



**Comments by Tom Easley, Director of Programs
The Rocky Mountain Climate Organization
On Draft Colorado State Water Plan
October 15, 2014**

Thank you for the opportunity for the Rocky Mountain Climate Organization (RMCO) to provide these comments on the current draft of the state water plan.

The state water plan provides an important and historic opportunity for the Colorado state government to address one of our state's greatest challenges – how to meet our water needs in a future that may be very different from the past because of human-caused climate change. We applaud Governor Hickenlooper for calling for this first-ever state water plan, and we applaud the Colorado Water Conservation Board (CWCB), the Interbasin Compact Committee (IBCC), basin roundtables, and the many stakeholders and interested Coloradans who are working to shape the plan.

Our comments address how information on climate change is presented in the draft state water plan and how climate change impacts should be addressed in the plan. We have nine major comments.

1. The water plan should clearly acknowledge that climate change greatly increases the state's water risks, and give these impacts the priority and urgency they deserve.

The current draft water plan provides far too little attention to climate change, with the issue not even mentioned in the introduction and several other chapters, and giving only cursory treatment elsewhere. The final plan should clearly lay out the ways in which climate change magnifies Colorado's water challenges, as that information is necessary to document why new actions are needed to meet our water needs in the future.

Western Water Assessment's recent update of its 2008 report for the CWCB, *Climate Change in Colorado*, provides much excellent information about how Colorado's climate may change and how those changes may affect our water resources. We suggest in particular that key information about projected climate changes (from section 5 of that report and from the supplemental online information on the WWA website) be included in the water plan.

2. The water plan should clearly acknowledge that there are different possible future pathways for the extent of climate change and its impacts on Colorado water resources.

The scenarios being considered along with the current plan drafts are an important way in which possible futures are being identified and considered as part of the water plan process. (See our comment 5 below.) However, nowhere in any of the current draft chapters is there even a single sentence indicating that there are different possible futures before us in terms of the extent of climate change and its impacts on Colorado water resources. This is one of the most important facts about climate change and should be clearly indicated. The Western Water Assessment's 2014 update of *Climate Change in Colorado* and WWA's online supplemental information (with additional detail on

