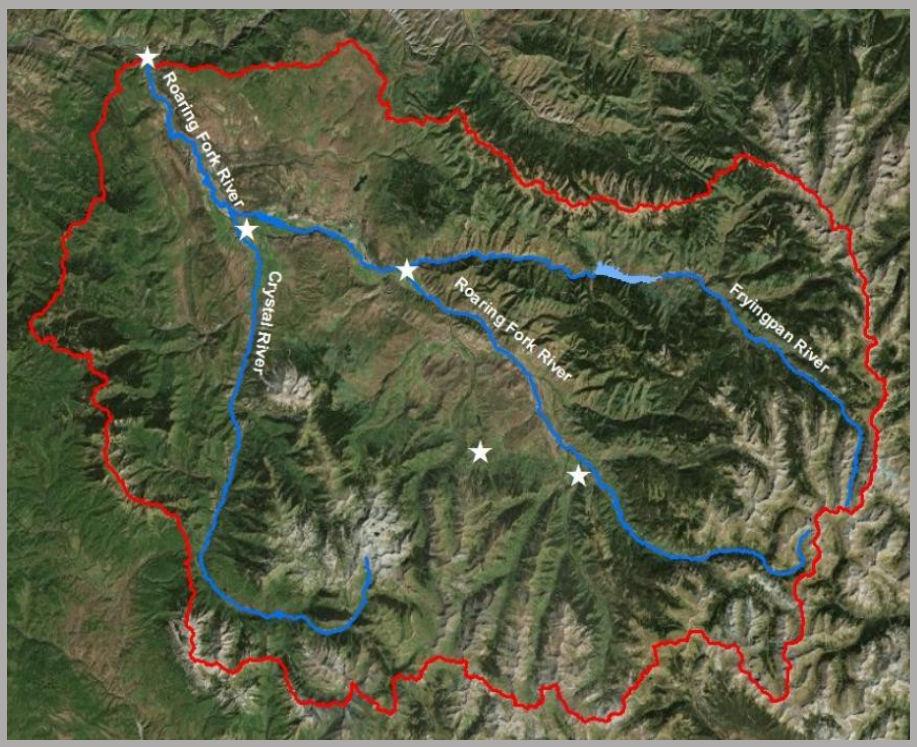

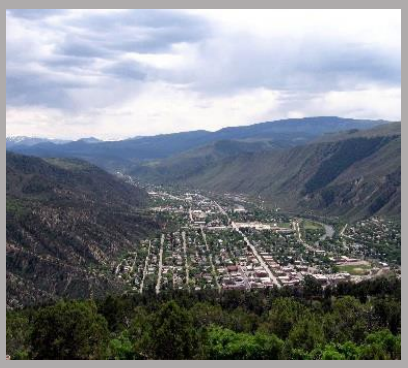

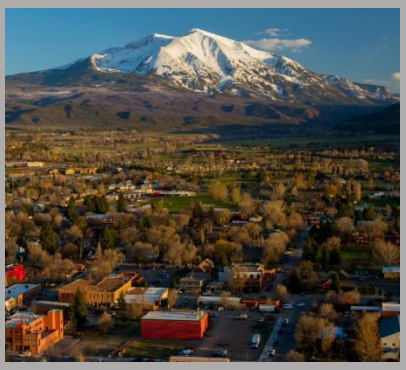

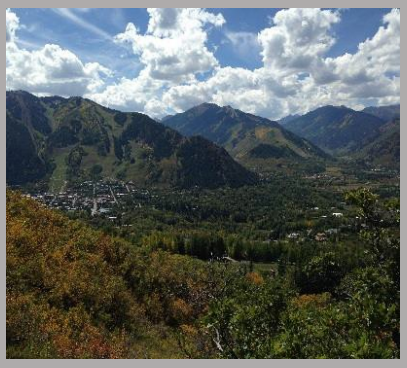

Regional Water Efficiency Plan

Roaring Fork Watershed, Colorado

ELEMENT Water Consulting & WaterDM

August 12, 2015

REGIONAL WATER EFFICIENCY PLAN

Roaring Fork Watershed, Colorado

RUEDI WATER & POWER AUTHORITY

PREPARED BY

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August 12, 2015

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ATTACHMENTS

Memorandum of Understanding Concerning the Preparation of a Roaring Fork Watershed Regional Water Conservation Plan.

Public Notice for Regional Water Efficiency Plan Public Review and Comment.

LIST OF ABBREVIATIONS

AF	acre-feet
AF/yr	acre-feet per year
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
C2E	Conserve to Enhance
CBRT	Colorado Basin Roundtable
CORE	Community Office for Resource Efficiency
CWCB	Colorado Water Conservation Board
CWW	Colorado WaterWise
BIP	Basin Implementation Plan
F	Fahrenheit
HOA	Homeowner Association
MOU	Memorandum of Understanding
RFC	Roaring Fork Conservancy
RWAPA	Ruedi Water and Power Authority

ACKNOWLEDGEMENTS

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- City of Aspen;
- Town of Basalt;
- Town of Carbondale;
- City of Glenwood Springs;
- Snowmass Water and Sanitation District;
- Colorado Water Conservation Board;
- Ruedi Water & Power Authority;
- Roaring Fork Conservancy;
- Community Office for Resource Efficiency;
- Colorado River District.

This Regional Water Efficiency Plan is the first of its kind in the State of Colorado. Staff from each of the participating municipalities provided access to detailed datasets and system information that facilitated the preparation of their individual Water Efficiency Plans. In addition to the municipal providers, representatives from local stakeholder groups were instrumental in identifying and selecting potential water efficiency measures to be implemented on a regional scale. The consultant team would like to thank the following individuals and organizations for their time and input on this document:

- Mark Fuller, Ruedi Water and Power Authority
- Rick Lafaro, Roaring Fork Conservancy
- Sharon Clarke, formerly with Roaring Fork Conservancy
- Jason Haber, Community Office for Resource Efficiency
- Kevin Reidy, Colorado Water Conservation Board
- Ben Wade, Colorado Water Conservation Board
- Lee Ledesma, City of Aspen
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- William Dolan, City of Aspen
- Jeff Rice, City of Aspen
- Kit Hamby, Snowmass Water & Sanitation District
- Boyd Bierbaum, Town of Basalt
- Robi Darcy, Town of Basalt
- Mark O'Meara, Town of Carbondale
- Jerry Wade, City of Glenwood Springs
- Buddy Burns, City of Glenwood Springs

- Robin Millyard, City of Glenwood Springs
- Stephen Bershenyi, City of Glenwood Springs Council & Ruedi Water and Power Authority
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- Ray Merry, Eagle County
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- Cynthia Covell, Alperstein & Covell, P.C.
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- Charlotte Jameson, University of Michigan
- Emma Maack, University of Michigan
- Liz Och, University of Michigan
- Kara Steeland, University of Michigan
- Dr. Julia Wondolleck, University of Michigan
- Roaring Fork Conservancy
- Ruedi Water and Power Authority

The project team wishes to sincerely thank all of those who were involved in conceptualizing this Regional Plan, particularly Mark Fuller who has managed the project along with Jason Haber, who was instrumental in securing the grant funding from the CWCB.

