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## 7. Water Resource Management and Protection

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This chapter examines those factors beyond supply and demand that affect water availability, such as natural hazards, watershed health, and water quality. Section 7.1 delves further into watershed health, how it can be affected by natural disasters, management strategies, and the critical role it plays in ensuring Colorado's water future. This section, in particular, emphasizes the ways that stakeholders can work together, with a focus on collaboration and information sharing. Section 7.2 provides an overview of natural hazards, which can result in serious consequences for our watersheds, drive up demands for water, and impact water quality. Natural hazards and watershed health both influence water quality, which is of utmost importance to water providers, and the wildlife which depends on healthy streams. Section 7.3 provides a detailed exploration of watershed management about quality and quantity and the organizations and regulations that are charged with its protection. Together, these three elements help to ensure that Colorado is adequately prepared to not just manage, but also protect the water resources we all rely upon.

### 7.1 Watershed Health and Management

Colorado's Water Plan promotes watershed health and supports the development of watershed coalitions and watershed master plans that address needs from a diverse set of local stakeholders.

#### Introduction

Watersheds connect terrestrial, freshwater, and coastal ecosystems, and provide ecosystem services, such as carbon sequestration, water supply, filtration, and purification.<sup>1</sup> Colorado watersheds support multi-objective uses for both consumptive and nonconsumptive water supply. Approximately 80 percent of Colorado's population relies on forested watersheds to deliver municipal water supplies.<sup>2</sup> Watershed health management strategies developed to protect this domestic supply will also protect other uses in the watershed.

Colorado's mountain watersheds have a strong influence on the quality and quantity of water. Watershed geography includes physical aspects, such as climate and geology, ecological aspects such as stream biology, as well as the relationship that humans have with the land and water. Healthy watersheds provide ecosystem services that benefit ecological processes, local and state economies, and social stability. Ecosystem services include flow regulation, flood attenuation, water purification, erosion control, and habitat protection.

This section begins by defining the physical processes that influence watershed health and then discusses recommended strategies for successful stewardship of watersheds and water supply. It

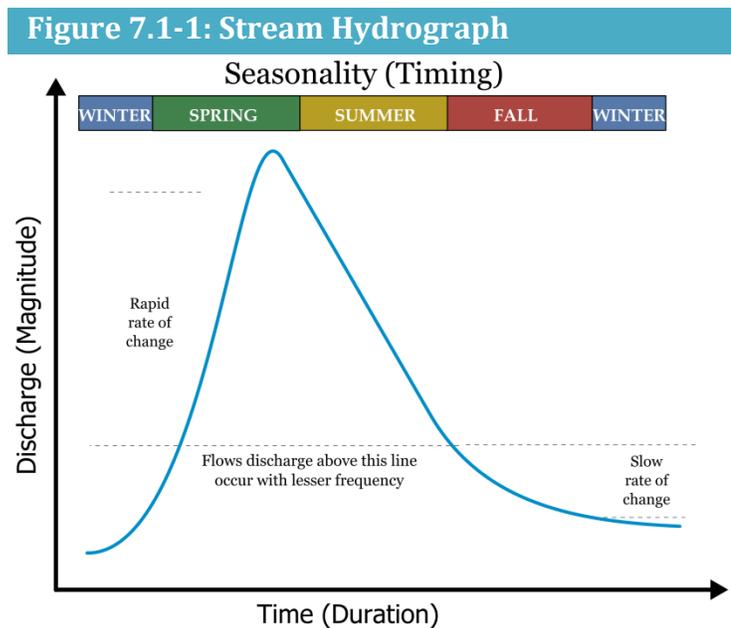
concludes with a summary of the watershed health strategies developed in the Basin Implementation Plans (BIPs).

### Watershed Health Science

A watershed is an area of land in which all water drains to a common point. Watersheds exist at all spatial scales, from the tiniest of tributaries to the largest rivers on earth. John Wesley Powell defined a watershed as “that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.” Headwater areas are the natural forebays of Colorado’s water supply. Headwater areas include forested watersheds, intermountain wetland complexes (parks), and the riparian corridors of stream valleys. As snowmelt and rain travels down gradient to reach rivers it must go through varying terrain, interacting with the biology and the physical environment of the watershed. This is the watershed’s ecosystem. Water quality and quantity are intimately linked to watershed health.

Watershed health can be broadly defined as a measure of ecosystem structure and function. Structure refers to species richness (characterized by abundance and diversity), inorganic and organic resources, and physical attributes (including habitat complexity). Function refers to ecosystem processes such as the hydrologic cycle, nutrient cycling, energy flow and succession.<sup>3</sup> A critical component of the hydrologic cycle is flow regime. Flow regime defines the magnitude, duration, frequency, rate of change, and timing of flows in stream systems. Magnitude refers to a river’s discharge. Duration describes a period of time a river experiences a given discharge. The frequency at which a river experiences a given discharge and the rate at which discharges increase and decrease, (i.e. change), also characterizes flow regime. Finally, the timing of discharges, or seasonality, is influenced by a watershed’s hydrologic function. Figure 7.1-1 represents an annual median flow hydrograph for a snowmelt driven stream. This figure describes the different elements of flow regimes. Society has adapted its water supply infrastructure to the flow regime of its watersheds. Changes in ecosystem structure and function have direct and indirect effects on a stream’s flow regime.

Watersheds support dynamic ecosystems that are subject to natural perturbations, such as fire, flood, and drought.<sup>4</sup> Resilient ecosystems exist in a state of dynamic equilibrium, (e.g., the flow regime may deviate around a mean while still maintaining its function). These watersheds experience natural



disturbances with little impact on function. Often, the impacts from fire, flood, and drought are exacerbated by anthropogenic, or human induced, impacts. For example, watersheds that have historically been managed to suppress fires have changed ecosystem structure and productivity. This results in fires that burn with greater intensity and leads to soil hydrophobicity that increases runoff and erosion. When natural ecosystem functions are altered, a watershed no longer exists in equilibrium. The resultant changes to hydrologic function and water quality have direct effects on water supply and infrastructure.

Sediment is the most concerning non-point source pollutant contributed from our forested lands.<sup>5</sup> An accelerated delivery of sediment in rivers has negative effects on both consumptive and nonconsumptive water uses. Sediment is contributed to river systems through natural processes that connect land and water. Increased volumes of sediment are contributed as a result of erosion caused by high to moderate burn severity fires, forest road infrastructure with failing stormwater management infrastructure, and other processes in which the landscape is altered by human or natural causes.

Forests and riparian corridors provide ecosystem services for watersheds that help protect, restore, and sustain water quality and quantity. Healthy forested watersheds absorb rainfall and snow melt and allow it to runoff slowly, recharge aquifers, sustain stream flows, and filter pollutants. Watersheds are largely protected when forest ecosystems are healthy because soil is protected, thereby preventing erosion, promoting soil moisture storage, and allowing groundwater recharge.<sup>6</sup> These services can offset natural hazards by reducing floods, maintaining plant communities, and reducing contaminants. Present day forest health concerns are largely attributed to climate change and forest stand density, (i.e. ecosystem productivity.)<sup>7</sup> Climate change has the potential to affect watershed health by increasing temperatures, altering precipitation patterns, and causing earlier snowmelt. This results in potential increases in stream temperatures, increased pollutant concentrations, reduced quality of aquatic habitats, and loss of wetlands. Conversely, healthy watersheds may increase climate change resiliency and provide natural carbon sequestration.<sup>8</sup>

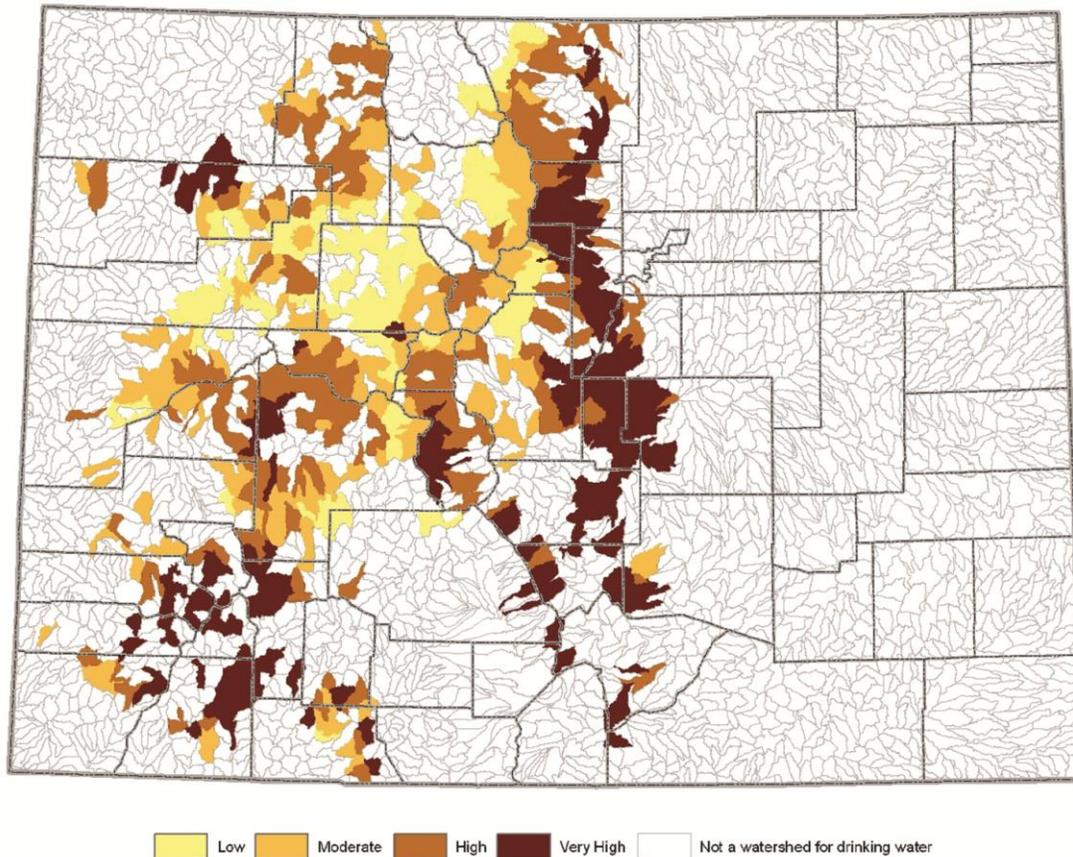
While forests are vital to overall watershed health, the physical extension of these lands are comprised of the lower elevation rangelands. Rangelands, wetlands and riparian corridors play a substantial role in water storage, transport, sediment control, water quality, wildlife habitat, and streamflows. Lower elevation watershed health may be favorably influenced by the presence of wetland complexes and optimal agricultural practices.

