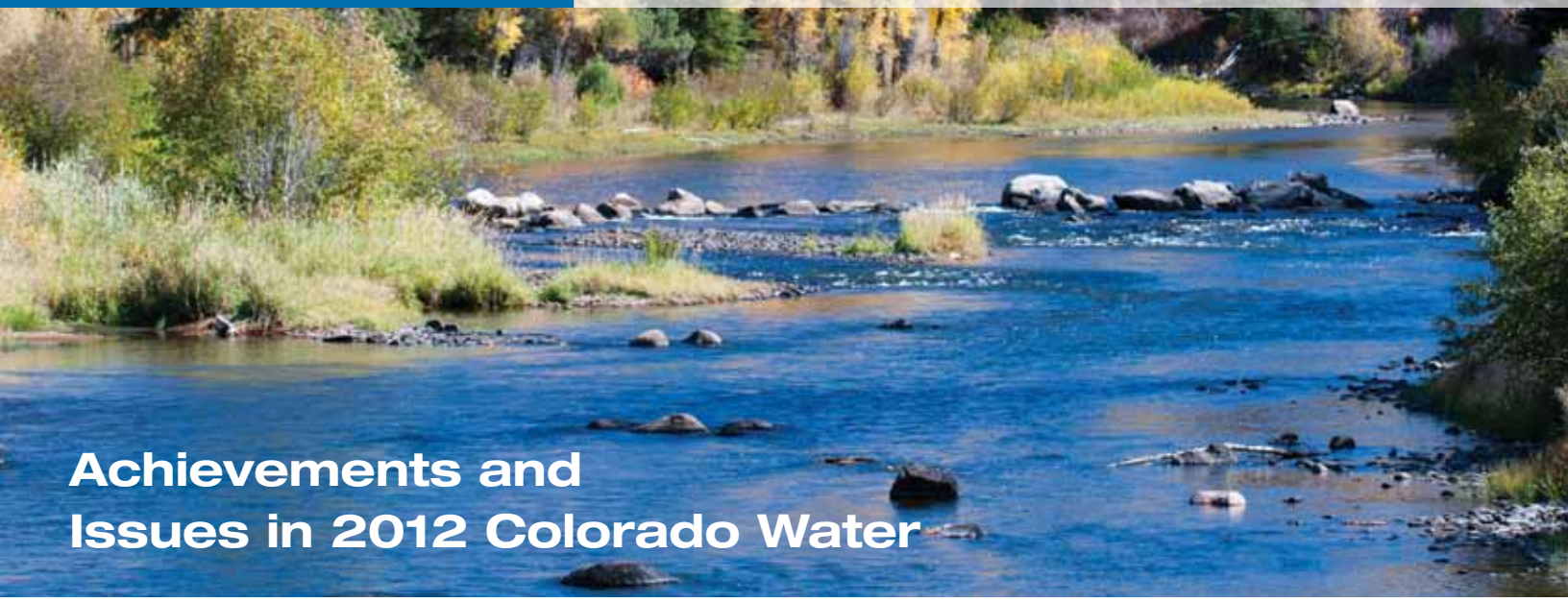
UNIVERSITY OF COLORADO BOULDER LEEDS SCHOOL OF BUSINESS

COLORADO BUSINESS REVIEW

A publication of the Business Research Division
Volume 78, Number 2, 2012

This issue:



Achievements and Issues in 2012 Colorado Water

Charles W. Howe

Background

There is no need to emphasize the importance of water to our state's economy. The high rate of population growth, the initiation of new industries, and the continuing importance of irrigated agriculture imply increasing water demands for the traditional commercial, urban, and agricultural users. Additionally, but of increasing importance, are the nonconsumptive uses that support water and snow-based recreation and maintenance of healthy water-related ecosystems. These ecosystems, in turn, support valuable bird communities and fisheries containing sport fish and protected endangered species. The Colorado Water Conservation Board (CWCB) projects water use by sector for 2050 as shown in Figure 1 on page 8.

The critical importance of agricultural water use stands out clearly: more than 80% of total water withdrawals and consumptive use are by the irrigated agricultural sector. Agricultural applications involve a 50% evaporative loss; the remainder returns directly or indirectly to a stream or groundwater aquifer. These proportions are representative of all the western states, not just Colorado. The obvious implication is that improvements in agricultural water use efficiency (through technical improvements or changes in cropping patterns) could free up large quantities of water to the advantage of farmers and to nonagricultural users who might buy the water.

The municipal and industrial (M&I) sectors together constitute the second-largest withdrawer of water from the state's supply systems. However, the M&I users typically consume only about 35% of their withdrawals. M&I applications tend to generate relatively high values in use, partially reflected in the high rates paid by M&I users. M&I uses projected to 2050 by the CWCB are shown in Figure 2 on page 9.

These projections illustrate likely increases in M&I uses above and beyond existing supplies. Preliminary "portfolio analyses" (looking at alternative sources and their costs) show several alternatives for partially "filling the gap" between current supplies and projected uses: increases in supply from projects that have already been planned (green space) and voluntary "passive" conservation by users. The remaining "gap" starts shortly after 2030 and continues to grow.

There is no question that the "*gap will be filled,*" either by finding other sources of supply or by motivating reduced water use by some future users. It is likely that further conservation will be stimulated by increasing prices for water (higher M&I prices and higher water right prices in the water market). However, as suggested by Figure 1, voluntary transfers from agriculture through land-use conversions and water sales will constitute a major part of the needed new supplies.

The costs of added supplies will play an important role in which alternatives are adopted. The CWCB has estimated the approximate costs per acre-foot for developing each class of alternative on the East Slope,

CONTINUED ON PAGE 8

Leeds School of Business
UNIVERSITY OF COLORADO BOULDER
BUSINESS RESEARCH DIVISION

From the Editor

Water is a critically important resource that not only affects the economy of the West but also the region's quality of life. Citizens of the West are keenly aware of the importance of water to households, industries, agriculture, a healthy ecosystem, and recreational pursuits—and the fact that many of these interests compete with one another. For that reason, this issue of the *Colorado Business Review* examines this topic from a variety of perspectives. CU-Boulder Professor Emeritus Charles Howe's article that begins on page 1 provides an overview of water issues facing the region and state. On this page, Trout Unlimited Executive Director David Nickum discusses the importance of healthy rivers to the state. The challenges in planning for Colorado's future water needs—and paying for them—is examined by Dick Wolfe, State Engineer and Director of Colorado Division of Water Resources, in an article that begins on page 4. Joe Stibrich, Deputy Manager of Water Resources with Aurora Water, highlights the Prairie Waters Project, which was designed to protect the city during droughts. See pages 6 and 7.