EXECUTIVE SUMMARY

PURPOSE

The Roaring Fork Valley is a scenic and historic part of Colorado that includes 14,000 foot peaks, snow-fed rivers, cities, towns, farms, ranches, homes, businesses, ski areas, and much more. Water is the lifeblood of the Roaring Fork Valley. Recognizing the connection between water conservation, water supply planning, and a broad interest in the Roaring Fork watershed, the water utilities of City of Aspen, Snowmass Water and Sanitation District, Town of Basalt, Town of Carbondale, and City of Glenwood Springs have all completed or updated their municipal Water Efficiency Plans in 2014 and 2015. These plans evaluated the projected water demands for each individual municipal supply system under passive and active water efficiency programs, and compared projected demands to their individual water supplies. Each water provider has selected appropriate efficiency measures to reduce water use and meet their water demand and supply objectives. The intent of this Roaring Fork Watershed Regional Water Efficiency Plan ("Regional Water Efficiency Plan" or "Regional Plan") is to build upon the individual municipal plans by unifying efforts and identifying programs that benefit from consistency and sharing of resources.

All communities and stakeholders in the Roaring Fork Valley (not just those that helped create this plan) are invited and encouraged to participate in the regional water efficiency effort.

The goals of this Regional Water Efficiency Plan for the Roaring Fork Watershed are to implement municipal water efficiency programs on a regional scale and to achieve higher and more effective benefits, compared to implementing the same programs individually.

The goals were first agreed to in the Memorandum of Understanding (MOU) that joined the participants together to seek funding from the Colorado Water Conservation Board (Appendix A). The MOU states that the cosignatories:

- "Recognize their individual interests in water conservation planning have regional significance within the Roaring Fork watershed."
- "May be able to implement elements of their individual water conservation plans more easily and more successfully if they are common components of a Roaring Fork Watershed Regional Water Conservation Plan."
- "Understand there are community and regional benefits from implementing a Roaring Fork Watershed Regional Water Conservation Plan, such additional water for drought protection, recreational uses and environmental uses."

The MOU outlined fundamental areas of agreement and basic principles that formed the underlying foundation of this Regional Water Efficiency Plan for the Roaring Fork Watershed.

This planning effort was funded in part by a Water Efficiency Planning Grant from the Colorado Water Conservation Board (CWCB), requiring that the grant money be used for municipal water efficiency planning purposes. ELEMENT Water Consulting and WaterDM were selected through an RFP process to prepare this Regional Water Efficiency Plan and the individual plans for City of Aspen, Town of Basalt, Town of Carbondale, and City of Glenwood Springs. SGM prepared the individual plan for Snowmass Water and Sanitation District.

Implementing municipal efficiency on a regional scale is just one of many important steps toward the region's broader watershed health goals, which necessitates engaging other stakeholders and water users. While the scope of this plan was limited to municipal water efficiency measures, other uses also impact the watershed; municipal efficiency cannot be the only approach to maintaining and improving the Roaring Fork Watershed. The activities identified in this plan are not intended to undermine or override Colorado's water rights system, and the hope is that this is the start of a broader conversation and a template that can include other stakeholders and sectors to extend the savings beyond the five municipal providers who were directly involved in creating this Regional Plan.

This Regional Plan provides a template that can include other stakeholders and sectors to expand and extend the savings beyond the five municipal water providers who were directly involved in creating this plan.

All water districts and water users in the Roaring Fork Valley are invited and encouraged to join the regional water efficiency effort, to adopt these basic principles of cooperation, and to help implement the recommended regional water efficiency activities described below.

RECOMMENDED REGIONAL WATER EFFICIENCY ACTIVITIES

The Roaring Fork communities share common interests, and there is consistency and overlap in the water efficiency-related efforts of the five municipal water providers participating in this regional planning effort. Connected through the Roaring Fork, Fryingpan and Crystal Rivers, and their tributaries, there is opportunity for municipal providers to work collectively with each other and with other stakeholders to improve the effectiveness of demand management and water efficiency for the benefit of the entire watershed. Certain programs benefit from being unified and having consistency (e.g. educational campaigns) and in sharing resources (e.g. developing model landscape/water budget information). The Regional Water Efficiency Plan provides this opportunity and unifies these efforts.

Four broad regional water efficiency programs were identified as part of this Regional Water Efficiency Plan, as summarized below. The regional efficiency programs were selected based on the individual municipal water efficiency plans as well as other local and national water efficiency-related efforts. The specific programs are intended to provide a menu of alternatives and it is understood that *every* program will not be appropriate for every participant, nor will

every participant be capable of participating in all of the programs. In some cases, it will be beneficial to conduct additional feasibility or pilot programs prior to full implementation.

1. **Water Loss Control Technical Assistance** – System auditing, loss tracking, infrastructure maintenance, leak detection and leak repair for water utilities can be improved by the consistent application of best practices. A coordinated effort to provide technical assistance for completing initial water audits and to establish a regular annual audit program for individual water providers is recommended. Information exchange across providers should be encouraged.
2. **Regional Water Efficiency Education and Information Campaign** – Engaging water users and stakeholders can be particularly effective when implemented on a regional scale. Potential initiatives include: (a) coordinated public outreach and education campaigns; and (b) a water efficiency challenge for businesses and homeowner associations (HOAs).
3. **Reduce Outdoor Water Use** – Reducing outdoor water use in the Roaring Fork region is a common goal amongst all of the plan participants. Potential initiatives that could benefit from regional coordination include: (a) a regional model landscape ordinance for new landscapes to be built smart from the start; (b) a landscape design and management certification program targeted at HOA's, property managers and landscaping professionals; and (c) an effort to install rain shut-off devices on irrigation systems across the region.
4. **Improve Water Resource Management** – Water utilities, other rights holders, and water users in the Roaring Fork Watershed can help create long-lasting benefits to streamflow conditions through efficiency and improved water resource management. Exploration of four program measures is recommended in this area: (a) linking water savings to environmental benefits (i.e. improved streamflows during low-flow events); (b) mechanisms to protect water rights and enhance instream flows; (c) improved water accounting for raw water systems; and (d) climate resiliency measures and additional research on climate change impacts on water supplies in the region.

IMPLEMENTING THE REGIONAL WATER EFFICIENCY PLAN

The water efficiency activities identified in this Regional Water Efficiency Plan provide the basis for implementing water efficiency in a regionally-coordinated manner. Executing the plan will require ongoing efforts and adaptive strategies to allow the plan to generate visible benefits, grow, and change. The following actions are recommended as next steps:

1. **Establish a Regional Plan Implementation Workgroup** with representatives of each major stakeholder group to meet regularly to report on and assist with regional plan implementation. Provide updates at other forum meetings and/or host regular open forms. Include annual reporting around the plan for all participants including:
    - Annual program implementation,

- Program impact estimates including program costs/avoided costs and water savings,
- Lessons learned,
- Public feedback on program,
- Periodic weather data and local trends,
- Water supply concerns,
- Recommendations for studies or pilot programs,
- Recommended plan modifications, and
- Establish ongoing implementation plan.

2. **Develop a funding plan for the Regional Plan implementation**. Identify potential annual and one-time funding sources (e.g. contributions from individual providers, CWCB implementation grants, Colorado Basin Roundtable (CBRT) funding, U.S. Bureau of Reclamation, Natural Resource Conservation Service, and other sources), establish funding commitments, and submit grant applications.

3. **Assign a Regional Plan Coordinator and divide responsibility** for implementing the plan across multiple individuals and organizations. To successfully implement this plan, committed people must step forward and work together. Identifying a plan coordinator and "plan champions" across jurisdictions and stakeholder groups is a critical step in the process. Potential lead organizations include: RWAPA, CORE, or the Roaring Fork Conservancy.

4. **Create a MOU for implementation** that details shared objectives, roles, and responsibilities. An MOU was beneficial in defining goals, expectations, and roles of individual water providers in forming the partnership to create this Regional Water Efficiency Plan. A similar type of agreement would be useful for establishing the roles and responsibilities of participants in the implementation phase.

