

adaptation

# Innovative Approaches for Adapting to Water Variability in the West

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## INTRODUCTION

*Sagebrush and cactus, red rocks and canyons define much of the Western United States' landscape.* While these attributes make for vivid movie sets, they also highlight the scarcity of water and underscore the challenge of drought management in the face of higher temperatures and changes in precipitation patterns.

Water planners traditionally have used the past to predict future fluctuations in water availability. However, under future climate change scenarios, the past is no longer thought to be a reliable predictor of the future. So which tools are Western water managers employing to assess vulnerability to climate change and adapt to meet the needs of people, wildlife, agriculture, and ecosystems? This brief examines case studies in New Mexico, Colorado, and across the West to reveal innovative approaches.

### New Mexico: Active Water Resource Management

In 2003, a severe drought combined with antiquated water laws brought New Mexico's Office of the State Engineer (OSE) to a crisis point. The U.S. Department of Agriculture had declared every county in the state a drought disaster area, and water users struggled to find adequate supplies.<sup>1</sup> With only a small percentage of the state's water rights fully adjudicated by the courts, a process that can take several decades, State Engineer John D'Antonio informed the state legislature that he needed more tools in the short term to address the water shortage. Former State Engineer Eluid Martinez observed, "[I]f the State Engineer does not have some kind of ability to regulate water rights in the absence of full adjudication... you might as well pack your bags...and have chaos in the state in terms of how you administer water rights."<sup>2</sup>

The state constitution establishes the doctrine of prior appropriation for water administration. In layperson's terms, water rights are assigned on a first come, first served basis. The system grew out of the state's early agrarian and mining economy. For example, an alfalfa farmer with senior rights might have priority over a downstream municipality's drinking water system because the farmer's rights were established first. Bill Hume, who served as Governor Bill Richardson's water policy advisor, noted that prior appropriation "is not a fluid system for changing uses," so more junior water users like municipal and industrial users can be cut off in times of drought. Hume explained that updating the water ownership system is not easy: "One could say that the system should be changed to reflect 21<sup>st</sup> century use [patterns], but water rights are property rights with great protections in law and tradition."<sup>3</sup> Complicating matters further in 2003, most tribal water rights had not yet been legally quantified. With so much uncertainty, the State Engineer's hands were tied in managing the state's limited water resources.

The state legislature responded to the crisis by passing legislation calling for expedited marketing and leasing of water in a way that would not interfere with adjudications or increase depletions.<sup>4</sup> The bill was signed by the governor and became section 72-2-9.1 of New Mexico Law. Under the statute, the OSE promulgated rules to establish Active Water Resource Management (AWRM) in 2004.

AWRM established more extensive water measuring and metering, set up a statewide water database (WATERS), identified seven priority basins for management,<sup>5</sup> designated basin managers ("water masters") and teams in the field, and developed schedules of implementation. Hume explained that "AWRM undertook not to change the doctrine of prior appropriation, but to put in place superintending rules to allow temporary changes in real time in case of drought and to provide financial rewards that water right owners would be compensated for giving up use during a drought."<sup>6</sup> The OSE also established rules for an expedited water transfer policy that includes marketing and leasing.

Despite the complexity of New Mexico water law, the concept of how AWRM should work is straightforward. For example, in a given year and basin, March snowpack numbers would be an early indication of a coming water shortage in that basin. The State Engineer would be able to determine whose water rights are likely to be curtailed and would give users the opportunity on a voluntary basis to expedite short-term leases of water rights. These types of transfers would be preapproved by the OSE, avoiding the normal water rights transfer process of notices,

hearings, and months of protests and appeals. The State Engineer explained that in this kind of marketplace, “the water goes to the highest economic use and eliminates strict priority administration in lieu of an alternative administration plan.”<sup>7</sup>

Implementation of parts of AWRM has been hindered by litigation. A 2005 lawsuit brought by Tri-State Generation and Transmission Association and the New Mexico Mining Association challenged the constitutionality of AWRM. In particular, the lawsuit questioned whether the State Engineer had the authority to issue regulations addressing priority administration prior to full adjudication. The case is on appeal to the New Mexico Supreme Court, which had been briefed but had not issued an opinion as of the writing of this paper. Regardless of the outcome of the case, certain portions of AWRM are allowed to continue, such as measuring and metering.