Our next issue will review Colorado's economy six months into the year. Look for it in your inbox this summer.

Please contact me with any comments at 303-492-1147.

Richard Wobbekind

Healthy Rivers for a Twenty-First Century Economy

David Nickum

When Colorado water law got its start in the nineteenth century, it was pretty simple. Like early miners who tried to be the first to "stake their claim" on a promising site, water rights were issued with a "first in time, first in right" scheme. This scheme allowed for orderly development and growth of Colorado's economy by diverting water from streams and applying it for out-of-river uses such as irrigation, domestic and industrial uses, and even hydropower generation. The value of keeping water in a river for ecological health wasn't a consideration.

For generations, water development followed that narrow nineteenth-century model. Dams, ditches, and pipelines were built to divert, store, and transport water out of Colorado's rivers for use elsewhere. The scale of these efforts grew dramatically in the twentieth century with large projects like the Colorado-Big Thompson and Fryingpan-Arkansas diverting vast quantities of water across the Continental Divide. The focus remained, however, on developing water for out-of-river uses with little thought given to the need of rivers themselves.

Today, with some of Colorado's rivers in serious trouble from diversions and drought, it has become clear that keeping healthy flows instream is vital to our ecological and economic health as a state. Travel and tourism is a primary driver of our state's economy, and active outdoor recreation—from fishing to hiking to camping—contributes more than $10 billion annually to Colorado's economy and supports 107,000 jobs across the state (Outdoor Industry Foundation).

Much of this revenue stream depends clearly and directly on rivers—like the nearly $1.3 billion generated by fishing, which sustains an estimated 14,600 jobs (Colorado Division of Wildlife). Or the $61.7 million generated annually by rafting on the Arkansas River, the most popular white-water destination in the nation and a key part of the local economy in areas like Salida (Colorado River Outfitters). Moreover, Colorado's magnificent environment with its flowing rivers, stunning landscapes, and world-class recreational opportunities are part of what attracts individuals and businesses to locate in our state.

Without healthy rivers, our state is dead in the water.

Colorado citizens understand this linkage. In this year's "State of the Rockies" poll from Colorado College, 97% of Coloradans noted that our parks, forests, and wildlife areas are an essential part of Colorado's quality of life, and 93% recognized them as essential to our economy.

Yet while flowing rivers and a healthy environment are major assets to Colorado's twenty-first century economy, too much of our water policy remains locked in nineteenth century mindsets. Often the focus remains on how users can draw water from our rivers for out-of-stream uses without considering how to maintain our rivers as healthy contributors to Colorado's economy and quality of life. So discussion continues to be dominated by "more of the same" as what we've done before—for example, the costly, controversial 500-mile pipeline scheme proposed to bring Green River water to the Front Range.

While new water projects will certainly be part of serving Colorado's future growth, we need a twenty-first century approach to water that recognizes and promotes the full range of values it provides. That means not only using water out of stream, but maintaining it instream to support fisheries and riparian habitat and the recreational opportunities and communities they sustain.

So what will a twenty-first century water policy look like in an era of water scarcity? It will start on a solid foundation of conservation. Water is a finite resource in the arid West, and we must use every drop as wisely as possible. The fastest, cheapest, and least harmful way of meeting our future water supply needs is to reduce our demands through efficiency. Our planning will rely on collaboration among all stakeholders and better tools for sharing water, such as partnerships between agriculture and cities to share water in periods of drought. New projects will also play their part, but they must be designed to address not only traditional water uses but the needs of the rivers from which they draw as well.

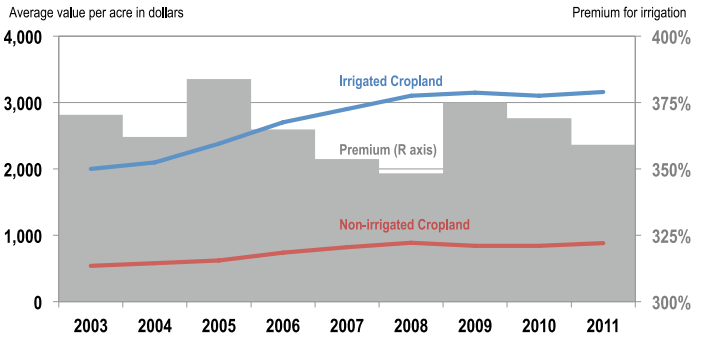
There are some hopeful signs. For example, the cities of Fort Collins and Greeley have engaged with conservationists in a "Shared Vision Planning" effort to fold river values into planning for the proposed expansion of Halligan and Seaman reservoirs. Colorado needs more of this kind of creative thinking if we are to find smart solutions to our water challenges.

Since settlement in the nineteenth century, Colorado's economy has grown and diversified dramatically. Our state's rivers and environment have become key economic drivers—not just as

CONTINUED ON BACK PAGE

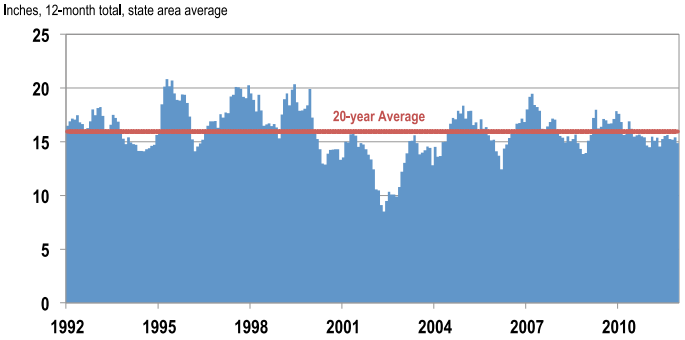
Data Related to Colorado Water Issues

Premium for Irrigated Cropland



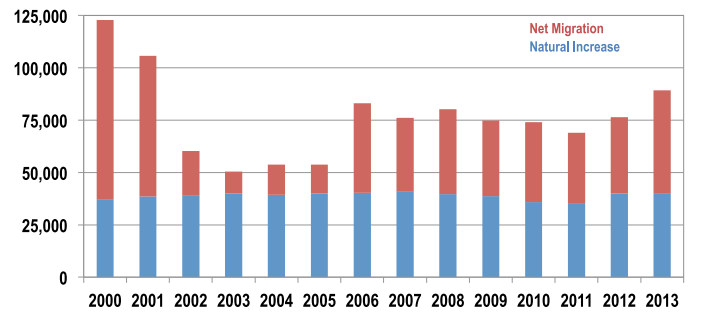
Source: USDA, National Agricultural Statistics Service.