Historical and Projected Colorado Temperatures Comparisons to 1971–2000 Averages

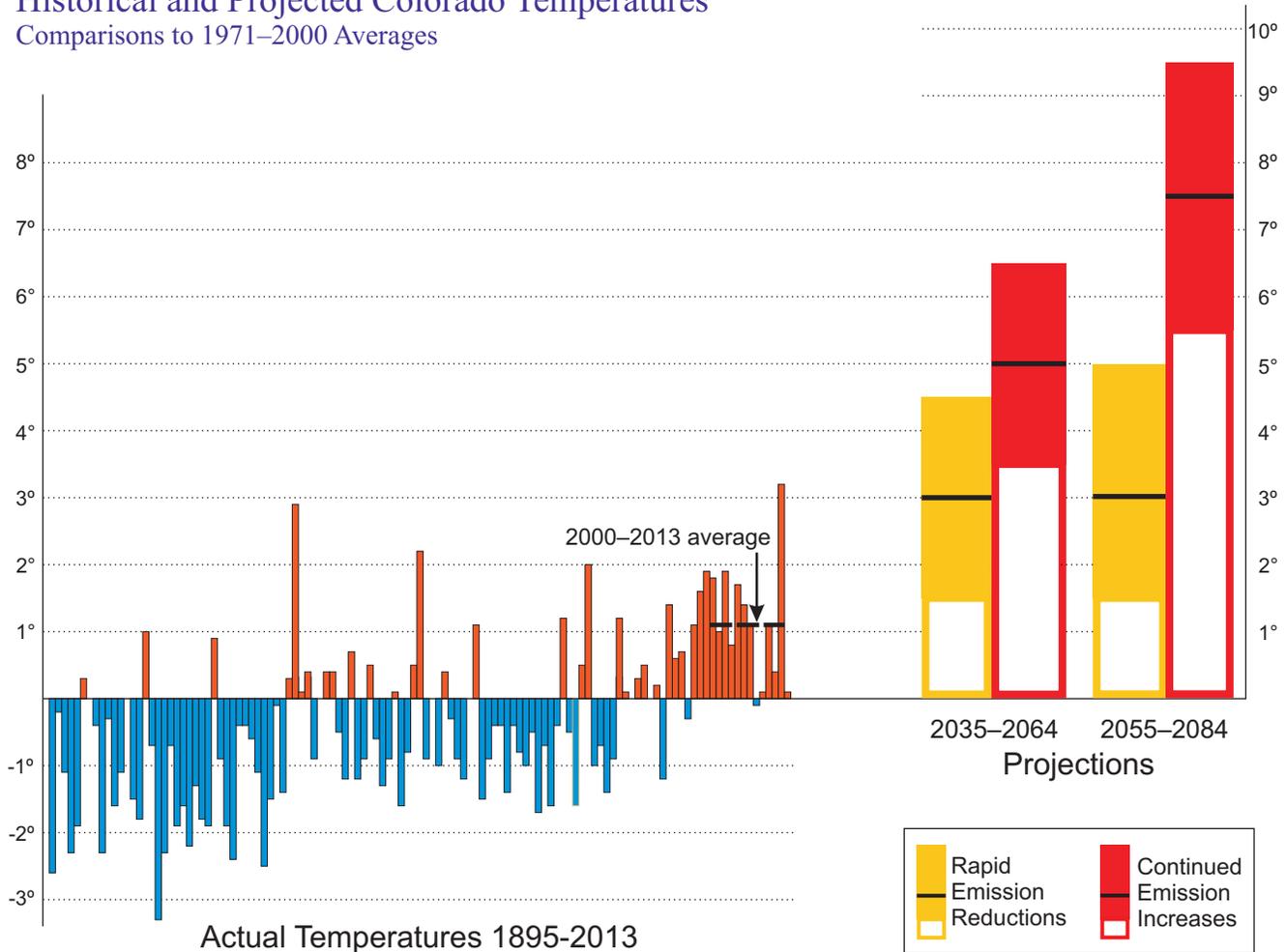


Figure 1. On the left, average statewide Colorado temperatures compared to 1971–2000, in degrees Fahrenheit. Temperatures in 2000–2013 averaged 1.2° higher. On the right, projections of statewide temperatures, again compared to 1971–2000, for two future periods, each with one scenario of rapid reductions in heat-trapping pollution (known as “representative concentration pathway,” or RCP, 2.6) and another of continued increases as in recent years (RCP 8.5). The solid colors show the 10th to the 90th percentiles of projections from 23 climate models for RCP 2.6 and 34 for RCP 8.5; the black lines show the averages. Historical data from the National Oceanic and Atmospheric Administration (NOAA), analysis by the Rocky Mountain Climate Organization (RMCO); projections from Western Water Assessment (WWA), University of Colorado at Boulder, using Coupled Model Intercomparison Project (CMIP5) models, as reported in *Climate Change in Colorado*, second edition 2014, and supplemental online information. Figure by RMCO.

WWA’s new climate projections) makes this clear. The figure above, prepared by RMCO using NOAA data on observed Colorado temperatures (for context) and WWA’s data on projected temperatures, illustrates the range of temperature increases we may face, according to the latest generation of climate models, depending on future levels of emissions of heat-trapping pollution. This range of temperature increases would lead to a range of potential impacts on Colorado water resources, and the water plan should convey that there is such a range of potential impacts, not one single climate-change future. Doing the latter would be implicitly misleading to Coloradans.

3. The water plan should summarize the substantial information on how climate change may affect our water supplies.

The current draft water plan now includes only four sentences about how climate change may affect

water supplies. This is woefully inadequate to explain to Coloradans the nature and dimensions of the risk that climate change poses to our water supplies. We note that Jim Lochhead, the CEO/Manager of Denver Water, in his comments on the draft plan, wrote that while the draft primarily focuses on how population growth may lead to water supply gaps, “climate change is potentially an equal or greater factor in the state’s future water gap.”