5. **Dedicate resources and pursue implementation of the plan**.

1. INTRODUCTION

1.1 PURPOSE OF THE REGIONAL WATER EFFICIENCY PLAN

Water is a precious natural resource in the Roaring Fork Watershed, and is critical to the maintenance of a healthy environment and the lifestyle enjoyed by its residents and visitors. The Roaring Fork Watershed is home to a large residential population including the municipalities of Aspen, Snowmass, Basalt, Carbondale, and Glenwood Springs. As with many mountainous areas in Colorado, the history of the Roaring Fork Watershed is rooted in mining and agricultural industries. Over time, recreation and tourism industries have flourished, which has led to an increase in population. All of these uses have contributed to changes in the timing and characteristics of water use. The Roaring Fork Watershed is also subject to transbasin diversions to the eastern slope of Colorado; the Fryingpan-Arkansas Project, the Independence Pass Transmountain Diversion System, and the Busk Ivanhoe Project divert from the headwaters of the Fryingpan and Roaring Fork Rivers. Not surprisingly, given the competing uses for the limited resource, the topics of water quantity, water quality, and instream flows are of tremendous interest from both a human and environmental perspective.

The Roaring Fork Watershed Plan was completed in 2012 and it, along with associated planning efforts, identified municipal water efficiency[1] as an important component of the long-term plan to improve watershed health. Recognizing the connection between water conservation, water supply planning, and a broad interest in the Roaring Fork watershed, the water utilities of City of Aspen, Snowmass Water and Sanitation District, Town of Basalt, Town of Carbondale, and City of Glenwood Springs have all completed or updated their municipal Water Efficiency Plans in 2014 and 2015 as an element of this project. Prior to this project, the City of Aspen and the City of Glenwood Springs were the only participants with efficiency plans on file with the CWCB. These plans evaluated the projected water demands for each individual municipal supply system under passive and active water efficiency programs, and compared projected demands to their individual water supplies. Each water provider has selected appropriate efficiency measures to reduce water use and meet their water demand and supply objectives. The intent of the Roaring Fork Watershed Regional Water Efficiency Plan is to build upon the individual municipal plans by unifying efforts and identifying programs that benefit from consistency and sharing of resources.

The goals of this Regional Water Efficiency Plan for the Roaring Fork Watershed are to implement municipal water efficiency programs on a regional scale and to achieve higher and more effective benefits, compared to implementing the same programs individually.

[1] The terms water efficiency and water conservation are used interchangeably throughout this document.

The goals were first agreed to in the Memorandum of Understanding that joined the participants together to seek funding from the Colorado Water Conservation Board (MOU, 2013). A copy of the MOU (attached) states that the cosignatories:

- "Recognize their individual interests in water conservation planning have regional significance within the Roaring Fork watershed."
- "May be able to implement elements of their individual water conservation plans more easily and more successfully if they are common components of a Roaring Fork Watershed Regional Water Conservation Plan."
- "Understand there are community and regional benefits from implementing a Roaring Fork Watershed Regional Water Conservation Plan, such additional water for drought protection, recreational uses and environmental uses."

The MOU outlines fundamental areas of agreement that form the underlying foundation of this Regional Water Efficiency Plan for the Roaring Fork Watershed.

This planning effort was funded in part by a Water Efficiency Planning Grant from the Colorado Water Conservation Board (CWCB) and in part by the five participating municipal water providers. In addition, the water providers contributed significant in-kind services in the form of staff time. The focus of the CWCB grant request and the water providers' contributions was municipal planning. The consulting team of ELEMENT Water Consulting and WaterDM were selected to prepare this Regional Water Efficiency Plan and the individual plans for City of Aspen, Town of Basalt, Town of Carbondale, and City of Glenwood Springs through an RFP and interview process. SGM prepared the individual plan for Snowmass Water and Sanitation District. The location of the water providers participating in the regional planning process is shown in **Figure 1,** below.

The scope of the CWCB planning grant limited this Regional Plan to analysis and recommendations of municipal water efficiency measures by the five utility participants. It is well understood that other demands for water such as agriculture also impact the valley and municipal efficiency cannot be the only approach to maintaining and improving the Roaring Fork Watershed. It is also understood that non-municipal water providers, including water and sanitation districts and ditch companies, have a significant role in local water management and that bringing those providers into water efficiency planning will be critical to the success of this plan. Implementing municipal efficiency on a regional level is just one of many important steps toward the broader watershed health goals. Engaging other stakeholders and water users and addressing other elements of water conservation will be essential steps in reaching these goals.

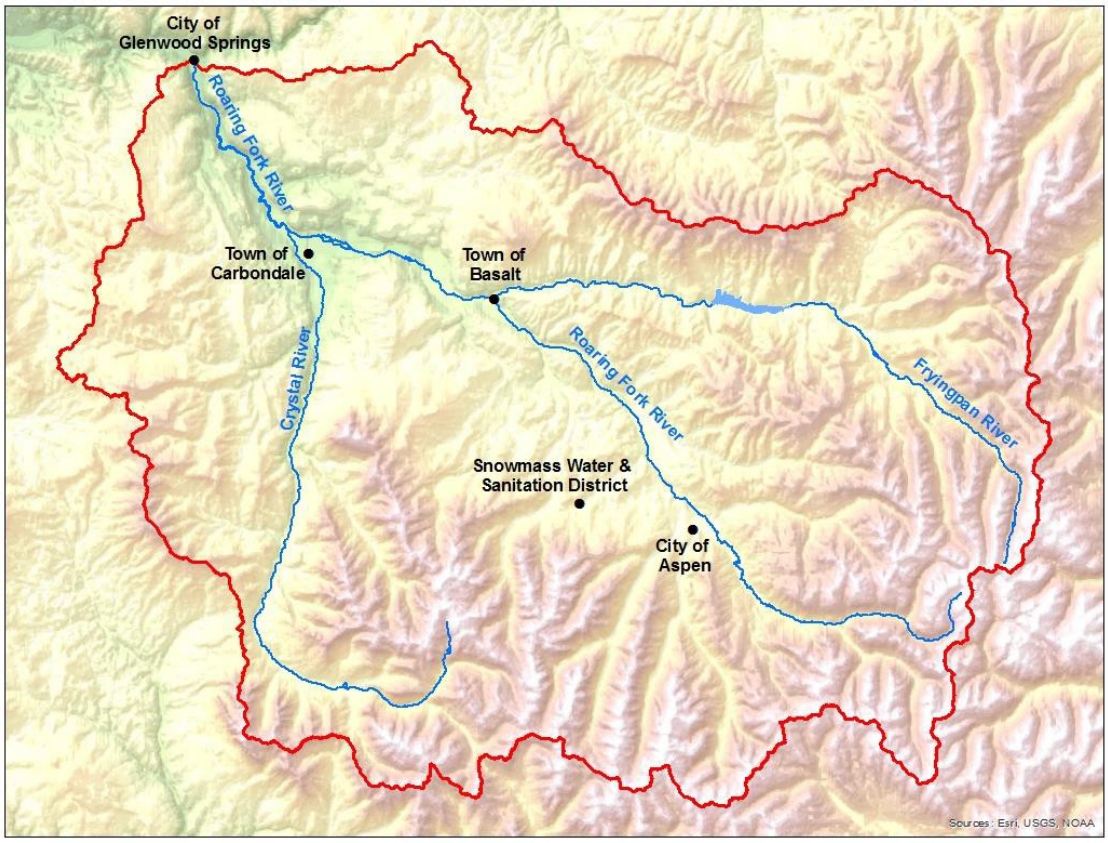


Figure 1. Water Providers Participating in the Roaring Fork Watershed Regional Water Efficiency Plan.

