

- Instream flow: 9,180 stream miles for 1,595 decreed water rights
- Natural lake levels: 126,000 AF acre-feet for 476 decreed water rights
- Recreational in-channel diversions: 17 decreed water rights, ranging in size from 35 cubic feet per second to 1,500 cubic feet per second)

It is critical to note that water is not consumed by environment or recreational uses, but rather held in streams and designated for those uses. This water is often reused multiple times downstream by agricultural, municipal, or industrial water users.

The ability to decree water for the natural environment, using instream flows, and recreation, using recreational in-channel diversions, provides Colorado with effective tools for meeting environmental and recreational needs. These state tools help to support state and federal values.

Climate change could impact environmental and recreational needs. If temperatures rise precipitously, the range of suitable habitat for cold water fish species is expected to diminish (Figure 5.3-2). Rises in temperature could also adversely affect plant communities (Climate Change and Cold Water Systems Workshop, 2013). Reduced water supplies due to increased evapotranspiration could also be a factor in maintaining the range of cold water species, due to lower capacity of reduced flows to dissipate heat (ibid).

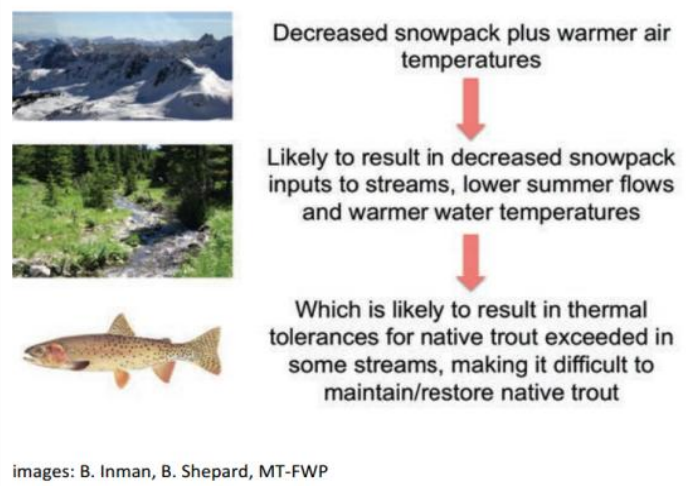
GOAL: Conservation of cold water native trout populations	
Climate Change Impacts & Vulnerabilities	Example Climate-Informed Actions
	Fish Management - Identify and restore “warm-adapted” populations of native trout. - Consider <i>not</i> restoring native trout into streams with high probability of warming past thermal limits.
	Habitat Management - Protect and restore currently occupied streams that are expected to stay cold. - Protect and restore streams that are currently too cold.
	Water Management Increase storage of water in upland and wetland areas (e.g., by reintroducing beaver, installing beaver mimic dams, installing upland micro-catchments).

Figure 5.3-2: Illustrative climate-informed actions in response to climate change impacts on the availability of suitable habitat for cold water native trout (Climate Change and Cold Water Systems Workshop, 2013)

Environmental and recreational needs are met through a variety of projects and methods, such as instream flow water rights, flow maintenance agreements, habitat restoration, and recreational in-channel diversions. As Figure 5.3-2 indicates, mitigation measures for cold water habitats may be needed to meet the future needs of cold water fish species, and environmental as well as agricultural and municipal partnerships will be critical. Several examples of multi-purpose projects are listed in Section 6.6 and 9.2, and a few multi-purpose projects that meet multiple needs are listed below:

- Arkansas Voluntary Flow Agreement
- Alternative Wild and Scenic Processes (e.g., the Upper Colorado, Lower Colorado, and Dolores River)
- Colorado River Cooperative Agreement
- Elkhead Reservoir Enlargement
- Rio Blanco River Restoration

References:

- The Contribution of Agriculture to Colorado's Economy: An Executive Summary.* Denver: Colorado Department of Agriculture (CDA), 2012.
http://www.colorado.gov/cs/Satellite/ag_Main/CBON/1251627037720
- Statewide Water Supply Initiative (SWSI).* Denver: Colorado Water Conservation Board (CWCB), 2010. <http://cwcb.state.co.us/water-management/water-supply-planning/Pages/SWSI2010.aspx>
- Portfolio and Trade-Off Tool.* Denver: CWCB, 2011. <http://cwcb.state.co.us/technical-resources/portfolio-tool/Pages/main.aspx>
- Nonconsumptive Toolbox.* Denver: CWCB, 2013.
<http://cwcbweblink.state.co.us/weblink/0/doc/172701/Electronic.aspx?searchid=b764b205-1125-4f18-b3e8-998e5e025e10>
- Harding, Ben. *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum.* Denver: CWCB, 2014
- 2050 Low, Medium, and High Population Projections.* Denver: DOLA, 2014.
- Coley/Forest, Inc. *Water and Its Relationship to the Economies of the Headwaters Counties.* Silverthorne: Northwest Colorado Council of Governments (NWCCOG), 2011.
http://nwccog.org/docs/qq/QQStudy_Report_Jan%202012.pdf
- Energy Needs Assessment Phase 3.* Glenwood Springs: Colorado and Yampa/White/Green Basin Roundtables, 2014.
- Estimated Use of Water in the United States in 2005.* Reston, VA: United States Geological Survey (USGS), 2005.
http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_5YR_DP03
- Great Northern Landscape Conservation Cooperative Rocky Mountain Partner Forum Workshop Summary Report for the Climate Change and Cold Water Systems Workshop.* Bozeman: GNLCC, 2013.
http://ecoadapt.org/data/documents/RMPF_climate_workshopreport_FINAL_small.pdf
- American Community Survey 2008-2012.* Suitland, MD: U.S. Census Bureau, 2012.
<http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>
- Metro / South Platte Draft Basin Implementation Plan.* Denver: Metro and South Platte Basin Roundtables, 2014.
<http://cwcbweblink.state.co.us/WebLink/0/doc/191973/Electronic.aspx?searchid=e44aa41d-46ee-43e3-bd91-c4302c3a1b2d>