### Watershed Partnerships

Managing watersheds for healthy ecosystem structure and function can provide a unique opportunity for watershed stakeholders. Successful watershed management necessitates a pragmatic approach that includes coalition-building, data collection, planning, prioritization, implementation, and monitoring. This is a cyclical process, and each phase requires continued efforts. Watersheds span across political boundaries, and watershed health management involves collaboration among many interested entities. Natural resource management may be the driver

that catalyzes a need for collaboration, but there are social, political, and economic interests that must be represented as well.

**Figure 7.1-2: Colorado State Forest Service Risk of Post-fire Erosion in Watersheds That are Important Sources of Drinking Water**



A watershed approach is a flexible framework for managing water resource quality and quantity within specified drainage areas, or watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. Coalition building typically starts when interested parties come together to discuss a watershed health concern. For example, many watersheds in Colorado are identified as having a high post-fire erosion risk as well as being a critical watershed for water supply (Figure 7.1-2).<sup>9</sup> This is an example where concerned stakeholders are engaging in collaborative dialogues to address very real watershed health concerns. Coalitions form to address a variety of concerns including pre- and post-fire mitigation, forest mortality, water quality impairments, flood mitigation and recovery, aquatic and riparian habitat enhancement, and land use change. The Front Range flooding of

September 2013 resulted in the formation of ten new watershed coalitions that developed master plans focusing on stream restoration. Other groups may come together to discuss watershed protection in a well-functioning ecosystem. Collaboration before a threshold crossing disturbance takes place sets the stage for faster and more resilient recovery measures.

The State of Colorado recommends partnerships form an organizational structure that consists of a diverse stakeholder group and a coordinator. This structure is recommended whether or not the coalition chooses to become incorporated. The coalition should be open to diverse interests within the watershed, as well as those interests directly affected by the outputs of the watershed. Diverse stakeholder input at the beginning stages of coalition building increases the likelihood that actions to improve watershed health will be successful. Engaged community members are more likely to participate in building political will, developing management options, and supporting project implementation. Stakeholder representation includes all levels of government, special districts, private landowners, businesses, citizens, non-profits, educators, recreational interests, agricultural interests, grantors, and conservationists. A paid watershed coordinator improves the chances for continued coalition success by servicing all coalition stakeholders equally and representing the interests of all coalition members. They are the unifying body, the moderator, the facilitator, and the manager. It is helpful for this person to have a background in both non-profit and governmental work.<sup>10</sup>

Ideally partnerships work to develop a watershed plan. A watershed plan is a strategy that defines a coalition's mission, goals and objectives along with assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan. It may include or be informed by a streamflow management plan (defined in Chapter 6.6). It can be developed as a guide for mitigation of fires, floods, or the development of new infrastructure. It can also be developed as a holistic approach for the rehabilitation of stream systems. The development of a watershed plan will require a leader with a certain level of technical expertise and the participation of a variety of stakeholders with diverse skills and knowledge to aid in the assemblage and assimilation of watershed information (e.g., geographic information systems data, maps, monitoring reports, risk analysis, and existing assessments).

A holistic watershed planning approach will provide the most technically sound and economically efficient means of addressing watershed health concerns. The process is strengthened through the involvement of stakeholders. This approach will address all the beneficial uses of the water supplied by the watershed, the criteria needed to protect the uses, and the strategies required to restore or protect ecosystem processes. This approach expedites cooperative and integrated water supply planning, which leads to successful implementation of watershed health management strategies. Examples of partnerships formed to address these issues are detailed below.

### Forest Health Partnerships

Fires are a part of Colorado's forest ecosystems. Forest management to prevent fires has proven to exacerbate burn intensity.<sup>11</sup> Many stakeholders have come together to address forest health through fire mitigation strategies. The U.S. Forest Service has partnered with Colorado's municipal

water providers, state agencies, and private interests through the Rocky Mountain Protection Partnership. This partnership functions to preserve water quality by mitigating the effects of forest landscape change caused by severe fires and pine beetles.<sup>12</sup> It is also a venue to strategize post-fire restoration in critical watersheds on public and private lands. Key municipal water providers include Denver Water, Aurora Water, Colorado Springs Utilities, Northern Water Conservancy District, and the Pueblo Board of Water Works. The National Forest Foundation and the Coalition for the Upper South Platte are non-profit organizations with a critical role in the partnership. Partner funds are being leveraged with federal and state funds to plant trees, treat hazardous fuels, restore riparian and wetland areas, treat invasive species, restore trails, decommission roads, restore stream channels, and engage volunteers.

Federal, state, and local governments and private partners formed the Watershed Wildfire Protection Group in 2007. The group's vision "is to protect Colorado water supplies and critical infrastructure from catastrophic wildfire and other threats by maintaining healthy, resilient watersheds through collaboration, implementation, leveraging, and education." Core members of this group include the Colorado Water Conservation Board (CWCB), the Colorado State Forest Service, the U.S. Forest Service, Denver Water, Aurora Water, the Coalition for the Upper South Platte, and J.W. Associates. The group provides education and outreach activities statewide and connects practitioners with funders.

The CWCB recommends that the entities listed in the paragraphs above be consulted when considering the formation of forest health partnership. These partnerships have explored strategies to implement pre- and post-fire mitigation projects prioritized to improve forest health and protect critical water supplies. Existing forest health partnerships are adept at leveraging funds and resources from federal, state, and local government agencies as well as from private companies, foundations, and non-profits. The CWCB funds from various grant programs including the Colorado Healthy Rivers Fund, the Colorado Watershed Restoration Program, the Fish and Wildlife Resources Fund, and the Water Supply Reserve Account have been leveraged to improve forest health. It is the success of partnerships like the Watershed Wildfire Protection Group that serve as examples for other watershed partnerships in the effort to build consensus among diverse stakeholders and implement cost-effective strategies that benefit all interests.

### Basin Implementation Plan Strategies

Watershed health for individual basins is largely focused on forest health concerns. The BIP guidance, provided by the CWCB, recommended this as a focus area. Forest health concerns are centered on wildfire, flooding, and sedimentation. Basins were asked to identify projects and methods that would protect critical water supplies and the environment in the event of a natural disaster at the watershed scale. The BIP guidance recommended that existing watershed assessments be assembled or developed. It also recommended beginning collaborative discussions on managing forests to benefit water supply. Basins with water supplies originating in another basin were encouraged to work collaboratively.

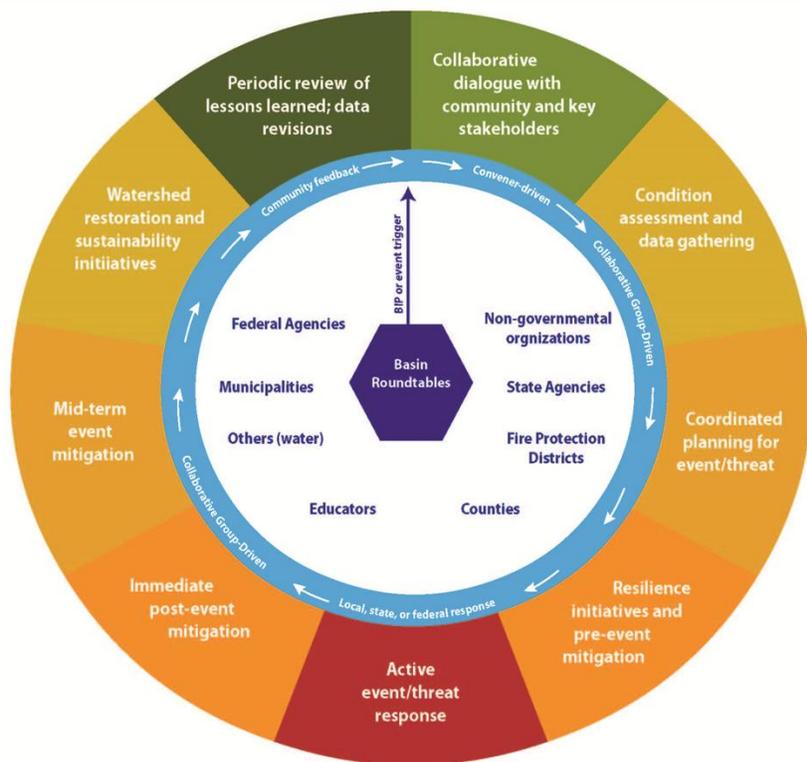
All of the basin roundtables identify wildfire as a watershed health concern. This includes recovery from existing fires and identifying pre-fire mitigation strategies. The Arkansas Basin illustrates a process with a strong emphasis on pre-disaster preparedness through collaborative dialogues with potentially affected parties. Figure 7.1-3 outlines the Watershed Health and Emergency Event Life Cycle and the role of stakeholders.<sup>13</sup>