1.2 WATER AVAILABILITY ISSUES

The Roaring Fork River Watershed is located within the Colorado River Basin in central Colorado on the west side of the Continental Divide. The watershed has a drainage area of approximately 1,453 square miles and extends from the river's headwaters near Independence Pass to its confluence with the Colorado River in the City of Glenwood Springs approximately 70 miles downstream. Snowmelt from the mountainous headwaters contributes to the streamflow in three primary rivers (Roaring Fork, Fryingpan, and Crystal) that eventually contribute to the flow in the Colorado River. The Roaring Fork River main-stem flows through the City of Aspen and joins the Fryingpan River in the Town of Basalt, and the Crystal River joins just downstream of the Town of Carbondale.

The natural hydrology of the watershed is driven by snowmelt from the mountainous headwaters; however, streamflows are affected by water diversions for direct flow and storage purposes. Water diversions include transbasin appropriations that are 100% depletive to the Roaring Fork Watershed as well as local diversions with variable degrees of consumptive use. As with other high mountainous regions in the semi-arid southwestern United States, the Roaring Fork Watershed experiences a wide range of climatic conditions from year to year as

well as from season to season. The Roaring Fork Watershed is “over-appropriated”, which means that at some or all times of the year, there is insufficient water to meet all demands. Under these circumstances, diversions are curtailed as needed under the prior appropriation system. Water is scarce in dry years, and competing water demands have the potential to adversely impact the natural environment by reducing flows in some natural waterways. Many providers use surface and groundwater storage to help regulate supplies to meet demands in dry years and through drought periods. The municipal water providers in the Roaring Fork Valley, with the exception of Snowmass Water and Sanitation District, have limited storage, making them more dependent on the seasonal snowmelt and runoff conditions and vulnerable to drought and water restrictions when snowpack is below normal.

Climatological records provide evidence of recurring major droughts in Colorado of various length and intensities. Water suppliers in the western United States accommodate this uncertainty through reservoir storage, consideration of "firm yields" in estimates of water availability, raw water supply development, and "demand side" strategies such as voluntary or mandatory restrictions on outdoor water usage. Climate studies indicate a shift toward earlier runoff and less water available in the late irrigation season, which could create shortages relative to historical conditions, particularly in situations where storage capacity is limited. Water supply systems in the Roaring Fork Watershed are also at risk from forest fire, floods, failure of infrastructure, and contamination of the raw water supply. In order to respond to emergency or drought situations, contingency plans are typically designed for implementation of mandatory conservation measures in stages that minimize impacts to the economy, life-styles, and environment of the community. Plans to reduce usage are necessary so that supply will be sufficient to meet demands during periods of drought.

Since 1973, the Colorado Water Conservation Board (CWCB) has been responsible for the appropriation, acquisition, protection and monitoring of instream flow (ISF) and natural lake level water rights to preserve and improve the natural environment to a reasonable degree. The CWCB holds a collection of ISF water rights in the Roaring Fork Watershed, many of which date back to the initiation of CWCB’s authority in 1973. Some of the ISF rights are typically unmet in dry years due to their relatively junior dates of appropriation as compared to other transbasin and local diversions. Future development activities and the effects of climate change have the potential to increase the frequency with which local waterways will fail to meet recommended ISF levels. The Roaring Fork Watershed Plan (RWAPA, 2012) listed the following issues facing the Roaring Fork Watershed:

- The state’s population of 5 million is expected to increase to almost 8 million by 2030. Eighty percent of the state’s population lives in the half of the state that receives about 20 percent of the precipitation. Recent studies identify a need for another 600,000 to 1,000,000 acre-feet of raw water by 2030 to serve increased population and related development. Those figures do not include water needs that might be generated by the effects of climate change, environmental and recreational uses, and energy development. By 2050, climate change could cause Colorado River flows to decline by

18 percent. Average Colorado Basin water storage could decline by 32 percent. Energy development could consume up to 200,000 acre-feet of water.

- On average, 37 percent of the Upper Roaring Fork Watershed (40,600 acre-feet) and 41 percent of the Upper Fryingpan Watershed (61,500 acre-feet) is already diverted annually to the Front Range. These are the 5th and 3rd largest transbasin diversions in the state, respectively.
- Almost 140 of 185 miles of streams surveyed in the Roaring Fork Watershed have moderately modified to severely degraded riparian habitat. In Colorado, riparian habitat represents less than three percent of the landmass but has the highest species richness with 75 to 80 percent of wildlife species using riparian habitat during some part of their life cycles. Functioning riparian areas reduce the risk of flooding and increase stream base flows.

1.3 PREVIOUS AND RELATED WATER STUDIES

Local stakeholders have long recognized the potential for continued and increased adverse effects on the health of the Roaring Fork Watershed, and have proactively completed several studies to identify and address critical issues. The Roaring Fork Watershed Collaborative, which is an informal gathering of local officials, planners, resource managers, and interested citizens, began meeting in 2002 to discuss local water issues. This effort led to the formation of a special Water Committee in 2005, and this group starting formulating the outline for a comprehensive Watershed Plan to assess conditions and recommend actions to preserve water resources. In late 2006, the Ruedi Water and Power Authority (RWAPA), a consortium of local governments, became involved as the official sponsor of the Roaring Fork Watershed Plan. RWAPA engaged Roaring Fork Conservancy (RFC) as the lead consultant on the project and secured funding for the preparation of the *State of the Roaring Fork Watershed Report 2008* (RWAPA, 2008). The 2008 report was widely recognized as a comprehensive, accessible, and valuable compendium of watershed conditions, and it was later supplemented by two guidance documents:

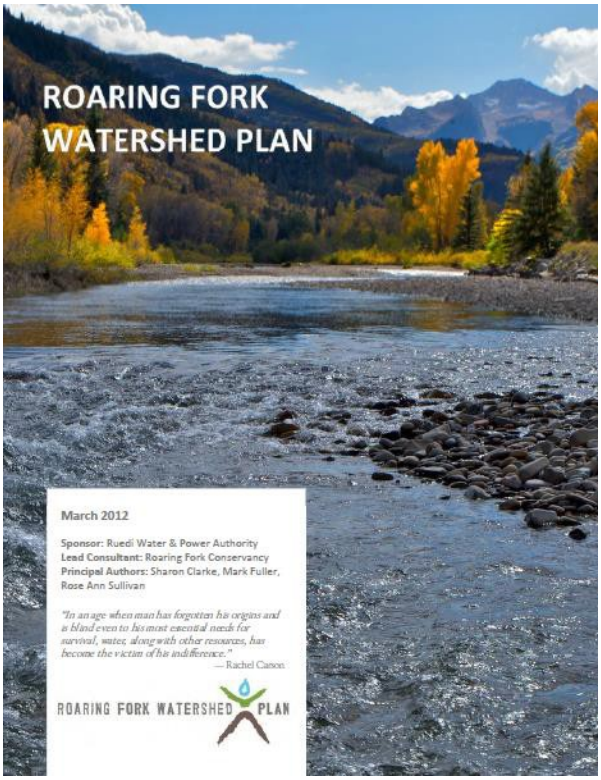
(i) *Why the Roaring Fork Watershed Plan Matters* (RWAPA & RFC, 2008), *and*
(ii) *Illuminating the Way Ahead* (RWAPA & RFC, 2010).