Annual Precipitation in Colorado



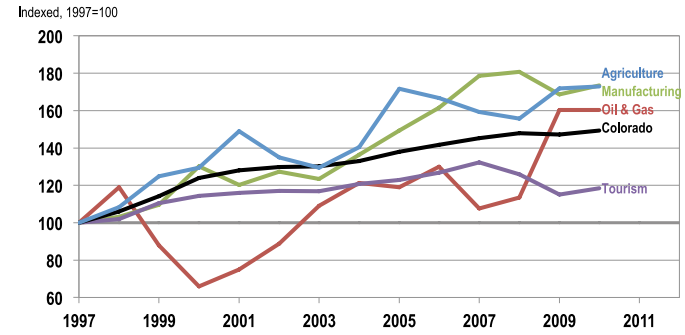
Source: NOAA, US Climate Division.

Population Changes in Colorado



Source: Colorado Department of Local Affairs.

Select Industries' Contributions to Real GDP



Source: Bureau of Economic Analysis.

Core Metrics Data

		Colorado Employment (In Thousands)	Colorado Unemployment Rate	Colorado FHFA Quarterly Housing Price Index	U.S. Consumer Price Index (Inflation)	U.S. Consumer Price Index (Core Inflation)[a]
2010	March	2,216.5	9.0%	271.2	217.4	220.8
	April	2,217.3	8.9	--	217.4	220.9
	May	2,225.1	8.9	--	217.2	221.0
	June	2,222.0	8.9	267.5	217.2	221.3
	July	2,224.7	8.9	--	217.6	221.5
	August	2,224.5	8.9	--	218.1	221.6
	September	2,222.6	9.0	260.3	218.4	221.7
	October	2,229.4	9.0	--	219.0	221.8
	November	2,230.2	9.0	--	219.4	222.1
	December	2,232.4	8.9	267.0	220.4	222.2
2011	January	2,241.4	8.8	--	221.0	222.6
	February	2,240.1	8.6	--	222.0	223.1
	March	2,244.7	8.5	258.0	223.2	223.4
	April	2,252.0	8.4	--	224.0	223.8
	May	2,250.9	8.4	--	224.6	224.4
	June	2,250.8	8.4	258.4	224.8	224.9
	July	2,257.6	8.3	--	225.5	225.4
	August	2,260.0	8.3	--	226.3	225.9
	September	2,262.9	8.2	261.1	226.9	226.1
	October	2,268.0	8.1	--	226.8	226.5
	November	2,265.3	8.0	--	227.0	226.9
	December	2,265.3	7.9	259.8	227.0	227.2
2012	January	2,284.2	7.8	--	227.5	227.7
	February	2,287.9	7.8	--	228.4	227.9
	March	2,290.5	7.8	N/A	229.1	228.4
	Month-over-Month[b]	0.11%	0.0	-0.49%	0.29%	0.23%
	Year-over-Year	2.04%	-0.7	-2.69%	2.65%	2.25%
	5-Year CAGR[c]	-0.26%	--	-1.41%	2.22%	1.75%

[a]Inflation less food and energy. [b]Quarter-over-Quarter for the FHFA Housing Price Index. [c]Compound annual growth rate.

Sources: Bureau of Labor Statistics (CES, LAUS, and CPI) and Federal Housing Finance Agency. Data seasonally adjusted.

The Ever Demanding Need for Water

Dick Wolfe

Water is the most precious resource in Colorado. It serves a seemingly endless array of consumptive and nonconsumptive uses. Most Coloradans do not realize that more than two-thirds of the water generated in Colorado goes out of state to principally meet our obligations under nine interstate compacts and other agreements with our sister states and the Republic of Mexico. See Diagram of State Water Flows.

We are essentially living with a fully developed resource, which means if we are to meet our future water demands, we will be required to find new water supplies or convert "old uses" to "new uses." Most of Colorado's water is currently used for agriculture (over 85%). Even though the demand continues to grow for traditional consumptive uses such as agriculture and municipal and industrial, there continues to be a growing need for water for nonconsumptive needs for recreation and the environment.

Starting in 2003 the Colorado Water Conservation Board (CWCB) embarked on an effort to determine the future water needs of Colorado (CWCB Water Supply Planning). In 2005, the Interbasin Compact Committee was created to assist in these efforts (CWCB Interbasin Compact Committee). These entities continue to evaluate the future needs for water in Colorado, both consumptive and nonconsumptive, and the trade-offs that will face decision makers, all while protecting existing uses of water and not impairing Colorado's ability to meet its obligations under the compacts.