To properly define and convey to Coloradans how climate change may affect water supplies, the water plan should summarize such information as:

- The CWCB’s Colorado River Water Availability Study, phase one, examined five representative climate-change scenarios, three of which showed substantial decreases in Colorado River flows, with the “hot and dry” scenario suggesting a 43 percent average decline by 2025-2054 in main stem river flows near the Colorado-Utah state line.
- The Joint Front Range Climate Change Vulnerability Study, using the same five representative scenarios, showed that four would lead to reductions in South Platte River flows, with the “hot and dry” scenario suggesting a 32 to 42 percent decline in river flows at South Platte.
- The U.S. Bureau of Reclamation’s Upper Rio Grande Impact Assessment presents an average projection based on climate-change models that climate change could reduce Upper Rio Grande basin water supplies by one-third by 2100. In Colorado, about a 25 reduction in water use would need to occur to continue satisfying New Mexico’s entitlement under the Rio Grande interstate compact (Bureau of Reclamation 2013).

The plan should convey a key point from scientific studies: that the higher future emissions of heat-trapping pollution are, the greater the impacts on water supplies are projected to be. For example, the Bureau of Reclamation’s Colorado River Basin Water Supply and Demand Study shows that with low future emissions, the average projection is that Colorado River flows at Lees Ferry will be 8 percent lower in both 2041-2070 and 2071-2095, but with medium-high emissions will be 10 percent and 13 percent lower, respectively (Bureau of Reclamation 2012). For another example, the Assessment of Climate Change in the Southwest United States, a regional input to the U.S. government’s third national climate assessment, includes projections for statewide Colorado April 1 snowpack, April-July runoff, and June 1 soil moisture, which show that the median projections for decreases in all those values are smaller with low future emissions than with medium-high future emissions (Cayan and others 2013).

4. The water plan should summarize the currently limited information on how climate change may affect water demands.

The current draft water plan provides only a too-short statement that climate change may increase water demands. The impacts on water demands, however, may well equal or exceed the much more studied impacts on water supplies, and also are more certain, as higher temperatures increase the needs of virtually all water users, from crops, livestock, lawns, to power plants.

The current draft water plan has essentially a placeholder for information from a forthcoming report for the CWCB (Harding 2014), and detailed information from that ongoing work is important to add to the plan. The plan also should summarize such other existing information as:

- The CWCB’s Colorado River Water Availability Study, phase one, projected that in all five studied representative climate change scenarios, Western Slope irrigation requirements would increase, by 7 to 27 percent in 2025-2054 and by 18 to 37 percent in 2055-2084.
- The Bureau of Reclamation’s 2012 Colorado River Basin Water Supply and Demand Study examined the impacts on basin water demands from 112 combinations of climate models and emission scenarios, and virtually all projected increased demands. The average projection is

for an increase in water demands of about 500,000 acre-feet per year, which would push the seven-state basin into a greater imbalance between available water supplies and demand for that water (Bureau of Reclamation 2012).

- Research published by the Water Research Foundation projects that the demand for water supplied by Colorado Springs Utilities could increase as a result of climate change by 6 to 23 percent by 2055 and by 7 to 45 percent by 2090 (Kiefer and others 2013).

As with the impacts on water supplies, the state water plan should make clear that the extent of projected increases in water demands depends on the future extent of climate change.

5. The scenarios used by the CWCB and basin roundtables for the water plan and basin implementation plan should include quantified possible impacts of climate change. The CWCB also should provide explicit guidance to basin roundtables on the consideration of climate change and the scenarios.