The Rio Grande Basin contributed to the Arkansas Basin’s watershed health planning process and is closely aligned with that of the Arkansas Basin’s approach to watershed health. The primary goal of the basin is to “protect, preserve and/or restore the sustainability of the Rio Grande Basin watershed by focusing on the watershed health and ecosystem function.” The basin developed a collaborative watershed coalition during the 2013 West Fork Fire, and they realized the benefits of such a group for restoration and protection of forested watersheds. The coalition known as the Rio Grande Watershed Emergency Action Coordination Team (RWEACT) has modeled post fire hydrology, improved their ability to forecast storms, identified flood potential and developed post-wildfire flood risk analysis maps. The basin’s watershed health actions emphasize forest management and stakeholder coordination. This includes forest thinning and prescribed burning as methods to improve forest health. In addition, the Rio Grande Basin included soil health for agricultural lands as a key action in its plan.<sup>14</sup>

The South Platte and Metro Basins also participated in the Arkansas Basin’s watershed health planning process. They propose a collaborative dialogue that focuses on post-fire mitigation across watershed (basin) boundaries. The deliverables from this process will include forest health manuals developed at a statewide level. The basin watershed health section also discusses insect infestations, but concludes that insects have little direct impact on water quality and quantity.<sup>15</sup>

The Southwest Basin has a history of collaborative watershed groups focusing on watershed health topics. This includes forest health and resiliency planning for the San Juan watershed, water quality monitoring on the Animas

**Figure 7.1-3: Coalition Stakeholder Figure**



River, watershed health assessments for the San Miguel watershed, and development of Source Water Protection Plans for 23 public water suppliers. A Source Water Protection Plan inventories potential sources of drinking water contamination in a defined watershed. The dialogue and action fostered by these efforts can help protect critical water supplies from fire risk, contaminants or other hazards.<sup>16</sup>

The Yampa, White, and Green Basin states that more than 1/3 of its jobs are dependent on water quality influenced by watershed health. They acknowledge that communities in the basin are susceptible to water quality issues caused by severe wildfires. The basin references a Critical Community Watershed Wildfire Protection Plan entitled "Upper Yampa Phase I Watershed Assessment: Prioritization of Watershed Base Hazards to Water Supply." Watershed wildfire planning is frequently recommended for watersheds critical to water supply. They provide composite hazard rankings for wildfire hazards, flooding/debris flow risk, and soil erodibility. This data are combined with Source Water Assessment and Protection data to prioritize critical watersheds.<sup>17</sup> Presently, the Watershed Wildfire Protection Plans are geared towards prioritizing forest health treatments for watersheds critical to drinking water supply, but they could be applied to any prioritized water use.<sup>18</sup>

The Gunnison Basin is addressing forest health concerns by partnering with the Colorado State and U.S. Forest Services to manage forests, insects, and wildfire. They also expect education and outreach associated with this effort. They did not participate in the Arkansas Basin's watershed health planning process, but they do plan to reference materials produced in the effort for future watershed health projects. However, there are several local watershed groups working in the Gunnison Basin to address general watershed health and specific water quality challenges. These groups have developed comprehensive watershed plans.<sup>19</sup>

A goal of the North Platte Basin is to enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health. To reach this goal the basin has funded a major study that monitors forest beetle kill, wildfire potential, and impacts to water quality and quantity. The study is nearing completion and looks at management alternatives in the post beetle kill forest environment. The basin intends to review, disseminate, and implement recommendations identified in the study.<sup>20</sup>

The Colorado Basin identifies 14 collaborative watershed groups actively engaged in improving watershed health. Primary watershed health concerns in the basin include wildfire risk and the evolving forest landscape. Both have the potential to impair water supply. The basin supports watershed wildfire assessments and there are currently 18 Community Wildfire Protection Plans within the basin.<sup>21</sup>

### Actions

To better understand and promote watershed health, it is important to support the development of watershed coalitions and watershed master plans that address needs from a diverse set of local stakeholders. The parties responsible for implementing action plans should be watershed coalitions and forest partnerships. Water supply stakeholders should participate in the development of

effective watershed coalitions. Coordination across watershed divides should be fulfilled by the Watershed Wildfire Protection Group, other watershed groups with a state or region wide geographic scope, and state agencies focusing on watershed health. These agencies include Colorado Parks and Wildlife, the Colorado Department of Public Health and Environment, and the CWCB.

1. Identify existing watershed coalitions and existing watershed plans and assessments, including source water protection plans.
2. Encourage and support capacity in many areas that currently do not have watershed groups or other groups that work with a broad set of local stakeholders.
3. Assist stakeholders in existing watershed groups to identify tools and resources that address gaps and build capacity in existing plans.
4. Identify public and private funding sources that can be used together to support watershed and forest health projects.
5. Identify watersheds critical to water supply.
6. Work toward a long-term goal of developing watershed master plans for watersheds critical to consumptive and nonconsumptive water supply.
7. Prioritize and implement projects identified in master planning.
8. Monitor projects.
9. Adaptive management.
10. Statewide coordination of watershed coalition and partnership plans, projects, monitoring, and adaptive management strategies.

## 7.2 Natural Disaster Management

Colorado's Water Plan promotes water resource resilience from natural disasters through strategic preparedness and response.

Natural disasters are potentially devastating natural events that may have detrimental effects on the state and its economy. In Colorado we are prone to droughts, floods, earthquakes, tornados, and wildfire. Since the turn of the century, Colorado has experienced many record breaking natural disasters including; our most intense single year drought (2002), most expensive wildfire (Waldo Canyon, 2012), most destructive wildfire (Black Forest Fire, 2013), most expensive winter storm (2003), and the most expensive summer storm (2009).<sup>22</sup> In fact, 54 percent of all homeowner insurance claims from 2009-2013 were a result of catastrophe, more than double the rate for the previous 12 years.<sup>23</sup> Natural disasters do not just affect people and property, but may have serious negative effects on our water systems and the amount of water available to meet the needs of Coloradans; additionally climate change has the potential to influence the frequency and severity of these events in the future.

### Climate Change Effects on Natural Disasters

In nine out of every ten years, a portion of the state experiences some level of drought conditions.<sup>24</sup> As discussed in Chapter 4, droughts and floods that make our water availability so variable may

also bring devastating economic and natural consequences to the state. Colorado has invested heavily in developing flood mitigation activities, both structural and non-structural; and leads the nation in innovative drought preparedness planning. While natural disasters cannot be prevented or avoided, these investments can help reduce adverse effects.

Given that water influences nearly all sectors of Colorado's economy, and that too little or too much can have a substantial effect on the environment and economy, it is important to understand how climate change may affect the frequency, duration, and intensity of these natural hazards. The Colorado Water Conservation Board (CWCB) has examined how water resources will be effected by climate change through many studies including: Climate Change in Colorado, The Colorado River Water Availability Study, The Joint Front Range Climate Change Vulnerability Study, the Colorado Drought Mitigation and Response Plan, and the Colorado River Basin Water Supply and Demand Study.<sup>25</sup>

The most likely effect of future climate change on water supplies is a shift in the timing of runoff. Projections indicate that runoff timing will shift one to three weeks earlier by mid-century because of increased temperatures.<sup>26</sup> This may affect water right holders who are only permitted to withdraw their allocation during specific timeframes, or those with limited storage. It is also likely to result in decreased late summer streamflow. This is because of both increased temperatures and the projection that precipitation will generally increase in the winter months, and decrease in the summer months.<sup>27</sup> At the same time, increased population and higher crop irrigation requirements will put additional pressure on a changing water supply.<sup>28</sup>

While precipitation trends are far less clear than temperature trends, some studies have examined what floods and droughts might look like under an altered climate. Our paleoclimate record shows droughts that are longer lasting and more intense than those experienced in the 20<sup>th</sup> and early 21<sup>st</sup> centuries.<sup>29</sup> However, there is much variability across the state. For instance, in the Yampa/White River Basin, the hydrologic paleo record shows that streamflows are variable enough to capture all but the wettest projected flows under various climate change conditions. Conversely, in the Arkansas River Basin, paleo flows accurately represent only one of the climate projections, and none of the driest.<sup>30</sup> These records reinforce that the past may not be a good predictor of the future.