Despite the legal challenge, the State Engineer views AWRM as a success. Metering and measuring in the seven priority basins was about 90 percent complete in July 2011 and the new water masters are learning how systems work in the field. Voluntary rotation plans and water banking have been successful in several locations, most notably the San Juan River where electricity generators and agricultural users have found a regional solution to compensate farmers for fallow fields so that power plants remain operational in times of water shortages.<sup>8</sup> The State Engineer notes that in order for the voluntary short-term alternative plans allowed under AWRM to work, adequate water rights must be held in the agricultural sector, or “green belt.”<sup>9</sup> In this way, short-term transfers can be made out of agriculture and into municipal and industrial use in times of drought. If all supplies are held by the latter types of users, who tend to be less flexible in consumption patterns, active water management becomes much more difficult.

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AWRM was not established as a climate adaptation policy *per se*, but its provisions will be helpful in responding to climate change impacts anticipated in the Southwest. Higher evaporation rates associated with average temperature increases are expected to exacerbate the severity and extent of drought in the region, with drought recovery becoming increasingly difficult.<sup>10</sup> AWRM combined with other options for water rights administration such as shortage sharing agreements, rotation agreements, and water banking will be essential adaptation tools.

Short of full adjudication of New Mexico’s water rights, innovative policies like AWRM are important as the population increases. In the face of future climate-related challenges, they are essential. “When push comes to shove,” said Susan Kelly, director of the University of New Mexico Law School’s Utton Transboundary Center, “[water managers] will have to be able to use different tools.”<sup>11</sup> Other Western states face similar challenges associated with water adjudications that take years to make their way through the judicial process. While each state has its own set of water laws and regulations, the principles of AWRM could be applied in other states around the country.

## **Water Utility Climate Alliance: A Regional Approach to Climate Change Assessment and Adaptation**

The Water Utility Climate Alliance (WUCA) was founded by water managers concerned by a gap in climate assessment and adaptation science needed to support their decisions on climate-related challenges. Its origins date to 2006, when the San Francisco Public Utility Commission organized the Water Utility Climate Change Summit. The Commission recognized that while individual utilities had been conducting independent climate assessments for several years, more discussion was needed about how to collaborate across utilities.<sup>12</sup>

WUCA emerged two years later to spearhead utilities’ efforts to understand the new challenges that climate change poses to drinking water utilities and options for protecting water supplies. The group has forged an effective working relationship with the scientific community and has engaged in assessments of climate science specific to the water sector, including vulnerabilities and projected impacts. The WUCA organizational model is useful for other sectors of the economy as they endeavor to understand how climate change will affect their operations and take steps to adapt.

Denver Water joined the group because WUCA members “were the first ones struggling with how to understand projections on climate change and what to do about it.”<sup>13</sup> Paul Fleming with Seattle Public Utilities says that WUCA adds value to utilities as “an important venue for us to amplify our voice and insert ourselves into the climate research arena.”<sup>14</sup> Membership in WUCA is heavily Western, with the notable exceptions of Tampa Bay Water and the New York City Department of Environmental Protection. Other members include the Central Arizona Project, Denver Water, the Metropolitan Water District of Southern California, Portland Water Bureau, San Diego County Water Authority, San Francisco Public Utilities Commission, Seattle Public Utilities, and the Southern Nevada Water Authority.

Water utilities deal with climate variability and its effect on water supply on a daily basis. Intense storms, droughts, changes in winter snowpack and spring runoff, and other factors are considered routinely. But future climate change is expected to amplify that uncertainty, so WUCA’s activities focus on the “adaptation value chain”: a spectrum of actions starting with **assessment** – i.e., identifying climate change impacts and system vulnerabilities – leading to **adaptation** responses to vulnerabilities.<sup>15</sup> David Behar, WUCA staff chair, says WUCA aims to “work with those doing the most research to understand [climate] science and the vulnerabilities of our systems.”<sup>16</sup> To date, WUCA has been successful in directing more federal research toward the practical needs of water utilities.<sup>17</sup>

In addition to providing input to federal research, WUCA contributes to the climate assessment and adaptation field by funding its own research. The group has commissioned two white papers “to enhance the quality and accessibility of regional climate change data to help reduce uncertainty and improve water resource planning, promote the development of adaptation strategies, assist overall decision-making efforts and support the development of water-related policies.”<sup>18</sup> The first paper, published in December 2009, examined options for improving climate modeling to assist water utility planners.<sup>19</sup> The second, published in January 2010, identified decision support planning methods for incorporating climate change uncertainties into water planning.<sup>20</sup> The white papers have been cited by member utilities as key accomplishments for the organization because they distill scientific research that is useful to water utilities and show how to incorporate climate science into water planning.<sup>21</sup>