The findings of the *State of the Roaring Fork Watershed Report 2008* and the guidance documents became the basis for a series of meetings with the public and technical advisors aimed at translating the Phase I findings into a series of goals, objectives, and actionable recommendations which would make up Phase II of the Plan. Phase II, consisting of the Roaring Fork Watershed Plan was completed in Mach 2012, and in tandem with the *State of the Roaring Fork Watershed Report 2008* and the two guidance documents, represents the final product of the watershed planning process that began with the Watershed Collaborative discussions in the early 2000s.

An overview of some of these efforts is provided below, along with reference to important related studies.

1.3.1 2012 Roaring Fork Watershed Plan

The 2012 Roaring Fork Watershed Plan (RWAPA, 2012) included a list of "Recommended Actions" for implementation. Several of these were related to water conservation and efficiency, as summarized below.



- **Action SW B1f.** Investigate if water conservation translates to environmental benefits under Colorado water law. Pursue opportunities for water conservation, if appropriate.
    - The *Opportunities for Water Conservation – Realizing the Streamflow Benefits from Local Conservation Efforts* report was finalized by Elk Mountain Consulting LLC in April 2012 (RFC, 2012).

- **Action SW D1c.** Support projects such as the University of Michigan Master's Project, *Fostering Implementation of the Roaring Fork Watershed Plan* (UM, 2010). Utilize the University of Michigan Master's Project's recommendations for improving public education and outreach, as appropriate.
    - The *Informing the Development of a Regional Water Conservation Plan for the Roaring Fork Watershed* report was finalized by University of Michigan graduate students in April 2014 (UM, 2014).

- **Action SW D1g.** Increase awareness of water conservation techniques and the importance of conservation. Identify and implement the most strategic water conservation measures.
    - RWAPA, RFC, and AspenCORE were instrumental in obtaining the grant from CWCB and in collaborating with local municipal providers to update individual municipal water efficiency plans and to develop this Roaring Fork Watershed Regional Water Efficiency Plan.

1.3.2 Opportunities for Water Conservation Report (2012)

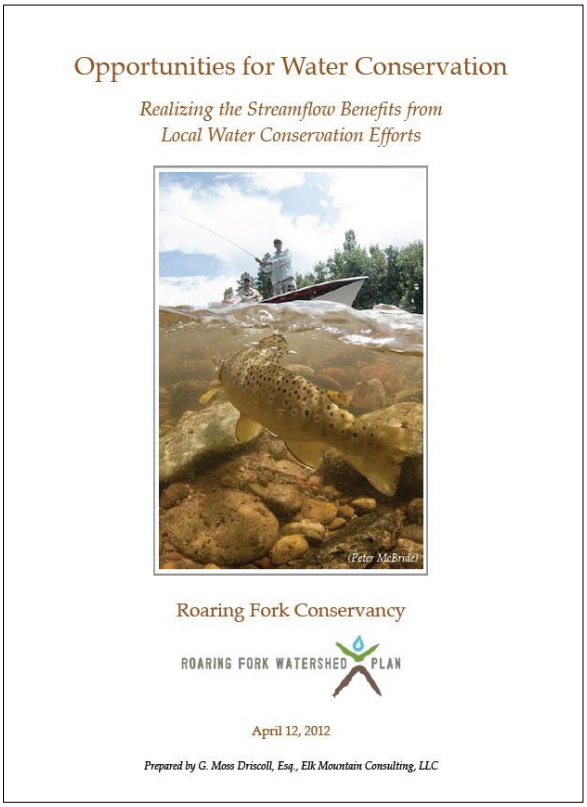
The April 2012 *Opportunities for Water Conservation* report by Elk Mountain Consulting (RFC, 2012) outlined several recommendations for using municipal and agricultural water conservation efforts to enhance streamflow conditions in the Roaring Fork Watershed, as

summarized below. One of the purposes of this Roaring Fork Watershed Regional Water Efficiency Plan is to advance the recommendations listed in the April 2012 report that pertained to municipal water conservation.

- **Recommendation No. 6.** Encourage and assist local municipal water providers to develop comprehensive water supply, drought mitigation, and water conservation plans.

- **Recommendation No. 8.** Develop a donation program for municipal providers in the watershed, and encourage the use of associated funds for local streamflow gaging and stream restoration and enhancement projects.

- **Recommendation No. 10.** Promote watershed-wide local water conservation efforts, and connect local programs to statewide water management planning efforts.



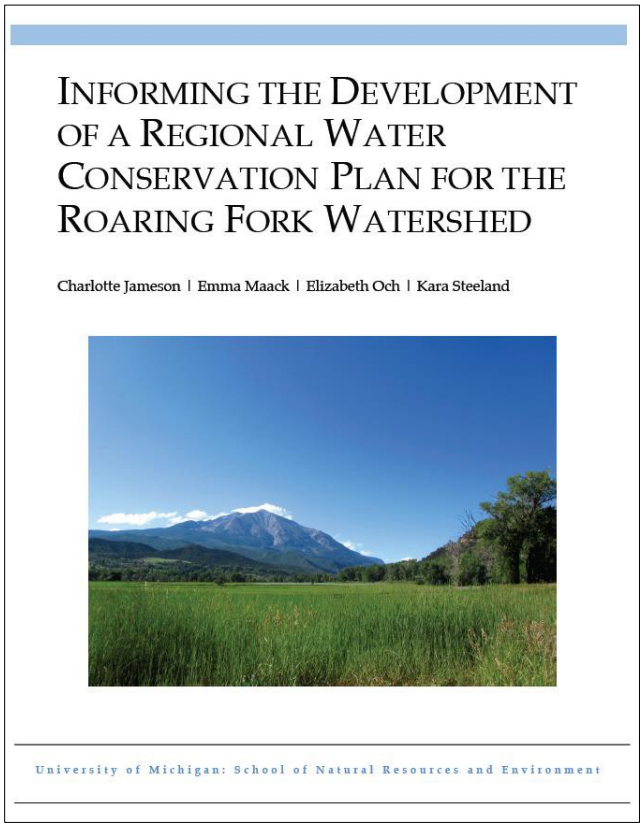
1.3.3 Informing the Development of a Regional Water Conservation Plan for the Roaring Fork Watershed (2014)

Recently, graduate students in the School of Natural Resources and Environment at the University of Michigan completed a comprehensive review of other regional water conservation planning processes to facilitate the development of this Roaring Fork Watershed Regional Water Efficiency Plan and associated public outreach and education campaign strategies (UM, 2014). The University of Michigan study identified nine key findings and recommendations for the Roaring Fork Watershed Regional Water Efficiency Plan:

1. Establish a transparent and open plan development structure that allows divergent stakeholders to actively participate.
2. Establish clear and equitable roles and responsibilities in a formal manner.
3. Build flexibility into the plan to accommodate differences in interests and needs.
4. Sustain regional collaboration by retaining a unifying mechanism or vision.
5. Maintain outreach to critical stakeholder groups and partner with them on plan development and/or implementation.
6. Dedicate staff time to coordinating and managing plan implementation.

7. Establish a dedicated funding source for plan development and long-term implementation.
8. Cultivate plan champions.
9. Incentivize implementation.

Through interviews with local water utility staff, the authors of the study identified that delivering consistent water conservation messaging and more effective education and outreach through collaboration with other utilities is a high priority. Utility personnel were specifically interested in focusing on outdoor water use and encouraging water-friendly landscaping materials and practices. The local utilities also recognized the opportunity to increase their leadership role, such as through improving ditch efficiency and management of non-potable systems.