When flood and drought extremes are directly examined under future climate conditions, substantial variability exists across the state. On the Colorado River at Cameo, the average intensity for droughts was somewhat greater than the historical intensity (-24 percent versus -19 percent); while the intensity of surplus, or flood spells was considerably lower than the historical surplus (27 percent versus 46 percent). When climate projections are taken into account, future projected drought intensities for the same length event range from -19 percent to -32 percent; while surplus intensities range from 17 percent to 38 percent. The frequency of such events depends on which climate projections are used.<sup>31</sup>

The frequency and intensity of wildfire may also change under a warmer climate, and will continue to affect watersheds and ecosystems. While it is understood that variability in Colorado's climate will continue long into the future and will include wildfires, drought, and floods, the influence of

climate change on these events is less certain. The use of scenario planning enables the state to modify and adapt planning processes as new information becomes available, increasing flexibility and resiliency.

### Preparedness and Response

As we look back at our recent history, the last few years have demonstrated the extreme variability that Colorado faces. The year 2011 was historically wet, 2012 was historically dry, and 2013 was both historically dry and wet. This variability presents immense challenges to water supply management and planning in Colorado.

The stories from the flood of 2013 involved damaged water infrastructure and diversion structures, facilities that were severely disconnected from the stream or river channels, streams and rivers that substantially changed course, homes and businesses that were damaged or washed away, watersheds affected by fire then flood, and thousands of agricultural acres at risk. The State and others responded expediently with grant and loan resources. This teaches us two things:

1. Coloradans know how to face and recover from disasters. People came together to support their neighbors, and the thousands of unknown heroes who made a huge impact on the lives of their neighbors and communities.
2. Yet, even when people come together to face catastrophe, having a plan and sufficient resources in place makes the immediate response and the long effort of recovery easier and less costly. In fact, studies have shown that for every one dollar of investment in natural hazard mitigation, society saves four dollars in response.<sup>32</sup>

Following the 2013 floods, the U.S. Department of Housing and Urban Development approved Colorado's Community Development Block Grant – Disaster Recovery to include the Watershed Resilience Pilot Program. This innovative holistic program, developed jointly by the CWCB and the Department of Local Affairs, is designed to provide watershed restoration, risk mitigation and community and economic development using a collaborative, coalition-of-partners approach. There is an immediate need to focus on capacity building, comprehensive watershed planning and project implementation to address long term catalytic watershed system improvements. The program will support capacity building, additional watershed master planning and conceptual design activities (including modeling and mapping), planning for multi-objective uses such as green infrastructure, greenways, recreation, transportation and recreation and funding for the implementation of projects agreed to in cooperative planning efforts. The amount allocated to this pilot program is \$25 million. The U.S. Department of Housing and Urban Development has never before approved a watershed resilience pilot program.

The 2013 floods did result in an opportunity to implement various resiliency aspects during the recovery period, opportunities that may continue to be used in the event of future flood events throughout the State. As an example, the 2013 flood resulted in unprecedented levels of damage to water supply infrastructure, creating the need to quickly rebuild to restore water management capabilities. The CWCB, CPW, and other partners encouraged water providers to consider multiple-objective designs when repairing diversion structures and other damaged infrastructure. These

multiple-objective designs encourage processes that can enhance fish passage, recreational uses, and movement of sediment. Many rebuilt structures were able to incorporate these design elements. However, as the 2013 flood recovery demonstrated, current levels of funding and the need for quick rebuilding often hampered well-intentioned efforts to incorporate these new features. New or enhanced funding sources for these activities must continue to grow to have them readily available at key times when they can be implemented into this infrastructure.

Other processes were successfully implemented during the recovery from the 2013 floods. As an example, the CWCB and CDOT have begun a very successful partnership to incorporate design principles for stream restoration and highway rebuilding into a complimentary, holistic process. This has resulted in more resilient stream and highway corridors while saving money during the construction process. This is a model that must continue in road/stream alignments, especially in the steep canyon environments.

The damaged streams that resulted from the 2013 floods highlighted the need for updated floodplain mapping that more accurately reflects post-flood conditions. A restudy of the hydrology of the flood affected areas indicated that in many of the damaged watersheds, the regulatory flood hydrology that had been in place for as much as 40 years understated the flood risk. State funded mapping processes put into place in Senate Bill 15-245 will accurately reflect this higher level of risk. Nevertheless, this process underscored the point that updated studies using modern methods are necessary throughout the State to insure that flood risk to landowners is adequately conveyed for the purposes of important land use decisions.

As described in Section 6.1, Scenario Planning and Adaptive Strategies, the future is uncertain. While Section 6.1 describes the types of projects and methods needed in general for average conditions, this section focuses on variability from year to year. In any given year, Colorado needs to be prepared to respond adequately to the extremes of flood, drought, and fire. To support local communities and prepare for the disasters that affect our water supply, the state has many agencies and programs working both to prepare for, and respond to, extreme events, and will continue these efforts into the future.

Communities in Colorado have a responsibility under the State's floodplain management standards (e.g. floodplain rules and regulations that meet or exceed the Federal Emergency Management Agency minimum requirements) to foster community resiliency and develop wisely in light of flood events. The CWCB works with the Colorado Office of Emergency Management and the Federal Emergency Management Agency to provide technical and financial support for these activities. In recent years, Colorado's flood regulations have been improved by increasing freeboard requirements for homes and businesses, with additional protection for critical infrastructure such as hospitals, fire stations, and nursing homes. The Flood Hazard Mitigation Plan for Colorado also helps the state and local communities better prepare for these events.<sup>33</sup>

The Colorado Drought Mitigation and Response Plan outlines the monitoring, mitigation, and response actions necessary to ensure that Colorado is adequately prepared for drought.<sup>34</sup> The Water Availability Task Force brings together state, local, and federal agencies to monitor

conditions on a monthly basis. Once an event occurs, the Drought Task Force is activated, bringing together a multitude of state agencies to collaboratively address the issues that arise.

At the local level the development of drought management plans can help communities prepare for future conditions, in which droughts are projected to increase in frequency and severity.<sup>35</sup> Furthermore, planning and preparedness before the onset of an event can reduce both physical and economic drought related effects. The CWCB has developed many tools and resources to aid in this process and made them accessible through the Drought Planning Toolbox.<sup>36</sup> Additionally, the CWCB is able to provide grant funding for up to 80 percent of the cost of both developing a plan and implementing proposed measures through the Water Efficiency Grant Fund. Currently, mid-sized communities, such as the Town of Firestone, Pagosa Water and Sanitation District and the Town of Erie have sought funding for plan development and approval by the CWCB. Larger providers, such as Denver Water and the City of Aurora have current drought management plans but have not sought state assistance or approval. Increasing the number of communities that have active drought management plans in place will increase the state's overall resilience to drought.

Technical and financial support for healthy watersheds, which can help reduce the risk of catastrophic fires and buffer against the effects of other natural disasters, can also be found. This is further described in Section 7.1, Watershed Health and Management. State agencies work closely with local and federal agencies on fire mitigation, response, and recovery. Because many watersheds are on federal lands, our intergovernmental collaboration is vital for protecting those resources. Additionally, as a headwaters state, our downstream neighbors have a vested interest in maintaining our healthy watersheds that contribute to their water quantity and quality. Building on these relationships may also contribute to better long-term protection of the resource.

Although much preparation exists for the eventualities of floods, drought, and wildfires, these events rarely unfold exactly as predicted. That is why flexibility is critical in fostering effective and efficient response to natural disasters when they occur. Colorado flood, drought, and wildfire plans are all updated regularly and make up part of the State's Natural Hazard Mitigation Plan, which is approved by both the Governor and the Federal Emergency Management Agency. These updates incorporate lessons learned, new policies, updated program information and, together with the working partnerships, enable Colorado to respond better to future natural disasters. Existing technical tools such as Colorado's Flood Threat Bulletin are useful for helping state agencies and effected communities prepare for substantial precipitation events. Future enhancements to tools such as these could provide even further benefits.

### Actions

1. The state of Colorado will continue to support and expand where appropriate drought, flood, and wildfire preparedness and response programs.
2. The state of Colorado will actively encourage local communities to develop drought preparedness plans by providing tools and resources for development and implementation.

3. The CWCB and the Colorado Recovery and Resiliency Office will implement the actions identified in the Colorado Resiliency Framework to build communities that are more resilient to natural disasters.
4. The CWCB and CDPHE will work with utilities, federal agencies, and others to proactively identify and address regulatory barriers to climate preparedness and adaptation.

### 7.3 Water Quality

Colorado's Water Plan promotes waters fully supporting their classified uses by 2050 through strategies designed to meet Colorado's current and future consumptive, recreational, and environmental water needs that incorporate as a key objective, the protection and restoration of water quality.

Coloradans have a strong connection to water. The quality of water in the state needs to be protected, and in some cases restored to support Colorado's heritage, communities, and way of life - now and into the future. Executive Order D 2013-005 recognizes this by stating "Colorado's water quantity and quality questions can no longer be thought of separately. Each impacts the other and our state water policy should address them conjunctively." The executive order also lists "a strong environment that includes healthy watersheds, rivers and streams and wildlife" as one of three core Colorado values. In addition, recent public survey results highlight the value Coloradans place on safe, clean water. These surveys indicate Coloradans believe the quality of both surface and groundwater is very important as a source of drinking water. Coloradans also believe the quality of water in streams and lakes is very important to support recreational uses. The survey shows public health is the most compelling reason to improve water quality, followed by wildlife and fish habitat.<sup>3738</sup>

As Colorado plans for its water future, better integration of water quality and quantity planning and management activities is critical. Opportunities to address existing water quality impacts and minimize future impacts must be prioritized to ensure Coloradans continue to have access to safe and clean water. Balancing increasing quantity demands with water quality protection and restoration requires on-going dialogue with all Coloradans and collaboration at all levels of government. Colorado's Water Plan offers a framework for moving forward with the quality and quantity conversations.