The group’s strong credibility in forums ranging from the U.S. House Science and Technology Committee<sup>22</sup> to the Western Governors’ Association is due in large part to the support it enjoys at the highest levels of utility management and the caliber of its staff support. More than 20 staffers from member utilities are on loan to WUCA, spending hours on collaborative work in addition to their many duties at their home offices. Staff members are in frequent communication with each other and hold monthly conference calls for sharing information.<sup>23</sup>

WUCA has made great strides in improving decision support for water utilities. Marc Waage with Denver Water explained that historically “future [water] supply was determined by looking at the past and assuming it would repeat itself. But to plan for multiple conditions in the future is a real transition for our utility and, I think, most utilities.”<sup>24</sup> WUCA’s work is highlighting “no regrets” strategies and policies that members are in various stages of implementing, such as conservation, water recycling, and desalination. “If we can create resiliency to climate change impacts through ‘no regrets’ actions, then relatively speaking, that’s an easy path to implement,” said David Behar with the San Francisco Public Utilities Commission. “But if these strategies are too expensive or not effective or infeasible, then we’ll have to talk about measures to address climate change more specifically. That’s where understanding the science is key.”<sup>25</sup>

In 2010, WUCA launched an ambitious new collaborative effort called Piloting Utility Modeling Applications for Climate Change (PUMA), which brings together WUCA members, Regional Integrated Sciences and Assessments (RISAs), and top scientists. The initiative will “leverage climate science and the relationship we’ve built in the scientific community to help utilities conduct state-of-the-art assessments.”<sup>26</sup> PUMA will identify the best climate models and techniques to conduct climate change impacts assessments for water systems, enhance understanding of the uncertainties inherent in modeling results, and acquire climate projection data in a form and scale that can be used by utility hydrologic models. Importantly, it will also “[i]nform developing conversations between climate science users and providers regarding how existing research meets or does not meet the needs of the adaptation community, how future investment in research might better serve society, and the nature of climate services needed on the ground in communities facing adaptation challenges.”<sup>27</sup>

WUCA's pioneering work has prompted the water community at large to follow its lead. For example, the National Association of Metropolitan Water Agencies is starting to look at climate impacts. As one WUCA member explained, "In some circles the water sector is viewed as more engaged and sophisticated [than other sectors], and WUCA has established that perspective."<sup>28</sup> WUCA has intentionally remained small to leverage the functional strengths of its coalition, and prospective members are evaluated according to a set of internal criteria.<sup>29</sup> WUCA is an excellent model of a specific sector systematically addressing its own needs in anticipation of future climate change. Other economic sectors, or even states and municipalities, could replicate WUCA's organizational structure and goals to identify and obtain scientific information needed for climate-related decision-making.

## Colorado: Joint Front Range Climate Change Vulnerability Study

The informal collaboration between two Colorado water experts, Lurna Kaatz, currently with Denver Water, and Veva Deheza with the Colorado Water Conservation Board (CWCB), led to an important regional effort known as the Joint Front Range Climate Change Vulnerability Study ("Front Range Study"). A 2008 report had already starkly laid out the high stakes: "Climate change will affect Colorado's use and distribution of water. Water managers and planners currently face specific challenges that may be further exacerbated by projected climate change."<sup>30</sup> The Front Range Study filled a void, Deheza explained, because "bringing together the state [government] with the [water] utilities was something we hadn't done before...it's a great example of the state working in partnership with utilities and foundation money."<sup>31</sup>

The CWCB is part of the Colorado Department of Natural Resources and serves as the State of Colorado's leader on climate change impacts assessment and adaptation responses. The CWCB has participated in two ambitious studies: *The Colorado River Water Availability Study*<sup>32</sup> and *The Joint Front Range Climate Change Vulnerability Study*.<sup>33</sup> The incentive to work together on these studies is strong, said Marc Waage, Denver Water's Manager of Water Resource Planning: "Denver Water is one of the utilities that will get hit first and hardest [by climate change] so it's important to put our energies into adaptation."<sup>34</sup> The Colorado River study has been effectively discussed in other climate adaptation summaries,<sup>35</sup> so the focus of this brief will be the Joint Front Range study as a model for other states and water utilities.