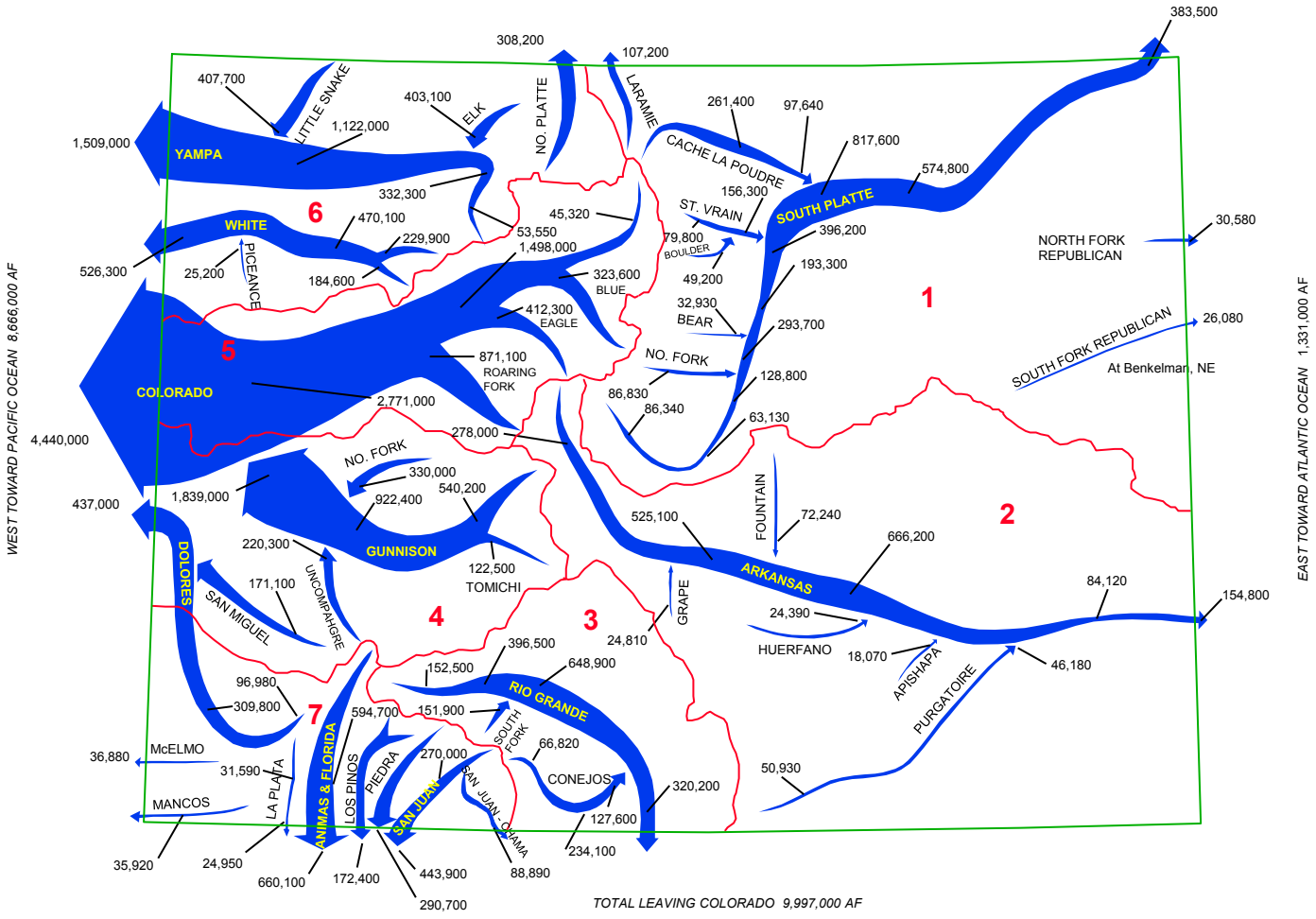
It is not just about meeting the water gap that challenges decision makers, but also how they will pay for these projects. Funding for water infrastructure projects is a primary function of the CWCB. The CWCB offers numerous loans and grants to water providers and other entities statewide for a variety of water-related projects, studies, and planning document (CWCB Loans and Grants). However, funding for these programs has been impacted tremendously by transfers of monies to offset shortfalls in the State's General Fund, as well as shortfalls in severance tax monies principally due to a declining price for natural gas. Consequently, competition will be greater for even more limited funds. This could cause delays in replacing aging infrastructure and in building future water infrastructure projects, or the result could be greater cost for these projects because they need to seek alternative funding sources that are most likely to be costlier.

The State of Colorado is concerned about the continued pressure on the conversion of water from agriculture to meet these future needs. The need to protect existing agriculture remains strong not only due to our strong heritage but for food security, economic vitality, and environmental benefits. However, there remain continued challenges within two major agricultural basins within Colorado regarding sustainability of water supplies for irrigation. The first basin is the Republican River basin in northeastern Colorado. The local water users (Republican River Water Conservation District [RRWCD]) have spent or committed more than $90 million for construction of a compact compliance pipeline, purchases, and retirement of surface and groundwater rights, and implementation of a land fallowing program, all to achieve compact compliance. The success of these efforts ultimately depends on final settlement negotiations with Kansas and Nebraska and getting them to agree that these efforts by Colorado will indeed achieve compact compliance for the continued irrigation of approximately 550,000 acres (Republican River Compact Compliance).

The second basin is the Rio Grande basin in south central Colorado. The Division of Water Resources is in the process of promulgating rules and regulations to allow the continued operation of approximately 6,000 high-capacity wells that are mostly used for irrigation of approximately 600,000 acres. The water users (Rio Grande Water Conservation District) are creating subdistricts to create a financing mechanism, as well as operate Plans of Water Management that will allow continued operation of these high-capacity wells and at the same time protect senior water rights and sustain the underground aquifers, while not impairing Colorado's ability to comply with the Rio Grande Compact (San Luis Valley Advisory Committee). There will be significant impacts on farmers, businesses, and communities if these efforts are not successful as thousands of wells will be required to shut down.

In addition to protecting existing uses, there continues to be a growing need for water to meet the needs of energy development in Colorado—whether it be from traditional needs of oil and gas well development or the potential needs of oil shale. The Division of Water Resources is responsible for the administration of produced water from oil and gas wells (Produced Nontributary Ground Water). One additional area that has garnered a lot of attention lately is the need for water for hydraulic fracturing purposes to stimulate production in the development of oil and natural gas wells (Water Demand for Hydraulic Fracturing). Even though the demand for water for these purposes is relatively small, this has not abated the concern for its competition for this limited and finite resource.

The State of Colorado has an important role in meeting today's challenges and creating a path to assist future decision makers in meeting future challenges. We are committed to seeking shared and collaborative solutions that address multiple needs and to develop new approaches to create a sustainable water future for Colorado. It is imperative that whatever solutions



are reached are supported widely and represent the interests of all, including recreational and environmental needs.

The enormous challenges facing us require the collective input of all stakeholders and a collaborative decision-making process that reaches common ground to develop a sustainable water future that meets our numerous and diverse needs. We all must be stewards of this precious resource and collectively be responsible for planning for our future.

References

Colorado Division of Water Resources. "Republican River Compact Compliance." http://water.state.co.us/SurfaceWater/Compacts/RepublicanRiver/Pages/RepublicanRiverHome.aspx.

_____. "San Luis Valley Advisory Committee." http://water.state.co.us/SurfaceWater/RulemakingAndAdvising/SLVAC/Pages/default.aspx.

_____. "Produced Nontributary Ground Water Home." http://water.state.co.us/groundwater/GWAdmin/NontribGW/Pages/default.aspx.

Colorado Division of Water Resources, the Colorado Water Conservation Board, and the Colorado Oil and Gas Conservation Commission. *Water Sources and Demand for the Hydraulic Fracturing of Oil and Gas Wells in Colorado from 2010 through 2015*. http://water.state.co.us/DWRIPub/CGWC%20Meetings%20and%20Process%20Documents/Oil%20and%20Gas%20Water%20Sources%20Fact%20Sheet%20-%20Final.pdf.