The following information is a starting point for an ongoing conversation. The discussion describes how quality and quantity are related to create a foundation for understanding this complex subject. It also identifies an integration goal to improve relationships in support of protecting and restoring water quality. Current water quality management is described as context for identifying ways to improve coordination and recommendations are made to move forward with meeting the integration goal. The water quality foundation for this conversation is in legislation and the Water Quality Control Commission (WQCC) and the Water Quality Control Division (WQCD) goals established to meet the intent of this legislation.

### Water Quality and Quantity Relationships

Water quality in Colorado is protected by state and associated federal statutes as well as local, state and federal regulations. The WQCC adopts regulations, guidance and policies required by the federal Clean Water Act (CWA), the federal Safe Drinking Water Act, and the Colorado Water Quality Control Act. The Colorado Department of Public Health and Environment, Water Quality Control Division, is the primary agency implementing these regulations, guidance and policies. This water quality management structure is different from what is in place for water quantity management. Understanding the existing relationships between these distinct management frameworks and looking for opportunities to improve coordination and integration is important for protecting the state's water resources.

### Water Quality and Quantity Connections

Managing water quantity may cause a change in water quality. When water is diverted to farms or cities, stored for future use or flood control, or managed as return flows to address downstream water rights, water quality can be affected. For example:

- Recreational fishing is a way of life in Colorado and is important to local and state economies. Deep reservoirs tend to thermally stratify in summer, with cold water settling to the bottom of the reservoir. Many reservoirs release water downstream from the bottom where the stratified water is very cold. There are places where cold water releases from the bottom of reservoirs have impacted downstream native fish and aquatic life. However, most of Colorado's Gold Medal Fisheries, which are managed by Colorado Parks and Wildlife (CPW), are located downstream of dams. Other surface water structures such as diversions to canals and off-stream reservoirs can also impact water quality and fisheries. Such modifications can result in low stream flows that can cause low oxygen concentrations, high water temperatures and higher concentration of pollutants. In Colorado, solutions are explored during project planning to address these types of water quality impacts that can be caused by surface water modifications.
- One option for addressing future municipal water supply needs is through alternative agricultural transfers such as rotational fallowing and interruptible supply options. However, high concentration of salts and other pollutants from this source water may require advanced water treatment technologies such as reverse osmosis to make the water useable for communities. The waste product from reverse osmosis has very high salt levels and cannot be discharged into the stream. Other disposal options for the waste product are limited. If a municipal provider has higher quality source water to blend with lower quality sources then this issue can be avoided. For example, Aurora Water recently completed the

**Figure 7.3-1: Black Lake No. 1 and No. 2\***



\*The lakes were enlarged so that stream flows could be maintained during snowmaking season.

Prairie Waters Project where both natural and constructed treatment allows potable water reuse to proceed without requiring new CWA permits.

- Implementing and maintaining drinking water and wastewater treatment in a semi-arid environment is challenging today and will continue to be in the future. Treatment infrastructure is critical to protecting public health and the environment. The ability of the stream to accept pollutants in wastewater without a negative impact to quality depends on the amount of water flowing in the stream. Water diversions upstream can result in fluctuating stream levels and therefore affect water quality. Changes in treatment process necessary to meet new, more stringent discharge limits or needed upgrades to aging infrastructure can increase operational costs for wastewater treatment facilities. However, protecting water quality through wastewater treatment and other measures can result in cost savings for downstream drinking water treatment facilities because it results in higher quality source water that could require less treatment.
- The Colorado Water Conservation Board (CWCB) is responsible for the appropriation, acquisition, protection, and monitoring of instream flow and natural lake level water rights to preserve and improve the natural environment to a reasonable degree. These water rights are established exclusively by the CWCB for nonconsumptive, in-channel or in-lake water uses to support minimum flows among specific points on a stream or levels in natural lakes. The rights are administered within the state's water right priority system. While Colorado law explicitly prohibits the WQCC and the WQCD from taking any action that requires minimum instream flows, the program has provided tangible water quality benefits across the state specifically for aquatic life classified uses.

Water quality and quantity cause-and-effect connections are integral to making sound water management decisions. These connections are considered during decision-making processes that are dependent on water quality and quantity statutory, regulatory and management relationships.

#### Statutory and Regulatory Relationships

At the state level, water quality and quantity are managed separately based on different constitutional, statutory and regulatory provisions. However, state and federal statutes that protect in-stream water quality recognize the importance of protecting water rights while still providing the authority to impose water pollution controls. The federal statute protecting drinking water quality also recognizes integration with water quantity by including protections for source water that reduces treatment costs.

Many state and federal water quality-specific regulations intersect with quantity management. The quantity of water available is essential for establishing water quality standards and ensuring standards are attained as required in state and associated federal water quality regulations. Water



\*Expansion of Gross Reservoir is part of the proposed Moffat Collection Expansion Project. This project will require 401 certification.

quality is also recognized in state regulations by addressing the quality of substitute water supplies used in exchanges and substitute water supply plans. Regulations governing reuse also support integration between water quality and quantity management.

One of the primary examples of the regulatory quality and quantity relationship is the WQCD's water quality certification of federal permits and licenses under Section 401 of the CWA as implemented through WQCC Regulation No. 82 (known as 401certification). Section 401 of the CWA directs states to certify that activities needing federal permits and licenses, such as many water development projects, comply with the applicable provisions of the state's water quality use classifications, standards and designation program during both construction and operation over time. WQCC Regulation No. 82 gives the WQCD three certification options for federal permits or licenses including the ability to certify, conditionally certify through identified mitigation measures or deny certification. Certification by the WQCD means that when the federal permit or license is implemented, the proposed project will comply with applicable surface and groundwater standards regulations, classifications and all other applicable water quality requirements for the affected waters. For example, if a project requires a CWA Section 404 individual permit from the Army Corps of Engineers, a 401 water quality certification is required from the WQCD. Section 9.4 discusses the 401 water quality certification in more detail.

The WQCC's adoption of site-specific standards and designations is another example of a quantity and quality regulatory relationship. Site-specific standards and designations may reflect a lower level of water quality than would have existed before a hydrologic modification such as a dam, diversion or return flows associated with exercising water rights.

The WQCC is solely responsible for the adoption of water quality standards and classifications; however, local government regulations can also have a water quality and quantity connection. For example, local governments are given permit authority over certain matters under the Areas and Activities of State Interest Act. Under the act, local governments can adopt regulations that address the impact of municipal and industrial water projects. These regulations, referred to as 1041 regulations, often require mitigation of water quality impacts from water projects. Associations of local governments also prepare Regional Water Quality Management Plans that establish water quality goals and recommendations for regional water quality management. Typically, local 1041 regulations require new water projects to comply with these plans.

### Water Management Relationships

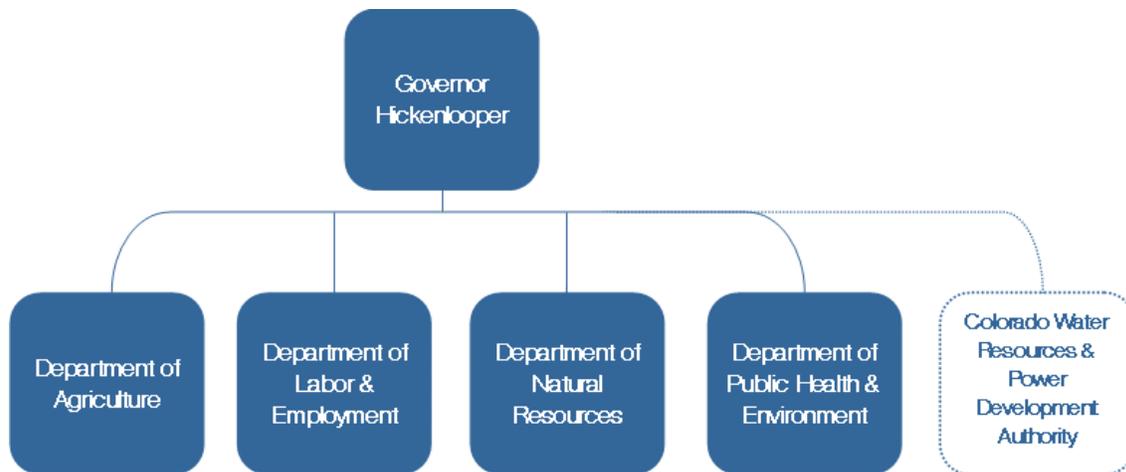
The roles and responsibilities defined in statutes and regulations are shared by many entities, which create a complex system for overseeing the state's water resources. At the state level alone, there are many entities involved with protecting water quality which requires coordination and integration to make sure water resources are appropriately managed.