This study also identified potential barriers toward getting residents to participate in regional municipal water conservation, and suggested the following topics need to be better understood and addressed through outreach and education:

- Social norms regarding water use (wanting green lawns regardless of monetary cost).
- Lack of homeowner control (property managers and landscaping businesses responsible for maintenance).
- Open ditch systems (unmetered or difficult to meter).
- Influencing tourists and second homeowners is difficult.
- Perceptions that water rights will be lost.
- Potential for downstream water rights to take any water left in the stream, thus cancelling out any streamflow benefits of conservation.
- Geomorphology makes it difficult to quantify the amount of water conserved and maintained instream.
- Conservation could reduce the income to water providers, thereby reducing the resources available to support recommended programs.
- Misconceptions about being a headwaters area and being 'water-rich' due to the Roaring Fork Valley's location.

1.3.4 Colorado Basin Implementation Plan

The Colorado Basin Roundtable, which represents a diverse group of Colorado River basin stakeholders, developed a Basin Implementation Plan (BIP) with the assistance of SGM, Inc. (CBRT, 2014). The BIP provides input for Colorado's Water Plan and includes common basin-wide themes for meeting future basin demands. Specifically relevant to municipal water conservation, the BIP includes recommendations to "develop local water conscious land use strategies" and "encourage a high level of basinwide conservation".

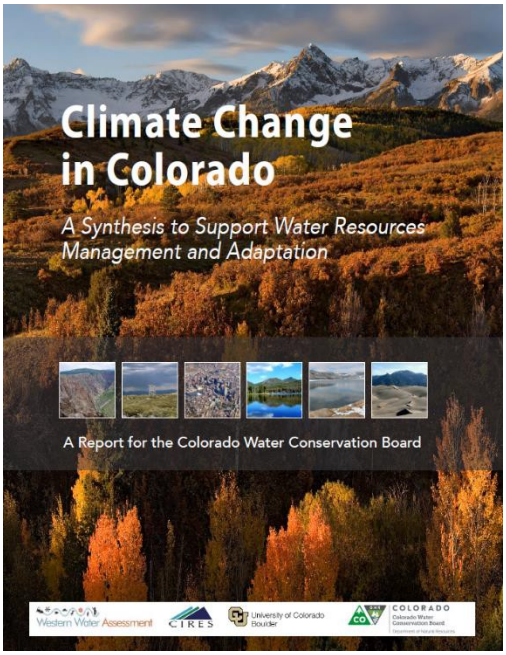
The BIP emphasizes the importance of repairing and restoring healthy rivers and streams and notes the need for a more systemic approach to projects and polices to restore and maintain healthy rivers. Examples of projects that have been identified toward that goal include: restoring sections of the Roaring Fork as it winds through the North Star nature preserve east of Aspen; the ongoing river restoration work in Basalt; and a restoration project on Cattle Creek, which flows into the Roaring Fork River between Carbondale and Glenwood Springs. Other environmental projects listed include whitewater parks in Basalt and Carbondale, which can support stream levels in the Roaring Fork River; the city of Aspen's project to reuse wastewater for irrigation and snowmaking; Pitkin County's effort to leave more water from its open space properties in the Roaring Fork; and efficiency efforts by local water utilities. Also mentioned are ongoing discussions with irrigators on the Crystal River to improve minimum flows in the Crystal below the diversion for the Sweet Jessup Ditch.

The Colorado River BIP includes potential projects, policies and processes for reducing municipal and industrial and nonconsumptive water supply gaps. The plan emphasizes the importance of water conservation and efficiency programs, opportunities for multipurpose projects, and the benefits of regional efforts between water providers, irrigators, conservation organizations and recreational enthusiast.

1.3.5 Climate Change Impact on Water Use

Traditional water planning is based on an assessment of demand and historical streamflow conditions, which likely will not capture the effects of a changing climate. A great deal of climate change analysis has been completed in recent years, including the "Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaption" report that was originally developed in 2008 and updated in 2014 (CWCB, 2014). These studies focused on

observed climate trends and the complex topics of climate modeling and projections of temperature, precipitation, snowmelt, and runoff. The 2014 climate change report concluded the following:



- Substantial future warming, with average temperatures increasing from 2.5°F to 5.5°F; summers warming slightly more than winters.
- Increased winter precipitation, although there is less agreement regarding precipitation trends.
- Decrease in April 1 snowpack, spring runoff shifting 1 to 3 weeks earlier by 2050, and decreases in late-summer flows.
- More frequent and severe heat waves, droughts, and wildfires.

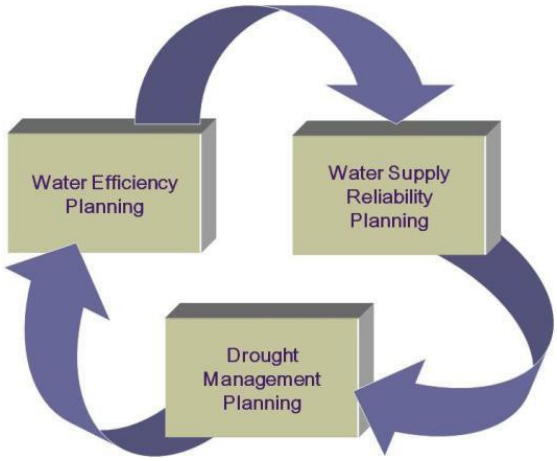
While climate change may increase the uncertainty in outdoor water demand projections, the net effect depends on numerous factors such as the amount and type of landscaping material, irrigation management practices, etc. Some of the impacts on water demands are included in the forecasts provided in the individual Water Efficiency Plans because recent water demand data, which reflect response to recent climate changes, are utilized to project future water demand patterns.

It is important to consider both demand-side, as well as supply-side, impacts of future climate change on overall water supply conditions. The forecast method provided in the individual plans, along with regular updates to the demand projections, will assist in this process.

2. INDIVIDUAL MUNICIPAL WATER EFFICIENCY PLANS

Water efficiency planning is a key component of an integrated water supply and resource management process. It helps improve the resiliency of the system and prepare for changes in both demands and supplies. Colorado Revised Statute § 37-60-126 requires a covered entity to develop, adopt, make publicly available, and implement a water conservation plan that will encourage its domestic, commercial, industrial, and public facility customers to use water more efficiently. According to the statute, a "covered entity" means a municipality, agency, utility, or other publicly owned entity with a legal obligation to supply, distribute, or otherwise provide water at retail to domestic, commercial, industrial, or public facility customers, and that has a total annual demand for such customers of two thousand acre-feet or more.

The City of Aspen and the City of Glenwood Springs are the only participants in this Regional Water Efficiency Plan that are currently required by statute to maintain CWCB-approved water efficiency plans; Snowmass is expected to bounce around the 2,000 acre-feet per year threshold for a number of years to come. In 1996, Aspen was one of the first cities in Colorado to develop and implement a water conservation plan. Glenwood Springs developed a CWCB-approved water conservation plan in 2009. In 2015, Aspen and Glenwood Springs updated their plans and the water utilities of Snowmass Water and Sanitation District, Town of Basalt, and Town of Carbondale also completed their municipal Water Efficiency Plans as part of the Regional Plan process in 2014 and 2015.



Under the individual planning process, distinct water demand forecasts were prepared to present a range of reasonable estimates of water demand into the future, given anticipated population growth, and to estimate the impact of the water conservation measures that occur both "passively" as a result of national and state plumbing codes and standards and "actively" as a result of specific programs and measures to be implemented by the water providers. These forecasts were also used for the important purpose of establishing the adequacy of local water supply systems to meet future demands. Each water provider has selected appropriate efficiency measures to reduce water use and meet their water demand and supply objectives. There is broad overlap in the water efficiency activities that the water providers have included within the individual Water Efficiency Plans. The intent of this Roaring Fork Watershed Regional Water Efficiency Plan is to build upon the individual municipal plans by unifying efforts and identifying programs that benefit from consistency and sharing of resources.