Although the current draft plan chapters do not now include them, short, subjective descriptions of possible future scenarios, based on several key factors including climate change, are being used by the CWCB, IBCC, basin roundtables, and others in considering the draft water plan. RMCO supports the use of multiple scenarios and the inclusion of climate change impacts on both water supplies and water demands as components shaping those scenarios. We think it is important that one scenario is based on high population growth and significant climate change impacts that both reduce water supplies and increase water demands, with the latter taken from the high end of the best current projections that are available. Such a scenario would represent a nearly worst-case situation, but one that is plausible and merits consideration. In addition, it appears that, so far, no quantified climate change analyses have gone into shaping the scenarios. One early document stated that a specified high level of future municipal and industrial demand for water, taken from analyses done for the 2010 Statewide Water Supply Initiative and used in the then-current hottest and driest scenario, could result from either high population growth or from climate change. However, SWSI 2010 clearly stated that the demand analyses done for that report did not consider climate change, and that climate change should be considered in future water planning. Obviously, it would not be sound to take a calculation of increase in water demand that could result from high population growth and use it to represent a hot, dry climate-change future. We understand that the CWCB staff continues to consider whether and how to base the current scenarios on quantitative analyses, and that much further thought and work may well have gone into the development of the scenarios. We recommend that quantified analyses of climate change effects on both water supplies and water demands should be used to define the scenarios in the final state water plan, and that the underlying analyses should be clearly explained and made available.

So far, the CWCB and IBCC have allowed basin roundtables to consider climate change essentially however they choose. Predictably, the results are widely divergent, from the North Platte Basin Implementation Plan, which does not even mention climate change, to the Rio Grande Basin Implementation Plan, in which climate change is given full attention, with other roundtables giving climate change consideration in varying ways and to varying extents. As the approach taken in the development of the state water plan is to largely defer to the basin roundtables, and as climate change is overriding importance across the state, RMCO believes that the CWCB and the IBCC should provide new guidance on how climate change should be considered, including by the roundtables. The best way to do this probably is through the development and use of the scenarios with clearly quantified assumptions of climate change impacts on both water supplies and water demands, as we recommend above.

6. The water plan should acknowledge how climate change greatly increases the risks of curtailments under interstate compacts of Colorado water rights.

Ultimately, Colorado's greatest water risk is that the exercise of existing in-state water rights may be curtailed because of the operation of interstate compacts. Particularly for the Colorado River, this risk is greatly magnified by climate change, as compact compliance is determined by flows at Lees Ferry, which depend on runoff from across the entire Upper Basin, including lower-elevation areas in other states which may be even more vulnerable to the effects of climate change on snowpacks than Colorado's higher mountains are. However, nowhere in the current draft is the interplay between compacts and climate change even addressed. The water plan should clearly acknowledge this potential impact of climate change, as it arguably is the strongest reason why new actions may be needed to meet our water needs in a changed future.

7. The water plan should acknowledge how climate change may affect environmental and recreational needs, watershed health, and other water-dependent values.

The current draft chapters of the state water plan on water-related environmental and recreational needs and watershed health do not even mention climate change impacts on those values, although those impacts could be substantial, even transformational.

For example, scientists have projected that with just a medium level of future emissions of heat-trapping pollution, changes in water temperatures and streamflows could lead to declines in western populations of cutthroat trout of 28 percent by the 2040s and 58 percent by the 2080s (Wenger and others 2011, Fleishman and others 2013). This is a matter of significant statewide importance, and also raises the need to examine the adequacy of the Colorado Water Conservation Board's current instream flow rights, which may need to be readdressed to meet the needs of trout and other species (needs which in the future will be defined as water not only for minimum flows but also deep enough to maintain acceptable water temperatures in a hotter environment).

As another example, other scientists have projected that even a very modest additional 1.8 degree Fahrenheit increase in average temperature could lead to a 656 percent increase in the area burned by wildfires in Colorado (Littell and others 2009, National Research Council 2011). Areas burned by wildfires are at far greater risk of flooding and flows of sedimentation into water supplies, so this, too, is a threat to our water resources.

8. The water plan should acknowledge how climate change may affect natural disasters.

The current draft of the chapter on natural resources includes more information on climate change impacts (such as effects on flooding and wildfires) than other chapters do. We applaud the CWCB staff for including the information in the current draft. Some of the information in the current draft needs updating, as new sources and information have become available since the chapter was drafted; in general, however, we think that this chapter in terms of climate change is much more complete and adequate than others.