The WQCC and the WQCD have defined water quality roles and responsibilities. The Colorado Water Quality Control Act also identifies several additional water quality implementing agencies:

- The Division of Reclamation, Mining and Safety
- The State Engineer

- The Oil and Gas Conservation Commission
- The Colorado Department of Public Health and Environment - Hazardous Materials and Waste Management Division
- The Division of Oil and Public Safety at the Department of Labor and Employment

**Figure 7.3-3: Colorado State Agencies and Quasi-Governmental Organizations with Quantity and Quality Responsibilities**



These agencies have initial responsibility for implementing groundwater quality classifications and standards adopted by the WQCC. These implementing relationships are defined through a Memoranda of Agreement. The WQCC can intervene in the event that it determines an implementing agency is not assuring compliance with water quality classifications and standards.

The Department of Natural Resources plays a critical role in managing water quantity in the state. The Division of Water Resources within the Department of Natural Resources is responsible for water administration, while the CWCB, another division within the Department of Natural Resources, sets water policy, completes water planning and reviews state wildlife mitigation plans. The Department of Natural Resources' Colorado Parks and Wildlife develops state wildlife mitigation plans, which address fish and wildlife resources affected by the construction, operation or maintenance of water diversion, delivery or storage facilities.

The WQCC and the WQCD are required by the Colorado Water Quality Control Act to consult with the CWCB before making any decision or adopting any rule or policy that has the potential to cause material injury to water rights. The CWCB receives copies of all WQCC rulemaking hearing notices and all notices include a provision requesting information from the public regarding potential impacts on water rights.

### Water Quality and Quantity Integration Goal

Executive Order D 2013-005 states “Colorado's water quantity and quality questions can no longer be thought of separately. Each impacts the other and our state water policy should address them conjunctively.” To this end, it is important to establish a goal related to quantity and quality integration between now and 2050. To develop this goal, many documents were reviewed including the CWA, federal Safe Drinking Water Act, the U.S. Environmental Protection Agency’s (EPA) strategic plan, Colorado’s Water Quality Control Act, the WQCD’s strategic goals, the WQCC’s strategic water quality goal and the Basin Implementation Plans (BIPs). These laws, goals and plans focus on broader actions than quality and quantity integration yet provide important insight for developing a quality and quantity integration goal as part of Colorado’s Water Plan.

*It is important to establish a goal related to quantity and quality integration between now and 2050.*

The CWA sets a national goal “to restore and maintain the chemical, physical and biological integrity of the Nation’s waters,” with interim goals that all waters be fishable and swimmable where possible. The federal Safe Drinking Water Act authorizes the EPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. The EPA states, and water systems work together to make sure that these standards are met. The EPA’s current strategic plan has a goal regarding protecting America’s waters to “protect and restore waters to ensure that drinking water is safe and sustainably managed, and that aquatic ecosystems sustain fish, plants, wildlife, and other biota, as well as economic, recreational and subsistence activities.”

The legislative declaration of the Colorado Water Quality Control Act includes the following goals:

- Achieve the maximum practical degree of water quality in the waters of the state.
- Provide that no pollutant be released into any state waters without first receiving treatment or other corrective action necessary to reasonably protect the legitimate and beneficial uses of such waters; to provide for the prevention, abatement and control of new or existing water pollution; and to cooperate with other states and the federal government in carrying out these objectives.

In addition, there are several Colorado Water Quality Control Act provisions that are related to water quantity and water rights:

- A primary goal of the Water Quality Control Act is protect, maintain and improve the quality of state waters for beneficial uses including domestic, wildlife and aquatic life, agricultural, industrial and recreational uses.
- Dischargers of pollutants may be required to meet a high degree of treatment to protect water rights.
- The WQCC and the WQCD must consult with the CWCB before making any decision or adopting any rule or policy that has the potential to cause material injury to water rights.
- Nothing in the state act is to be construed or applied to cause or result in material injury to water rights.

- The WQCC and WQCD shall not require an instream flow for any purpose.

The WQCD's mission is to protect and restore water quality for public health and the environment in Colorado. The WQCD's strategic plan states that it will achieve its mission by pursuing the following goals:

- Prevent waterborne disease and reduce chronic public health risks from drinking water through improved implementation of the federal Safe Drinking Water Act and Colorado's drinking water statutes and regulations.
- Protect all designated uses by attaining water quality standards through improved implementation of the CWA and Colorado Water Quality Control Act and associated regulations.
- Restore impaired water quality to attainable standards through improved implementation of the CWA and Colorado Water Quality Control Act and associated regulations.

Finally, the WQCC's strategic water quality goal is that Colorado's waters will fully support their classified uses by 2050 and these uses could include drinking water, agriculture, recreation, aquatic life and wetlands.

Better integration of water quality and quantity is required to address the Water Quality Commission's overall goal for water quality. Based on review of the laws, goals and plans summarized above, a quality and quantity integration goal was developed.

**Recognizing the inter-relationship between quality and quantity, strategies designed to meet Colorado's current and future consumptive, recreational and environmental water needs will incorporate, as a key objective, the protection and restoration of water quality.**

The following steps further refine and advance this goal:

- The basin roundtables are encouraged to actively incorporate water quality into decision making processes for consumptive, recreational and environmental projects. To help facilitate this effort, the WQCD will provide basin-scale water quality information to the basin roundtables for their use in updating their future BIPs. This information was originally developed as part of the Statewide Water Quality Management Plan.
- Project proponents must understand the nexus between water quality and quantity and work to avoid or mitigate water quality impacts of a project through the implementation of best management practices, whether associated with 401 water quality certifications or otherwise. The WQCD will support this effort by developing guidance on the 401 water quality certification process and best management practices identification.
- The WQCD, in concert with other stakeholders including watershed groups and those with point and nonpoint discharges, will continue to employ available programs to maintain, and in some cases, improve water quality at a basin-scale. Progress will be documented over time in the WQCD's Integrated Report and WQCD's Statewide Water Quality Management

Plan. The Integrated Report is typically updated every two years and will be used to track progress on the quality portion of the integration goal over time.

- The information reported in the WQCD's Integrated Report should also be used in the CWCB's scenario planning efforts when evaluating the status of future *signposts* (see Chapter 6.1). By tracking this information through time, water quality and quantity managers will know if efforts to integrate water quantity and quality are successful and can make course corrections as part of the adaptive management plan efforts.

### Current Water Quality Conditions

As plans for meeting consumptive, recreational and environmental needs are produced that recognize the many interactions of statute, regulation and management activities, it is important to understand current water quality conditions in the state. Understanding current water quality conditions is also fundamental for ensuring compliance with water quality regulations as they pertain to water supply planning and implementation activities.

Evaluating the status of surface water quality in Colorado requires understanding the classified uses for waterbodies throughout the state. A classified use is a specific type of use for an identified waterbody and can include domestic water supply, agriculture, recreation, aquatic life and wetlands. The WQCC assigns classified uses to stream segments and adopts water quality standards for many different pollutants to protect these waterbody-specific uses.

The state is also required to have an antidegradation policy as part of its water quality standards. Antidegradation protects the value of high quality surface waters. Colorado's antidegradation policy establishes that, at a minimum for all surface waters, the existing classified uses and the water quality necessary to protect those uses must be maintained; these are *use protected waters*. The antidegradation policy also provides extra levels of protection for two other types of waters that are designated by the commission. *Outstanding waters* receive the highest level of protection requiring that quality must be maintained at current levels (no degradation). *Reviewable waters* are high quality waters which receive an intermediate level of protection. The rules for antidegradation review require a public process before the natural capacity of a waterbody to dilute and absorb pollutants and prevent harmful effects is completely allocated to a project or permit where a new or increased impact is proposed. Use of such capacity is allowed if the review shows it would accommodate important economic or social development for the area in which the waters are located.

Standards are the basis for evaluating the status of water quality for each waterbody. When available data show water quality standards are not being met, the waterbody is identified in regulation as impaired. These impaired waterbodies, as well as other information about water quality in the state, must be identified in a biennial report to the EPA (Integrated Water Quality Monitoring and Assessment Report [Integrated Report]).

For waters that attain water quality standards, the challenge is to maintain the existing good water quality to protect classified uses such as drinking water supplies, robust fisheries and recreational opportunities.

For waters not meeting water quality standards, the most common causes of river and stream impairments are selenium, pathogens such as E. coli, and iron. For lakes and reservoirs, the most common causes of impairment are selenium, mercury and dissolved oxygen saturation. When water quality standards are not attained, the ability to use water for domestic water supply, agriculture, aquatic life or recreation can be impacted.

Figure 7.3-4 presents statewide information and is based on available water quality data. Different regions or basins within the state have varying water quality conditions and may have unique water quality challenges. Water quality impairments may also exist in streams or lakes that either have little to no available data or have yet to be assessed through the Integrated Report process.

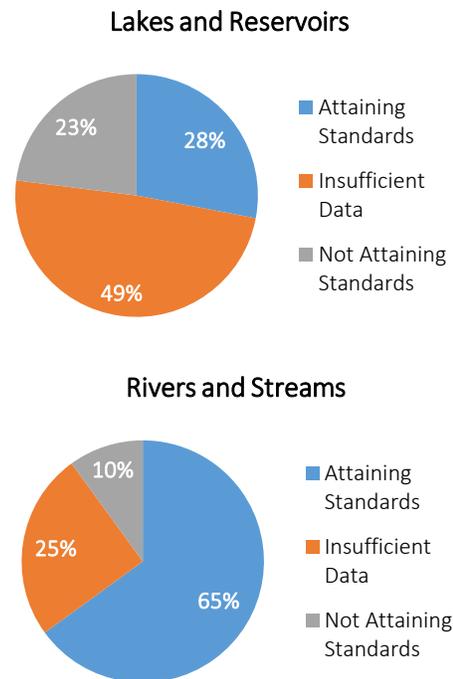
Future Water Quality Conditions

Many changes will happen over the next 35 years that have the potential to affect both regional and statewide water quality. Understanding these changes is important as plans are under development for addressing the municipal and industrial supply gap as well as meeting recreational and environmental needs over the next 35 years.