However, no two communities are exactly alike. Certain water efficiency programs such as tiered rate structures, specific incentive programs, and leak detection may be more effectively implemented at a local level due to differences in municipal codes, resources, and needs. Individual Municipal Water Efficiency Plans serve to address these programs and provide the flexibility needed to make implementation effective.

2.1 WATER EFFICIENCY PLAN SUMMARIES

Summary information from the individual water efficiency plans (in sequence from upstream to downstream) prepared and submitted to the CWCB are presented below. When summed together, the individual water efficiency plans have set goals to reduce water demands by over 2,000 acre-feet per year by 2030 to 2050.

2.1.1 City of Aspen

- **2014 Service area population –** 10,508 (permanent), 36,540 (peak summer month)
- **2013 Water produced –** 3,203 AF
- **Key issues impacting water demand –** The City of Aspen has been actively promoting water efficiency for more than 20 years and water demand has declined steadily over that time, even as the population has increased. The City approved its first water conservation plan in 1996 and has demonstrated a long-term commitment to wise water stewardship and responsible and efficient use of its water resources. Aspen has limited storage and the water supply is most vulnerable in the late summer, after the snowmelt runoff period when many tourists and second homeowners are in town and landscape irrigation demands are still high. Furthermore, the available water supply is limited by Aspen's commitment to actions to protect decreed instream flows.
- **Considerations impacting the Regional Water Efficiency Plan –** Aspen has sufficient water resources to meet future demand forecasts. Tourism and part-time residents impact Aspen's water demand during the critical summer months. The City's top water efficiency priorities are outdoor water use reductions.

2.1.2 Snowmass Water and Sanitation District

- **2014 Service area population –** 2,865 permanent, 13,400 (during peak ski season)
- **2012 Water produced –** 1,918 AF
- **Key issues impacting water demand –** The Snowmass Water and Sanitation District (SWSD) hopes to encourage and equip customers to incorporate efficient water use into their daily activities rather than relying entirely on mandates and regulation to enact change. Water use in the SWSD has declined over the past five years even as the population has increased.
- **Considerations impacting the Regional Water Efficiency Plan –** The SWSD possesses adequate water rights to meet current demands. Projections by the SWSD of available raw water supplies and water rights indicate that they will be able to legally and physically supply sufficient water to meet anticipated future build-out as well. Through water conservation, SWSD can reduce the amount of water diverted from the Snowmass Creek basin. High water demands during the late summer irrigation season and the winter ski season often coincide with low streamflow periods. The CWCB maintains a junior water right for minimum instream flow in Snowmass Creek. Although SWSD's water rights are senior to the CWCB's water right, the SWSD Board adopted maintenance of the Snowmass Creek instream flow as a stewardship goal for 2014. SWSD's water efficiency priorities include improved metering, conservation oriented rates, and water loss control.

2.1.3 Town of Basalt

- **2013 Service area population –** 2,198
- **2014 Water produced –** 586 AF
- **Key issues impacting water demand –** Basalt is expanding and anticipates a future growth rate of approximately 2 percent per year. Water demand has increased very

little in the past five years even as the Town's population has steadily increased. Reducing outdoor use and increasing irrigation efficiency, particularly for second homeowners, are goals for Basalt.

- **Considerations impacting the Regional Water Efficiency Plan –** Under current conditions, Basalt has sufficient water resources to meet future demand forecasts. The Town of Basalt owns and operates its own potable water system, which currently includes four water sources with a combined production capacity of just over 2 million gallons per day. The Town's potable water supply sources include diversions of groundwater under the direct influence of surface water from natural springs as well as groundwater diversions from alluvial wells. Basalt is the only participant in the regional planning effort that relies primarily on a groundwater supply. Basalt's water efficiency priorities include educating customers and landscape contractors about appropriate water use, installing rain shutoff devices, and reducing system water loss.

2.1.4 Town of Carbondale

- **2010 Service area population –** 6,427
- **2014 Water produced –** 1,208 AF
- **Key issues impacting water demand –** Carbondale continues to expand and is planning for the population to grow at a rate of approximately 2.5% per year. Water demand has increased at a slower rate than the population over the past five years. Reducing outdoor use and increasing irrigation efficiency are goals for Carbondale.
- **Considerations impacting the Regional Water Efficiency Plan –** Carbondale has sufficient water resources to meet future demand forecasts. It obtains its potable water supply from surface water sources in the Nettle Creek drainage, a tributary to the Crystal River, and from groundwater sources along the Crystal and Roaring Fork Rivers. The Town has a total of four wells, with three located in the Roaring Fork alluvial aquifer and one located in the Crystal River alluvial aquifer. The Town's top water efficiency priorities are educating customers about appropriate outdoor water use and reducing water loss.

2.1.5 City of Glenwood Springs

- **2013 Service area population –** 10,581
- **2013 Water produced –** 1,998 AF
- **Key issues impacting water demand –** Glenwood Springs is a growing city with diverse topography. It is a tourist destination on an interstate highway and major rail line. Due to effective water efficiency, over the past 10 years metered water demand has declined even as the population has increased.
- **Considerations impacting the Regional Water Efficiency Plan –** Glenwood Springs has sufficient water resources to meet future demand forecasts. The City is located at the foot of the Roaring Fork Valley and does not rely much on water from the Roaring Fork Valley. The City obtains its potable water supply from diversions on Grizzly and No Name Creeks, tributary streams located to the *north* of the Colorado River at the edge

of the Flat Tops Wilderness Area. The City also holds the rights to 500 acre-feet per year (AF/yr) of water in Ruedi Reservoir, which the City can divert as a backup supply. The City's top water efficiency priorities are educating customers about appropriate outdoor water use and reducing water loss.

A summary of the water efficiency activities included in all of the five individual plans is presented in Table 1.

Table 1. Water Efficiency Activities Included in the Individual Plans.

Water Efficiency Activities
FOUNDATIONAL ACTIVITIES
Automatic Meter Reading Installation and Operation
Enhanced Water Loss Control
Conservation-Oriented Rates
TARGETED TECHNICAL ASSISTANCE AND INCENTIVES, AND NATURAL REPLACEMENT OF FIXTURES AND APPLIANCES
Fixtures, Appliances, and Incentives
Outdoor Water Efficiency
Commercial, Institutional, and Industrial Water Efficiency
ORDINANCES AND REGULATIONS
Regulatory Measures
Water Reuse, Recycling, and Raw Water Use
Waste of Water Ordinance
Landscape development regulations for new construction
EDUCATIONAL ACTIVITIES
Public Information, Customer Outreach and Education

3. SELECTION OF REGIONAL WATER EFFICIENCY ACTIVITIES

The Roaring Fork communities share common interests. As shown in Table 1, there is consistency and overlap in the water efficiency-related efforts of the five individual water providers participating in this regional planning effort. There is opportunity for the municipal providers to work collectively with each other and with other stakeholders to improve the effectiveness of demand management and water efficiency for the benefit of the entire watershed. Certain programs benefit from being unified and having consistency (e.g. educational campaigns) and

The specific programs included in the Regional Plan are intended to provide a menu of alternatives. Every program will not be appropriate for every participant, nor will every participant be capable of participating in all of the programs.

in sharing resources (e.g. developing a local model landscape/water budget information). The Regional Plan provides this opportunity and unifies the efforts.