Colorado Water Conservation Board. "Water Supply Planning." http://cwcb.state.co.us/water-management/water-supply-planning/Pages/main.aspx.

_____. "Interbasin Compact Committee." http://cwcb.state.co.us/about-us/about-the-ibcc-brts/Pages/main.aspx/Templates/Home.aspx.

_____. Loans & Grants." http://cwcb.state.co.us/LoansGrants/Pages/LoansGrantsHome.aspx.

Republican River Water Conservation District. http://www.republicanriver.com/.

Rio Grande Water Conservation District. http://www.rgwcd.org/.

Dick Wolfe, M.S.A.E., P.E, State Engineer and Director of Colorado Division of Water Resources, may be contacted at dick.wolfe@state.co.us.

Aurora's Response to Drought

Joe Stibrich

It was just a simple snowpack summary. A graph of squiggly lines that compares snowpack levels from year to year. But back in March, the thick blue line representing 2012 had staff at water departments across the Front Range eying their computers nervously. The line was the lowest it had been since 2002.

And it was dropping every week.

In Colorado, snowpack turns into runoff, and runoff translates into water supply. Water supply for millions of people. Meetings were scheduled, officials were notified. Additional watering restrictions were considered.

At Aurora Water, staff studied the same graph. And although they, too, were anxious about what the year's runoff would bring, they knew that for this year anyway, they would have what they needed for their 335,000 residents.

The Prairie Waters Project was Aurora's sigh of relief.

As the city's latest addition to its water supply portfolio, Prairie Waters was designed to do exactly what it *will* do this year—protect the city in times of drought. And it was designed as a result of the drought of 2002—a year when every Front Range city was in a water crisis. Aurora was no exception.

In March of that year, snowpack was 70% of average, which was considered manageable. But something odd happened, something Aurora Water staff had never seen.

The snowpack vanished.

"Starting in the last week of that March, the snowpack began to melt, evaporate. The snowpack disappeared, literally, reducing by 50% every week through April. By the end of the month, the snow was gone," Brian Fitzpatrick, Aurora Water's Water Resources Manager at the time, said. "We were sandbagged. We knew it would be a sub-par season, but we had no idea that it was going to become the disaster that it was."

By March 2003, Aurora had less than a nine-month supply of water.

Officials knew they had to come up with a long-term plan to meet the city's water needs, and they had to do it fast. They evaluated dozens of possibilities. They landed on the concept of the Prairie Waters Project.

Most of the water the city owns flows back to the South Platte River. Through the complexity of Colorado's water laws, the city still owns that water, but in years past, there was no way to recapture it. With Prairie Waters, they could.

The project was the brainchild of former Aurora Water director Peter Binney, and it was unlike any other in the region.

While ambitious, Prairie Waters seemed tailor-made for Aurora. The project embraced a responsible use of resources, and no new water rights needed to be acquired. It avoided impacts to local wildlife landscapes, maintaining rural open space and river corridor habitats. It required no significant federal permits, and local municipalities and county jurisdictions supported the project through cooperative agreements. Most importantly, perhaps, the project was practical, using billions of gallons in reusable water supplies not currently being captured and used.

Construction began in 2005. It was one of the largest water projects undertaken in Colorado in more than 35 years.

The Prairie Waters system starts near Brighton, where 17 wells pull the water from the lower South Platte through hundreds of feet of sand and gravel to clean out impurities. The process is called *riverbank filtration*. It's been used in Europe and the United States for more than a century and is one of the most effective natural ways of removing contaminants.

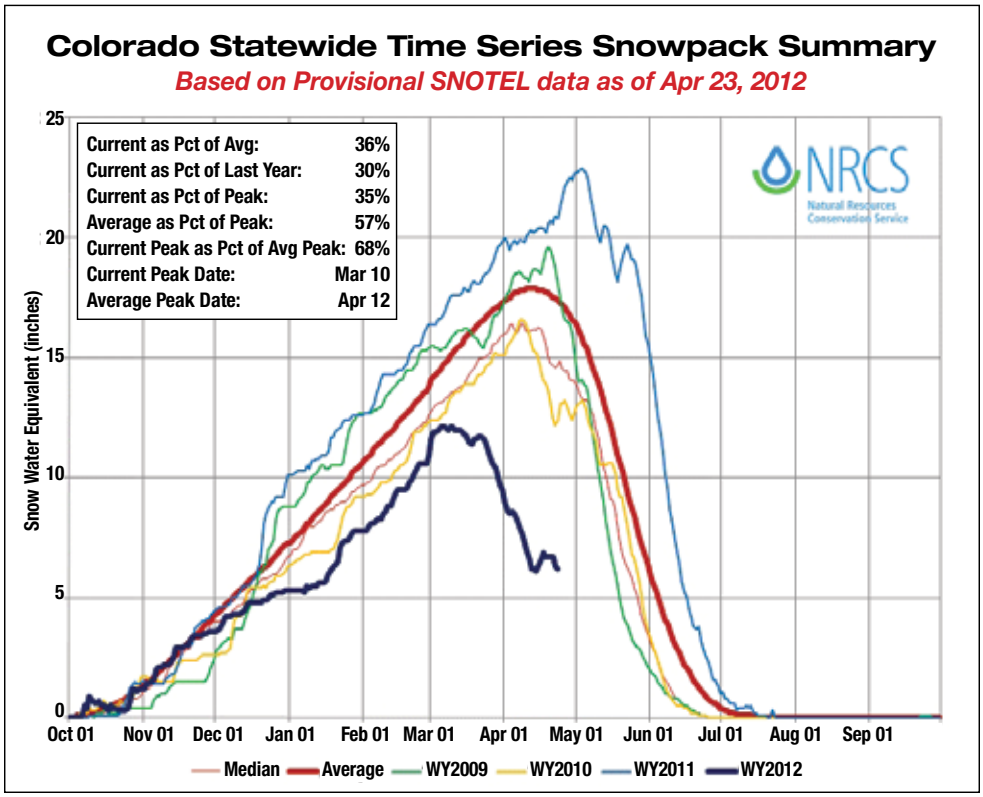
The water then travels to an aquifer recharge and recovery basin. The water is slowly drawn through the gravel material in the basin, which provides additional purification. From there, the water travels through nearly 34 miles of pipeline before reaching the Peter D. Binney Water Purification Facility, a 70-acre, state-of-the-art treatment plant near the Aurora Reservoir.