Future water quality conditions will not only be affected by water quantity decisions but will also be influenced by changing water quality regulations. Currently, there are additional proposed regulations designed to further protect and restore water quality. Examples include increased nutrient controls, more stringent arsenic standards and a revised selenium standard. There is also renewed emphasis on implementing actions that will produce measureable, positive changes in water quality. Recognizing the possibilities associated with potential change, both water quantity and quality managers need to seek opportunities to protect and enhance water quality in the future.

Other factors affecting future water quality conditions are also important. As the economy and population grow and land uses change, there will be increased water quantity demands and additional stressors on water quality. Future land use decisions are a substantial factor as water quality can be impacted by increased urbanization and associated stormwater runoff, volumes of discharged municipal wastewater and industrial discharges including those from the energy sector. As streams are depleted from additional diversions, existing concentrations of pollutants increase, and water treatment and wastewater treatment processes relying on those streams will become more difficult. New issues may also arise from emerging contaminants or interactions among different constituents that are not now known. These potential effects could be negative though

**Figure 7.3-4: Current Water Quality Conditions<sup>39</sup>**



there can also be opportunities for positive change, which reinforces the critical nature of informed and integrated water resource management decisions.

The potential for future positive or negative water quality impacts is compounded by climate change. Predicted effects from a changing climate on water quality include:<sup>40</sup>

- Potential streamflow volume decreases in the Rockies and interior southwest, and increases in the east and southeast coasts.
- Higher peak streamflow will increase erosion and sediment transport; loads of nitrogen and phosphorus are also likely to increase in many watersheds.
- Many watersheds are likely to experience substantial changes in the timing of streamflow and pollutant delivery. In particular, there will be a tendency to shift from snowmelt-dominated spring runoff systems to rain-dominated systems with greater winter runoff.
- Changes in nutrient and sediment loads are generally correlated with changes in hydrology.
- Warming air temperature can directly raise stream and lake temperatures, which can harm aquatic organisms that live in coldwater habitats, such as trout. Additionally, warmer water can increase the range of non-native fish species, permitting them to move into previously coldwater streams. The population of native fish species often decreases as non-native fish prey on and out-compete them for food.

Planning for water quality impacts from these potential fundamental system shifts is challenging and highlights the need to make measurable progress on the water quality and quantity integration goal.

### Water Quality Management

Current water quality decisions are made in the context of a management system based on statutes, regulations and implementation processes. This system defines the boundaries to protect and restore water quality, and it also offers opportunities for flexible, integrated approaches for meeting consumptive, recreational and environmental needs. The existing water quality management system is a starting point for finding opportunities and maximizing them to facilitate improved integrated water resource management decisions.

The statutory and regulatory framework for water quality discussed in Subsections 2.4 and earlier in 7.3 establishes the requirements for protecting and restoring water quality in the state. This framework is implemented through processes at the state and local level. Classified uses and the water quality standards established to protect these uses are also discussed. Both are critical to protecting and restoring water quality in the state and are established through WQCC processes with public input.

Water quality management processes also include monitoring, data assessment and reporting. Monitoring and data assessment are essential to identifying and characterizing water quality problems, revising water quality standards, and developing and evaluating the results of control programs. Monitoring is completed in conjunction with many statewide partners. The WQCD uses its own data as well as partners' data in assessments that support evaluating the status of statewide and basin-scale water quality with respect to meeting water quality standards. Information about

attainment of water quality standards is provided in the Integrated Report discussed in 7.3.2 and is also identified in regulation (WQCC Regulation No. 93, Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List); both are adopted by the WQCC through public processes.

When streams and lakes are identified that do not meet water quality standards, a restoration plan is produced that defines how much of the pollutant causing the impairment can be in the stream or lake to still ensure that water quality standards are attained. The allowable amount of the pollutant is then divided among all the different sources of the pollutant, both point and nonpoint. A point source is a sewage treatment plant or industrial facility discharge and nonpoint sources are diffuse sources of pollution such as runoff from agricultural field or abandoned mines. This restoration plan is called a Total Maximum Daily Load (TMDL). There is a public notice process associated with TMDL development that provides the opportunity for input as the restoration plan is produced. Once the TMDL is approved by the EPA, the TMDL is the basis for implementing necessary actions to bring the stream or lake back into attainment. As an alternative to implementing controls to meet existing water quality standards, TMDLs can also result in a re-evaluation of standards and sometimes classifications. Implementation actions can be defined in a TMDL implementation plan, in a locally driven watershed plan or in a locally driven regional water quality management plan (208 plan). Watershed plans and 208 plans identify stressors to water quality and address other water quality improvement and protection activities necessary to meet local and regional goals. The WQCD works with local partners and local plans to implement priority projects to restore and maintain water quality at a watershed or regional scale.

The WQCD is also actively engaged in promoting and supporting source water protection planning across Colorado through the Source Water Assessment and Protection (SWAP) Program. The program is designed to define drinking water supply areas and identify potential water quality and contaminant risks to drinking water systems. The SWAP program, in collaboration with the Colorado Rural Water Association, provides technical and financial support to encourage voluntary local planning efforts and the implementation of best management practices (BMP's) to minimize source water quality impacts. This effort is a collaborative stakeholder process that contributes to protecting and restoring water quality in the state.

The WQCD uses information from all these local plans to support its own planning efforts. For example, the WQCD produces a Statewide Water Quality Management Plan for approval by the WQCC. The Statewide Water Quality Management Plan compiles water quality information at a statewide and basin scale in support of implementation activities. This compilation, as well as the Integrated Report, WQCC policies, and other WQCD documents, supports the WQCD's strategic planning that promotes progress toward national water quality goals and provides specific metrics for measuring that progress.

The purpose of these plans, at different scales by numerous partners, is defining and prioritizing actions for the improvement, restoration and protection of water quality. Implementation tools used by the WQCD include Section 401 water quality certifications (discussed in Section 9.3),

permits that allow discharges to streams and lakes, as long as certain limits or control measures are met, and funding support for partners. The federal CWA prohibits the discharge of pollutants from a point source to surface water without a permit. Because the state has developed a program that meets the requirements of the federal CWA, the primary discharge permit program in Colorado is administered by the WQCD rather than by the EPA. The permits issued to point sources specify the limits or controls that are required to meet Colorado's water quality standards.

Implementation tools often require the development of strategies or best management practices that when completed result in the improvement, restoration and protection of water quality. Strategies are also used to address consumptive and nonconsumptive needs. These are summarized in Sections 6.3 through 6.6 of this plan. Examples of strategies that have a quality and quantity nexus include, but are not limited to:

- Water reuse including direct potable reuse, indirect potable reuse, non-potable reuse and graywater use. These strategies are further described in Section 6.3.
- Storage including reservoirs and aquifer storage and recovery.
- Source water protection best management practices such as proper storage and disposal of pesticides and proper management of septic systems.
- Stormwater best management practices including retention and detention can improve the quality and quantity of this supply and could be incorporated into water management practices. In Colorado, stormwater has not typically been considered a source of supply but this could be explored in the future.
- Nonpoint source best management practices will be critical to improving water quality for recreational, environmental and consumptive needs in the future. Examples of nonpoint source best management practices include mine tailings removal, riparian buffers, constructed wetlands and habitat restoration.
- Green infrastructure is being discussed at a national level and application of this concept is being explored in Colorado. The focus of the green infrastructure concept is to weave natural processes into the built environment, which can provide stormwater management, flood mitigation, air quality management and riparian zone restoration.
- Water quality trading is based on the fact that sources in a watershed can face very different costs and regulatory requirements in the control of the same pollutant. Trading programs allow facilities facing higher pollution control costs to meet their regulatory obligations by purchasing environmentally equivalent (or superior) pollution reductions from another source at a lower cost, thus achieving the same water quality improvement at a lower overall cost.

Funding and financing is discussed in detail in Chapter 9; however, the WQCD provides various financial assistance opportunities to assist with efforts to protect public health and the environment. The WQCD administers the following financial assistance programs:

- State revolving funds provide low-interest loans to governmental entities for drinking water and water quality improvement projects.

- The Water Quality Improvement Fund provides grant funds for water quality improvement projects using civil penalties from water quality violations. State House Bill 11-1026 amended the statute to authorize grants for stormwater management training and best practices training to prevent or reduce the pollution of state waters.
- Source water protection grants provide funding for pilot planning projects and development and implementation projects.
- The small system training and technical assistance set-aside provides grant funding to assist with the costs of planning and design for small drinking water systems serving less than 10,000 people.
- State statutes 25-8-703 and 25-1.5-201 authorize funding, when appropriated by the legislature, for small community domestic wastewater and drinking water projects. These programs provide grants to municipalities for costs associated with planning, design and construction of drinking water and wastewater treatment plants.
- Nonpoint source grant funds are distributed through a competitive process to local project sponsors to implement projects which restore impaired waters, prevent future impairments or raise public awareness.