The Front Range Study is the kind of assessment that many states and regions will have to undertake in order to understand how climate change will affect local water availability. Kaatz said the study was designed carefully so it would be a useful case study for others.<sup>36</sup> The Study is distinguishable from WUCA's efforts because it will provide localized results specific to Colorado's Front Range waterways including the Arkansas, Big Thompson, Boulder Creek, Cache la Poudre, upper Colorado, South Platte, and St. Vrain River Basins. The project steering committee includes Aurora Water, the City of Boulder, the City of Fort Collins, Colorado Springs Utilities, Colorado Water Conservation Board, Denver Water, and Northern Colorado Water Conservancy District. Research partners include the Water Research Foundation, Riverside Technologies, inc., the National Center for Atmospheric Research, and the Western Water Assessment.

The Front Range Study was designed to give metropolitan water agencies along Colorado's Front Range the education, tools, and methodology to understand the potential effects of climate change on their water supplies. The Study's "unified approach is intended to help Front Range water providers communicate with their customers and the media cohesively, using consistent hydrometeorological data, methods, and climate change scenarios."<sup>37</sup> Kaatz noted that it was crucial to have a transparent and simple process for selecting the Study's climate models and scenarios, which are becoming a standardized set for other studies in Colorado. Now results can be compared across the region.<sup>38</sup>

The Front Range Study has undertaken a streamflow sensitivity analysis on the seven watersheds identified above so water utilities will have localized streamflow information under a range of future climate scenarios. "Each provider can use these future streamflow scenarios in conjunction with its water rights allocation assumptions to estimate the impacts of various climate change scenarios on its water supply."<sup>39</sup> Historical streamflow from 1950 to 2005 was evaluated, and then two hydrologic models were applied independently to assess projected changes under different climate change scenarios for the years 2040 and 2070.<sup>40</sup>

Education for participants has been a successful component of the Front Range Study process. Deheza explained that they were “working to establish common technical language with regard to climate.”<sup>41</sup> Monthly meetings and education sessions have been held for participants to refine the Study’s scope, educate participants about climate change and hydrologic science, and provide regular updates on the Study’s progress.<sup>42</sup> The meetings have been open to other Front Range communities or any other stakeholders.

Kaatz says the process has been very successful, yielding not just important tools for water managers but also helping the academic community understand what kind of data and modeling results are most useful to utilities.<sup>43</sup> Deheza observed that the Front Range Study process opened up relationships and opportunities on climate that might not have occurred otherwise.<sup>44</sup> Both Kaatz and Deheza emphasized that the process used for the Front Range Study could be replicated by other regions or states concerned about water supply vulnerability to climate change.

## Conclusions

The water and climate efforts developed by New Mexico, WUCA, and the Front Range Study participants illustrate innovative responses to changing water availability in the face of climate change. New Mexico’s AWRM demonstrates a creative administrative approach to measuring and managing a state’s water resources within the constraints of the formal water adjudication process. As climate change deepens the challenges water managers face, other states could benefit by employing elements of New Mexico’s AWRM approach. Water utilities across the country will benefit from WUCA’s leading-edge research, regardless of whether they become members. Other economic sectors, such as electric utilities, could benefit by adopting this organizational model. Finally, the Joint Front Range Study is an excellent – and by design, replicable – model for studying a region’s water availability while simultaneously educating participants about climate science. Climate change is likely to compel other states and regions to undertake studies like it in the future. Together, these three case studies highlight creative approaches to assessing the water sector’s vulnerability to climate change and developing responses that meet the needs of people, wildlife, agriculture, and ecosystems.

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<sup>1</sup> Bossert, Paul. “Active Water Resource Management.” *Water Matters!* October 2008. Updated by Susan Kelly 2010.

<sup>2</sup> Quoted in *Bossert*.

<sup>3</sup> Interview with Bill Hume, former water policy advisor to Governor Bill Richardson, May 25, 2011.

<sup>4</sup> *Bossert*.

<sup>5</sup> The basins are: Lower Pecos River, Lower Rio Grande, San Juan River, Upper Mimbres, Rio Gallinas, the Nambe-Pojoaque-Tesuque Basin, and the Rio Chama.

<sup>6</sup> *Hume interview*.

<sup>7</sup> Interview with John D’Antonio, New Mexico State Engineer, July 6, 2011.

<sup>8</sup> *D’Antonio interview*.

<sup>9</sup> *D’Antonio interview*.

<sup>10</sup> Gutzler, David S. and Tessia O. Robbins. “Climate variability and projected change in the western United States: regional downscaling and drought statistics.” *Climate Dynamics*. DOI 10.1007/s00382-010-0838-7, June 8, 2010.