The plant uses ultraviolet oxidation, high-intensity ultraviolet lights that destroy unwanted contaminants. It's one of the most advanced water purification processes in the country, and is one of the largest UV treatment facilities in the nation. Activated carbon filtration completes the process before the water is blended with the rest of the city's mountain supply in order to create consistent taste through the city's water supply systems.

Water began flowing through the pipes of the Prairie Waters system in 2010. It was built in just five years and nearly $100 million under budget.

Today, the system can deliver 3.3 billion gallons of water (10,000 acre-feet) a year, representing an additional 20% of the city's annual water use, but it was designed with expansion in mind. Ultimately, it will be able to deliver more than 16 billion gallons of water each year.

Prairie Waters alone doesn't guarantee the city ample supplies in times of drought—if 2012 continues to be dry and the drought extends into 2013, reservoir levels in the



Binney Water Purification Facility, part of the Prairie Waters system

mountains could drop significantly and supplies could still be limited next year. But the system helps the city diversify its water resource, and it provides a significant percentage of guaranteed water supplies, an advantage many cities cannot claim.

It has also opened the door to conversations about regional water supply solutions.

Once Prairie Waters was completed, Aurora found itself in an enviable yet difficult position. By then, Aurora's system had fully recovered from the 2002 drought, and the Prairie Waters Project was in place for drought protection, but there was a large financial obligation for the city to bear. The project cost more than $650 million to construct. Because Prairie Waters was designed to provide a "drought-hardened" supply to the City, project water over and above the City's normal needs would be available during nondrought years. The concept of selling the additional project water was an intriguing one to Aurora officials.

Among water providers in the Denver Metro region, there was an increased awareness that independent projects built by single water providers are no longer the most economically viable approach. Regional cooperation has been an emerging trend in the nation, and Aurora officials recognized the benefits of working together to find common solutions.

Collaborations with other water providers can often reduce costs, foster joint development of water supplies, and increase operational efficiencies. In addition, partnerships can minimize the impact of declining growth, which results in reduced development fee revenue and provides an avenue for sharing the increasing cost of acquisition and development. Ideally, it can increase regional financial stability.

Discussions began, and ultimately, the Water Infrastructure and Supply Efficiency (WISE) Partnership was formed.

Aurora Water, Denver Water, and the South Metro Water Supply Authority (SMWSA), which represents 15 water providers in Douglas and Arapahoe counties, are developing a water delivery agreement that, if approved, can provide South Metro with water each year so they can reduce their reliance on aquifers—underground water supplies that are dwindling.

The Prairie Waters system provides the infrastructure backbone for the partnership, carrying and treating water supplies from Aurora Water and Denver Water to South Metro. While the agreement provides for water deliveries to South Metro at varying levels, it also recognizes that Aurora's and Denver's first priority is serving their customers, so in times of need, the cities will keep the water within their own systems.

Revenues from this partnership will help Aurora Water pay for—and expand—the Prairie Waters and will help stabilize water rates. Denver Water will also be able to use capacity in Prairie Waters during times of emergency in exchange for sharing in infrastructure and operational costs.

The agreement, once approved, will be one of the first of its kind in the country. It will be a critical step toward bolstering water supplies in the Colorado Front Range southern area, while better using water resources in Aurora and Denver. Negotiations are ongoing, but it is anticipated that the agreement could be finalized by the end of this year.

"Prairie Waters has forged a new path not only for drought protection but as an innovative and environmentally friendly solution to increasing water supply demands," Dan Mikesell, Aurora Water's interim director, said. "And now it could help the entire region."

Joe Stibrich is the Deputy Manager of Water Resources with Aurora Water.

where the growth of demand is greatest (Colorado Water Conservation Board 2012):

Already identified and planned projects:	$14,000 per acre-foot
Active conservation:	$7,200 per acre-foot
Agricultural transfers:	$33,500 per acre-foot
New supplies:	$28,000 per acre-foot

Comparatively, Douglas Kenney has estimated these costs based on historic projects or project estimates for new projects (Kenney 2011). His estimates suggest that when least cost alternatives are used in the analysis, the costs for the four categories above might be: active conservation $5,200 per acre-foot; water transfers, $14,000 per acre-foot; and new projects, $16,200.

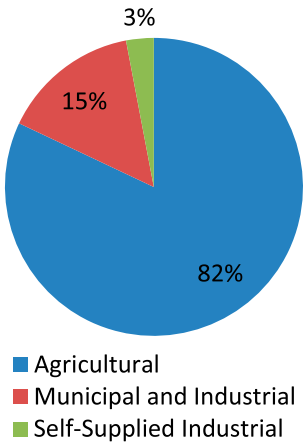
Potential climate change poses a major uncertainty on all of these water demands and costs. The *Joint Front Range Climate Change Vulnerability Study* (Rocky Mountain Climate Organization 2012) indicates the following ranges of changes in *streamflows* for the 2025 period compared with historic 1950–2005 flows, depending on the particular climate scenario and hydraulic model chosen:

Colorado River:	+17% to –22%
South Platte:	+27% to –42%
Poudre:	+23% to –18%
Arkansas:	+16% to –15%

It is clear that the next two decades will see substantial changes in the allocation of water supplies among the sectors (especially transfers from agriculture) and that costs to the customer will increase substantially. Additionally, conservation will play an increasing role in reducing demands, and, consequently, increasing available supplies.

Figure 1

Projected 2050 Water Use by Sector



Source: Colorado Water Conservation Board.

Achievements in the Water Sector

In 2005, the Colorado Legislature passed the Colorado Water for the 21st Century Act (HB 05-1177) that provided for the establishment of basin roundtables and the Interbasin Compact Committee (IBCC) to better coordinate and facilitate negotiations regarding water among the eight major basins of the state (including a "metropolitan area roundtable" for the Denver Metro area). The intention was to stimulate cooperation rather than competition among the basins, especially East Slope versus West Slope. The basic idea for these new institutions was the brain child of Russell George, then head of the Colorado Department of Natural Resources. The roundtables were to "facilitate discussions within and between the basins on water management issues, and to encourage locally driven collaborative solutions to water supply challenges" (section 37-75-104).