In addition, the Water Supply Reserve Account administered by the CWCB is another financial tool that provides grants to assist Colorado water users in addressing their critical water supply issues and interests. The funds help eligible entities complete water activities, which may include competitive grants for:

- Technical assistance regarding permitting, feasibility studies and environmental compliance.
- Studies or analysis of structural, nonstructural, consumptive and nonconsumptive water needs, projects, or activities.
- Implementation of structural and nonstructural water projects or activities.

### Water Quality and BIPs

The various basin roundtables have addressed water quality in the BIPs in two major ways: through quality-related basin goals and measurable outcomes, or through identification of projects and methods with a water quality nexus. In many basins across the state, public water systems, municipal governments, and communities have developed source water protection plans with specific water quality prevention strategies. Many basins also have watershed plans in place that identify priority actions necessary to both protect and restore water quality. These prevention, protection, and restoration strategies and actions should be considered during the project development and prioritization stage. The WQCD can provide information about protection and watershed plans that are in progress or completed.

Every basin roundtable addressed water quality in goals and measurable outcomes. Several basins addressed water quality issues in the context of greater watershed health, while others look to established water quality standards as a potential measurable outcome. The Rio Grande Basin Roundtable established the following goal: “Make progress toward meeting applicable water quality standards throughout the Basin.”<sup>41</sup> This approach demonstrates how the basin may use the

planning process to work closer with the Colorado Department of Public Health and Environment, to make progress toward meeting established standards.

The Yampa/White/Green Basin Roundtable references water quality, as it relates to uses within the basin, in their goals: "Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses."<sup>42</sup> This water quality-centric goal follows the strong BIP theme of protecting existing uses within the basin and providing for future development, recognizing the importance of both quality and quantity. This type of goal seeks to establish how water quality fits within their vision of the basin's future.

Basin roundtables have also addressed water quality issues through identification of projects and methods which have a water quality nexus. For example, the South Platte/Metro BIP identifies 18 projects with a connection to water quality, ranging from assessment of wildfire restoration, to sediment mitigation projects, to mine remediation.<sup>43</sup> These projects address water quality issues at the source, seeking to improve quality through implementation.

The Gunnison Basin identifies currently ongoing projects and methods which address water quality issues. These include several programs related to Colorado River water quality, such as the Gunnison Basin Selenium Management Plan, and projects funded through the Colorado River Basin Salinity Control Forum.<sup>44</sup> Additional localized projects for improving municipal infrastructure also have benefits for water quality.

Through these goals, outcomes, and identified projects and methods, the basins seek to address water quality concerns at a more local level. Future efforts of the roundtables will prioritize projects and methods by basin goals, and water quality overall will benefit from this incorporation of quality concerns into the goals and outcomes framework.

### **Actions**

The WQCD worked with the Colorado Water Quality Forum and the WQCC to develop recommendations. As Colorado's Water Plan is updated in the future, these recommendations serve as a starting point for implementation efforts focused on:

- A. Integrated water quality and quantity management.
- B. Policy considerations.
- C. Financial considerations.
- D. Stakeholder and public outreach.

In addition, these recommendations need to be assigned to a responsible party and prioritized for implementation over time.

#### **A. Integrated Water Quality and Quantity Management Actions**

Recommendations to promote increased integration of water quality and quantity management include:

1. Evaluate water quality impacts associated with proposed solutions and scenarios presented in the BIPs and in Sections 6.3 through 6.6 of Colorado's Water Plan. Identification of

impacts will help define the scope of strategies that need to be explored to protect and restore water quality. Information developed about these impacts will be shared among all involved parties.

2. Define opportunities in cooperation with basin roundtables, the CWCB and others for projects or processes that restore and enhance existing water quality conditions to address potential water quality effects resulting from implementing water quantity solutions. An initial step to implement this recommendation is to assist the basin roundtables in developing water quality goals, objectives and measurable outcomes based on current water quality information for each basin to use when updating their BIPs. This collaboration supports the basin roundtables in identifying projects and methods that integrate water quality and quantity management to protect and restore water quality.
3. Define green infrastructure approaches for the arid west and explore how green infrastructure can be used to address Colorado's consumptive and nonconsumptive gaps. For example, green infrastructure in the arid west can go beyond stormwater management activities and low impact development methods to include landscape-scale land use planning that addresses where activities should occur on the landscape to meet dynamic goals, including protecting and restoring water quality. Existing information developed by green building and stormwater management groups provides a starting point for developing and maintaining a library of green infrastructure options.
4. Evaluate new water supply projects and the potential for multiple benefits, including water quality protection and enhancement. Strive to ensure that all water quality benefits are incorporated into the project plans.
5. Examine how new or existing supply projects can be designed and operated to advance water quality objectives. Actively pursue incorporation of these design and operation considerations into proposed projects.
6. Identify the role of reuse by developing a library of reuse examples such as direct potable reuse, indirect potable reuse, non-potable reuse, graywater use and the associated water quality issues that need to be addressed for each type of reuse. Ensure that these issues are addressed in any initiative that desires to use these resources. Reuse and identified actions are discussed further in Section 6.3.
7. Promote the use of aquifer storage and recovery since water quality impacts associated with this storage strategy are minimal.
8. Explore the role of stormwater management from both a quality and quantity perspective to determine if stormwater is a viable additional source of supply to address consumptive needs.
9. Address nonpoint sources through on-going management activities that play an important role in protecting and restoring water quality for the benefit of future water uses. These activities should include cataloguing and evaluating local government land use planning tools that minimize nonpoint source pollution associated with development. A comprehensive approach to nonpoint source management including water quality trading should be explored.

10. Identify the risks of climate change as they relate to integrated water quality and water quantity management. Develop specific recommendations for addressing these risks.
11. Explore how the CWA requirements and Safe Drinking Water Act requirements can be most efficiently and cost effectively integrated. Develop specific recommendations for implementation.

### B. Policy Considerations

Chapter 10 of Colorado's Water Plan summarizes legislative recommendations. In addition to the legislative recommendations, policy considerations related to quality and quantity integration include:

1. Continue to engage in creative, solution oriented actions such as site-specific standards, temporary modifications, discharger specific variances, pollutant trading and conditional 401 water quality certifications. Use all available means to improve water quality and protect the high quality waters that are better than necessary to support classified uses. Maintain ongoing, non-regulatory programs including nonpoint source management and source water protection planning. These solution orientated actions will also be necessary when addressing impacts from climate change.
2. Establish a more complete understanding of the concept of net environmental benefit as wastewater reuse continues to be maximized in Colorado. This concept is focused on the demonstration that the ecological value of using effluent to support riparian and aquatic habitats exceeds the ecological benefits of removing the discharge from the waterbody.
3. Review and appropriately modify existing regulations, guidance and policy documents for new types of wastewater reuse so that revisions will protect public health and the environment while also providing sufficient flexibility for water suppliers to develop new water reuse projects across the state.
4. Consider and document the water rights implications of water quality strategies and the water quality implications of water development strategies as they both pertain to integrated water quality and quantity management. For example, integrated stormwater management may have effects on downstream flows and possible water rights impacts would have to be understood and addressed before such a strategy could be implemented.
5. Continue to work with neighboring states to address interstate water quality and quantity issues to protect Colorado's compact entitlements.
6. Continue statewide monitoring that supports assessment of the quality and quantity integration goal and measures.

### C. Financial Considerations

Future efforts to integrate water quality and quantity will require funding. The recommendations outlined below may be further detailed in Chapters 9 and 10 of Colorado's Water Plan.

1. Continue to fund nonpoint source pollution management efforts. Identify new funding opportunities and nonpoint source pollution control strategies.
2. Identify costs and funding sources for implementation of green infrastructure and reuse.

3. Pursue state funding of regional watershed-based water quality planning to better integrate current and future water quantity efforts.
4. Develop and implement state funding mechanisms for future water projects that implement consumptive and nonconsumptive strategies consistent with Colorado's Water Plan. Emphasis should be placed on funding those portions of projects that result in a public benefit.
5. Develop and implement state funding mechanisms for implementation of mitigation activities required under a state water court water rights decision or a federal or state water quality protection regulatory action.
6. Develop and implement funding mechanisms for the protection, restoration or enhancement of water quality values in river or stream reaches.
7. Explore ways to facilitate innovative treatment and engineering solutions through technology transfer and liability management techniques.

#### D. Stakeholder and Public Outreach

Stakeholder and public outreach is critical to meeting the water quality and quantity integration goal. The recommendations outlined below may be further detailed in Chapter 9.5 of Colorado's Water Plan.

1. Use a watershed approach for outreach and community engagement around water quality, ways to protect water quality and solutions to address water quality issues. Colorado's many watershed groups already use this approach to effectively plan for and implement actions that protect and restore water quality. The approach can be used when developing and implementing strategies that integrate water quality and quantity management.
2. Monitor public attitudes and opinions about water quality as it relates to domestic water supply as well as environmental and recreational uses of water to refine future water quality goals and measurable outcomes.
3. Develop additional water quality goals and performance measures based on the completed BIPs from the basin roundtables.
4. Conduct joint CWCB and WQCC meetings at least annually to discuss water quality and quantity integration issues.
5. The WQCC should consider holding workshops as part of its annual basin rulemaking process. Workshops should have participation from basin roundtable representatives for the basin that is the subject of the annual rulemaking hearing to gather input and share information related to progress on water quality and quantity integration efforts.

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