<sup>11</sup> Interview with Susan Kelly, Director of the Utton Transboundary Center, University of New Mexico Law School, May 17, 2011.

<sup>12</sup> Interview with David Behar, Staff Chair of WUCA and representative of San Francisco Public Utilities Commission, April 25, 2011. For example, Seattle Public Utilities had commissioned research on climate change impacts on water its supply and hired a full-time staff member to focus on climate.

<sup>13</sup> Interview with Marc Waage, Manager of Water Resource Planning, Denver Water, June 21, 2011.

<sup>14</sup> Interview with Paul Fleming, Manager of the Climate & Sustainability Group, Seattle Public Utilities, June 10, 2011.

<sup>15</sup> *Fleming interview*.

<sup>16</sup> Behar interview.

<sup>17</sup> See May 2009 testimony of David Behar and Paul Fleming re: establishment of a National Climate Service before the Subcommittee on Energy and the Environment of the U.S. House Science and Technology Committee. Available at [http://www.wucaonline.org/html/actions\\_federal.html](http://www.wucaonline.org/html/actions_federal.html).

<sup>18</sup> WUCA website available at [http://www.wucaonline.org/html/actions\\_publications.html](http://www.wucaonline.org/html/actions_publications.html).

<sup>19</sup> See Barsugli, Joseph, Chris Anderson, Joel Smith, and Jason M. Vogel. "Options for Improving Climate Modeling to Assist Water Utility Planning for Climate Change." Prepared for WUCA, December 2009.

<sup>20</sup> See Means, Edward III, Maryline Laugier, Jennifer Daw, Lurna Kaatz, and Marc Waage. "Decision Support Planning Methods: Incorporating Climate Change Uncertainties into Water Planning." Prepared for WUCA, January 2010.

<sup>21</sup> Waage interview.

<sup>22</sup> Written testimony of David Behar and Paul Fleming available at [http://www.wucaonline.org/html/actions\\_federal.html](http://www.wucaonline.org/html/actions_federal.html).

<sup>23</sup> Behar interview.

<sup>24</sup> Waage interview.

<sup>25</sup> Behar interview.

<sup>26</sup> Behar interview.

<sup>27</sup> Modeling Applications (PUMA) Project Description." Available at [http://www.wucaonline.org/assets/pdf/puma\\_project\\_description.pdf](http://www.wucaonline.org/assets/pdf/puma_project_description.pdf).

<sup>28</sup> Fleming interview.

<sup>29</sup> Behar interview.

<sup>30</sup> Ray, Andrea J., Joseph J. Barsugli, Kristen B. Averyt, et al. "Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation." A report for the Colorado Water Conservation Board. 2008.

Available at <http://cwcb.state.co.us/public-information/publications/Documents/ReportsStudies/ClimateChangeReportFull.pdf>.

<sup>31</sup> Interview with Veva Deheza, Office of Water Conservation & Drought Planning Section Chief, Colorado Water Conservation Board, July 19, 2011.

<sup>32</sup> See <http://cwcb.state.co.us/technical-resources/colorado-river-water-availability-study/Pages/main.aspx>.

<sup>33</sup> See <http://cwcb.state.co.us/environment/climate-change/Pages/JointFrontRangeClimateChangeVulnerabilityStudy.aspx>.

<sup>34</sup> Waage interview.

<sup>35</sup> See, e.g., "State Authority and Climate Change Adaptation," prepared by Stratus Consulting Inc. for the Climate Resource Center, Georgetown University Law Center. 2010.

<sup>36</sup> Interview with Lurna Kaatz, Climate Policy Analyst, Denver Water, June 21, 2011.

<sup>37</sup> Water Research Foundation Scope of Work for the Joint Front Range Climate Change Variability Study. January 9, 2009. Available at <http://cwcb.state.co.us/environment/climate-change/Documents/ProjectMaterials/SOW.pdf>.

<sup>38</sup> Kaatz interview.

<sup>39</sup> Water Research Foundation Scope of Work.

<sup>40</sup> See the following for more detail on climate scenarios: <http://cwcb.state.co.us/environment/climate-change/Documents/JFRCCVSClimateModelsSelection.pdf>.

<sup>41</sup> Deheza interview.

<sup>42</sup> Kaatz interview.

<sup>43</sup> Kaatz interview.

<sup>44</sup> Deheza interview.

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