In addition to the roundtables, the legislation created the IBCC, composed of representatives from each basin roundtable, at-large representatives appointed by the governor, and several members appointed by legislative committees. The roles of the IBCC include creating a positive environment for statewide negotiations, discussing the socioeconomic and environmental impacts of water development, and guiding the negotiation of interbasin compacts. These entities have been quite successful in creating dialog among the basins and in creating cooperative solutions to water issues.

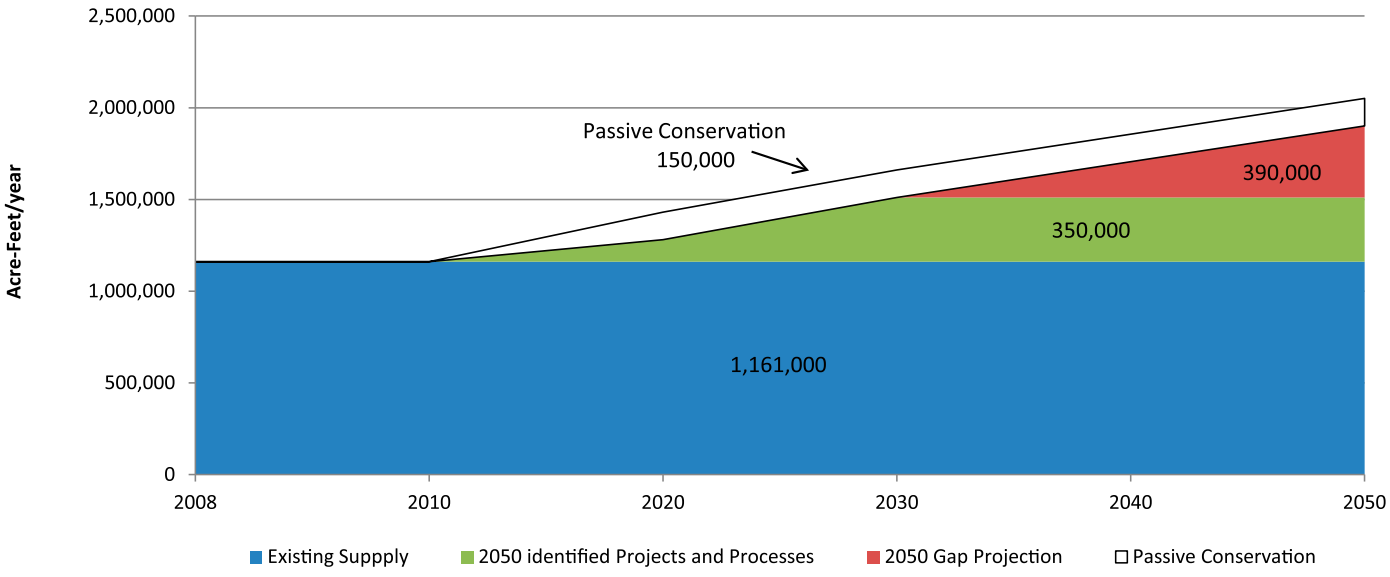
Following a different path for interbasin cooperation, 35 water providers, local governments, and the ski industry agreed to the path-breaking Colorado River Cooperative Agreement in April 2011, potentially changing the way water is managed in the state (Colorado River Cooperative Agreement 2011). "Focused on cooperation, the proposed agreement brings parties who traditionally have been at odds together as partners on a path to responsible water development benefitting both the East and West Slopes" (Denver Water 2011).

The agreement provides that any project proposed by entities in the Metro Region will be developed only in cooperation with those entities possibly impacted by the development. All parties have agreed to identify and address future environmental issues in the headwaters of the Colorado River and provide for protection of river flows and water quality along the entire reach of the main stem Colorado.

Denver has committed to continued conservation and reuse of its interbasin water and cooperation with utilities in Douglas and Arapahoe counties that will

Figure 2

2050 Municipal & Industrial Gap for Medium Scenario



Source: Colorado Water Conservation Board.

lessen their reliance on nonrenewable groundwater. The agreement provides funding for watershed, water treatment, and aquatic habitat improvements in the Colorado River Basin.

The CWCB's Instream Flow Program marks a major expansion of the "beneficial use doctrine" at the heart of western water law. Recognizing the need to preserve natural stream flows, to preserve riparian ecosystems, and to provide for water-based recreation, the CWCB and the legislature established the nonconsumptive use (or instream flow) program. Under this program, the CWCB can file for water rights to be dedicated to instream flow and lake level maintenance. Under the same legislation, any entity owning surface water rights can permanently or temporarily dedicate those rights to instream flow maintenance to be administered by CWCB. Focus areas for streamflow preservation have been identified on 33,000 miles of streams and lakes with active management programs on one-third of those miles. The focus area includes 12,000 stream miles of cold water fisheries and 11,000 with warm water fisheries, some involving endangered species protection.

Finally, Colorado has encouraged water markets as a voluntary but efficient mechanism for reallocating water as demands change. Water markets have the advantage of confronting the water user (farmer or town) with the real "opportunity cost" of using raw water (benefits foregone in other uses). While water markets operate in each major basin to some extent, the most efficient market in the state (and probably in the nation) is that developed by the Northern Colorado Water Conservancy District (NCWCD). The district administers the water from the Colorado-Big Thompson Project and has issued shares (allotments) that allow each owner to claim a proportional share in the water annually available to the district. These shares are easily tradable among beneficial uses (urban, industrial, or agricultural), subject only to the approval of the NCWCD Board. Colorado has the most active water market among western states, and the NCWCD market accounts for a large percentage of all Colorado transactions (Howe 1987, 2008).

Remaining Issues

While much has been accomplished in Colorado's water sector, numerous issues remain to be confronted. Only four will be noted here: (1) the impacts on rural communities of water transfers from irrigated agriculture to other uses, (2) problems and risks related to Colorado's use of Colorado River water, (3) risks from climate change, and (4) a reduction of the "transaction costs" that attach to water rights transfers among users.

Colorado water law has long recognized that water rights are personal property that can be bought and sold, subject to the principles of "beneficial use" and "no injury" to other water users. As a result, water rights have been traded among users for more than 100 years, generally to the benefit of all parties. As population and technologies have changed, the demands for and values of water in different uses have changed. Water markets are a mechanism for allowing mutually beneficial water transfers to take place in response to these changes.

Transfers out of agriculture need not injure agriculture and the local economy. If a farmer installs more efficient irrigation technology, it may be to his/her advantage to sell the water that has been saved without reducing crop production. If the ag-urban transfer is the result of changing land use as towns expand, the transfer of water supports continued economic growth.