9. The water plan should provide an overall framework for state consideration of and adaptation to climate change impacts on water resources, and guidance to water utilities (especially smaller ones) on how they may consider and adapt to climate change impacts.

The current draft water plan consists primarily of background information on Colorado water resources and a compilation of possible actions identified by the various basin roundtables. Other states have used a water plan to identify a much more comprehensive framework of actions that are needed to

adapt to climate change impacts, as well as other challenges. An example is the 2013 draft update to the California water plan (California Department of Water Resources 2013). In Colorado, a full framework of actions to adapt to climate change impacts on water resources would include, for example, state assistance to water utilities (especially smaller ones, those with fewer staff and other resources) to help them adapt to climate change in their operations. There are effective methods available for climate change adaptation by water utilities (Means and others 2010). Most smaller utilities, however, have not begun the process of adapting to climate change (Udall and others 2013). Information and technical assistance from the CWCB could be important in assisting them. As another example, the Colorado state government could do more in cooperation with other states and other parties to identify multi-state, basin-wide actions to address climate change impacts.

10. The water plan should identify key gaps in the available information and analysis needed to understand and address climate change impacts on water resources, and identify how those gaps can and will be filled.

The current draft plan does not identify gaps in data, information, and analyses that are needed to help state government agencies, water utilities, and others understand and address climate change impacts on water resources. Identifying and addressing these needs, such as through data collection, monitoring, and modeling, is an important part of building the capacity to meet our water needs in a changed future (Brekke and others 2011, Udall and others 2013). We recommend that the CWCB and the IBCC include in the plan areas in which more data, information, and analyses are needed, and how those needs will be met. These areas likely would include analyses to identify climate change impacts on agricultural and on municipal and industrial water demands, the possible effects of climate change on potential interstate compact calls, and more.

References

L. Brekke and others. 2011. Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information. Bureau of Reclamation and U.S. Army Corps of Engineers.

Bureau of Reclamation. 2012. *Colorado River Basin Water Supply and Demand Study: Study Report*. Boulder City, NV: Bureau of Reclamation, Lower Colorado Region.

Bureau of Reclamation. 2013. *West-Wide Climate Risk Assessment: Upper Rio Grande Impact Assessment*. Albuquerque: Bureau of Reclamation, Upper Colorado Region.

California Department of Water Resources. 2013. *Public Review Draft of California Water Plan Update 2013*. Sacramento: California Department of Water Resources.

D. Cayan and others. 2013. Chapter 6, Future Climate: Projected Average. In G. Garfin and others, editors, *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*. Report by the Southwest Climate Alliance. Washington: Island Press.

E. Fleishman and others. 2013. Chapter 8, Natural Ecosystems. In G. Garfin and others, editors, *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*. Report by the Southwest Climate Alliance. Washington: Island Press.

J. Kiefer and others. 2013. Changes in Water Use Under Regional Climate Change Scenarios. Water Research Foundation.

- J. Littell and others. 2009. Climate and wildfire area burned in western U.S. ecoprovinces, 1916–2003. *Ecological Applications*, vol. 19, pp. 1003–1021.
- E. Means III and others. 2010. Decision Support Planning Methods: Incorporating Climate Change Uncertainties into Water Planning. Water Utility Climate Alliance white paper. San Francisco; Water Utility Climate Alliance.
- National Research Council. 2011. *Climate Stabilization Targets: Emissions, Concentrations, and Impacts Over Decades to Millennia*. Washington: National Academies Press.
- S. J. Wenger and others. 2011. Flow regime, temperature, and biotic interactions drive differential declines of trout species under climate change. *Proceedings of the National Academy of Sciences*, vol. 34, pp. 14175–14180.
- B. Udall and others. 2013. Chapter 10, Water: Impacts, Risks, and Adaptation. In G. Garfin and others, editors, *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*. Report by the Southwest Climate Alliance. Washington: Island Press.