However, if the water transfer takes water out of the major basin (and thus out of the regional economy), it can leave the local economy depressed in the absence of opportunities for reinvesting the water sale proceeds. The impacts on the regional economy are also severe if the transfer is very large. A major example has been the sale of 100,000 acre-feet out of the Colorado Canal in Crowley County that left the local economy totally depressed. Under these conditions, assistance to the basin-of-origin during the period of adaptation may be warranted.

Risks related to further use of Colorado River water constitute an important issue. In brief, these risks are related to (1) environmental impacts to the Colorado River Delta in Mexico and (2) legal risks related to Upper

CONTINUED ON BACK PAGE

COLORADO BUSINESS REVIEW

Leeds School of Business
UNIVERSITY OF COLORADO BOULDER

BUSINESS RESEARCH DIVISION

The *CBR* is a quarterly publication of the Business Research Division at CU-Boulder. Opinions and conclusions expressed in the *CBR* are those of the authors and are not endorsed by the BRD, the Leeds School of Business faculty, or the officials of CU.

View our website: http://leeds.colorado.edu/brd/

Richard L. Wobbekind, editor; Cindy DiPersio, assistant editor; Brian Lewandowski, technical advisor; Lynn Reed, design.

This report is not produced at taxpayer expense. The University of Colorado Boulder is an equal opportunity/affirmative action institution.

For information/address change:

Business Research Division
420 UCB, University of Colorado Boulder
Boulder, CO 80309-0420 • 303-492-8227

HEALTHY RIVERS,

CONTINUED FROM PAGE 2

resources to be mined and used, but as living assets that support billions of dollars in recreation and sustain the outstanding quality of life that draws business to Colorado.

Our economy has made the transition—now it's time for our water policy to join the twenty-first century.

David Nickum is Executive Director of Colorado Trout Unlimited, whose mission is to protect, conserve, and restore Colorado's coldwater fisheries and watersheds. Trout Unlimited has 10,000 members in Colorado. He may be contacted at dnickum@tu.org.

References

Colorado Division of Wildlife. http://wildlife.state.co.us/SiteCollectionDocuments/DOW/AboutDow/08DOWEconomicImpactReport.pdf.

Colorado River Outfitters. http://www.croa.org/media/documents/pdf/2011-commercial-rafting-use-report-final.pdf.

Outdoor Industry Foundation. http://www.outdoorindustry.org/pdf/ColoradoRecEconomy.pdf.

ACHIEVEMENTS AND ISSUES,

CONTINUED FROM PAGE 9

Basin obligations under the Colorado River Compact of 1922. As noted in several major articles in Colorado newspapers, the delta of the Colorado River in Mexico has been dried up through consumptive use by the seven U.S. basin states. The delta was once a prime habitat of flora and fauna but has suffered as river flows across the border have diminished. If further out-of-basin diversions occur, it will be increasingly difficult for the United States to meet its (1944) obligation to deliver 1.5 million acre-feet annually to Mexico.

The second risk from further diversions from the Upper Colorado is that the Upper Basin states (Colorado, Wyoming, New Mexico, and Utah) may find it increasingly difficult to meet their obligation under the 1922 Colorado River Compact to deliver 75 million acre-feet (on a 10-year running average) to the Lower Basin states (Arizona and California). Should a shortage occur that could not be met from storage in Lakes Powell and Mead, the Lower Basin could "put a call" on the Upper Basin under which all water rights in the upper Colorado Basin that have been issued since the 1922 compact would be precluded from diverting water until the compact obligation was again met. While there are Western Slope rights that predate the 1922 Compact, they constitute a small part of total annual diversions in the Upper Basin.

The Bureau of Reclamation and the states have been working on further agreements to avoid such a situation, but projects like the proposed pipeline from Flaming Gorge would increase the risk of such a call.

Finally, *climate change* is likely to increase the variability of rain and snow in Colorado. This would increase the need to be able to make water transfers quickly and efficiently even more important than it is currently. Increasing this capability requires that the "transaction costs" connected to both temporary and permanent water transfers be substantially reduced. Since most transfers require some degree of water court review, the weight of such reductions rests on the water court review process, making it quicker and less costly to transacting parties.

Conclusions

While problems remain in the Colorado water sector, real improvements and innovations have been made. This history bodes well for the future. The municipal supply-demand gap will be met, largely through agricultural transfers and conservation. Increases in irrigation efficiency and crop selection will mitigate the negative impacts on agriculture and rural communities. Public education will continue to reinforce conservation in urban and industrial water use. And, like it or not, the prices that all water users will have to pay for water service will continue to increase to cover the increasing costs of supply alternatives and to temper our water demands.

Charles W. Howe is Professor Emeritus in the Department of Economics at the University of Colorado Boulder. He may be contacted at charles.howe@colorado.edu.

References

Colorado River Cooperative Agreement. 2011. http://www.crwcd.org/media/uploads/20110428_CRAC_mediation_agreement.pdf.

Colorado Water Conservation Board. February 2012. "Colorado's Water Supply Future," http://cwcb.state.co.us/about-us/about-the-ibcc-brts/Documents/RoundtableSummit2012/Cost%20Fact%20Sheet.pdf).

Denver Water. April 28, 2011. "Historic Proposed Agreement Heralds a New Path for Colorado Water." http://www.denverwater.org/AboutUs/PressRoom/9CFFD175-B3CF-924E-CB428E261C057122/.

Howe, Charles W. 1987. "Project Benefits and Costs from National and Regional Viewpoints: Methodological Issues and Case Study of the Colorado-Big Thompson Project." *Natural Resources Journal*, Vol. 27, Issue 1, Winter, pp. 5-20, http://lawlibrary.unm.edu/nrj/27/1/03_howe_project.pdf).

_____. 2008. "Water Law and Economics: An Assessment of River Calls and the South Platte Well Shut-Down." *University of Denver Water Law Review*, Vol. 12, Issue 1, Fall.

Kenney, Douglas. June 2011. *Relative Costs of New Water Supply Options for Front Range Cities: Phase 2 Report*. http://www.rlch.org/archive/wp-content/uploads/2011/09/Kenney-et-al-Phase-2-Relative-Costs-of-Water.pdf

Rocky Mountain Climate Organization. March 2012. *Joint Front Range Climate Change Vulnerability Study*. http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=157704&searchid=4575fc8b-6a7b-4a33-bbf8-35266b2c6742&dbid=0.