In selecting the regional efficiency programs described below, the individual municipal water efficiency plans were considered along with other sources of information including the *Guidebook of Best Practices Guidebook for Municipal Water Conservation in Colorado* (CWW, 2010), the University of Michigan study referenced above including other regional plans cited in that report, the Alliance for Water Efficiency's 2011 report – *Water Efficiency for Instream Flow: Making the Link In Practice* (AWE, 2011), and other local and national water efficiency related efforts. In addition, discussions with local providers and interested parties augmented and refined the Regional Plan's recommendations. Regional efforts that compliment and expand upon components within the new municipal water efficiency plans were a key area of focus. Only program measures that can be successfully implemented in a cost-effective manner were selected for inclusion in the final plan. The specific programs included in the plan at this time are intended to provide a menu of alternatives and it is understood that *every* program will not be appropriate for every participant, nor will every participant be capable of participating in all of the programs. In some cases, it will be beneficial to conduct additional feasibility or pilot programs prior to full implementation.

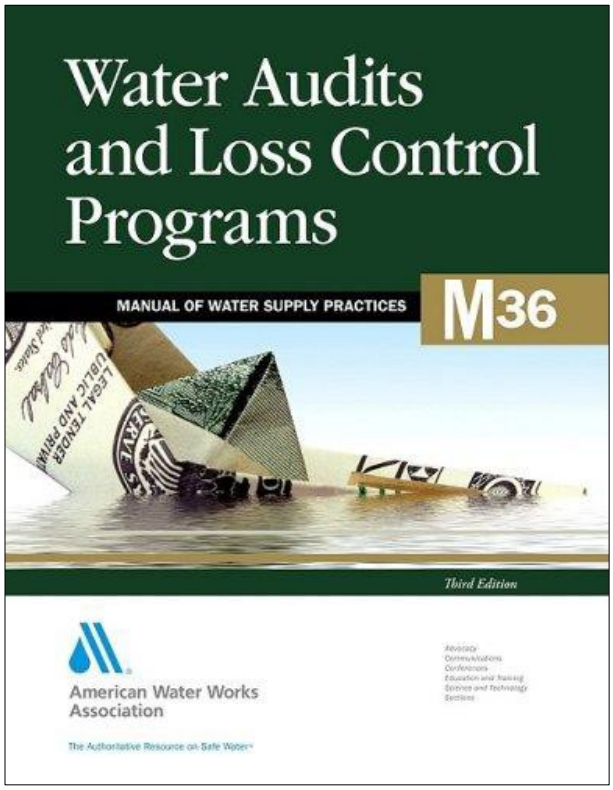
Four broad regional water efficiency programs identified, as described below. A range of estimated implementation costs and potential water savings is provided[2]. These regional programs can increase water efficiency and be successfully implemented at a reasonable cost.

3.1 WATER LOSS CONTROL TECHNICAL ASSISTANCE

Water loss control is the practice of system auditing, loss tracking, infrastructure maintenance, leak detection and leak repair for water utilities, and can be applied to both treated and raw water systems. Leak detection and repair are familiar water agency practices, but true water loss control is more pragmatic and comprehensive than simply finding and fixing leaks. The American Water Works Association (AWWA) water loss method detailed in the M36 Manual of Water Supply Practices (AWWA, 2009) is considered the industry standard and an efficiency best practice. Still relatively new to water utilities, the M36 standardized approach has recently been adopted by

[2] Water savings in this plan generally refer to reductions in treated water demands, which typically translate to reductions in diversions but not necessarily a 1:1 reduction in consumptive use.

some utilities in Colorado. To date, no utilities in the Roaring Fork region have completed a M36 water audit.



Auditing a water distribution system for real and apparent losses and evaluating the costs of those losses is the foundation of water loss control. Real losses are actual physical losses of water due to leaks or other problems with the system. Apparent losses are due to meter inaccuracy, unauthorized consumption, and data handling errors. Cost and benefit considerations drive implementation actions in the recommended method, described in detail in the AWWA M36 Manual (AWWA, 2009). The water audit typically traces the flow of water from the site of withdrawal or treatment, through the water distribution system, to customer properties. The water balance summarizes the components and provides accountability, as all of the water placed into a distribution system should, in theory, equal all of the water taken out of the distribution system.

The combination of the system water audit and the water balance provide a variety of useful measures of utility water loss. Of particular interest to water agencies is the ability to quantify the costs of real and apparent water losses and to use this information to improve the bottom line. Traditional water loss accounting focused on the percentage of unaccounted for water. Under the M36 method, the term “unaccounted for water” is eliminated and is replaced by “non-revenue water” which is partially comprised of “real and apparent losses”. This method improves understanding and accountability for utility water loss and has the potential to make a positive impact for Roaring Fork water providers in the coming years.

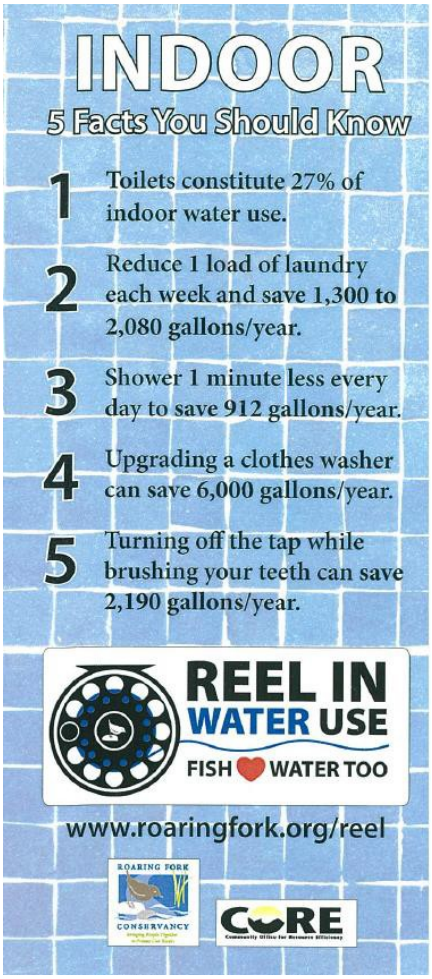
As an important component of the Roaring Fork Watershed Regional Water Efficiency Plan process, most participating providers hope to implement annual M36 water audits in the coming year, and to establish an annual audit process. As part of this Regional Water Efficiency Plan, technical assistance for completing the water audits using the M36 method and establishing an annual audit program could be obtained. While the audits will be completed at the individual water provider level, technical staff from the individual providers can exchange information to increase the success of tracking and managing water loss. The CWCB is interested in promoting the use of M36 water audits and has provided grant funding for water

audit implementation technical assistance and training for small utilities in Colorado. This approach is recommended for the Roaring Fork Valley.

Range of estimated annual implementation costs: For technical assistance in conducting water audits and establishing an ongoing program for up to five water providers: $5,000 -$20,000. These are one-time costs. It is assumed that water providers will conduct future water audits without assistance.
Range of estimated annual regional water savings: 400 – 600 AF/yr by 2050.[3]
Potential for CWCB implementation grant funding? Yes – up to 100% of program cost.

3.2 Roaring Fork Watershed Regional Water Efficiency Education and Information Campaign

Previous planning efforts have recognized the importance of creating a recognizable water efficiency campaign/brand across the Valley, targeted toward residents, students, tourists, landscape professionals, and agriculture. This Regional Water Efficiency Plan provides a mechanism to formalize these efforts and create an effective and sustaining program around public outreach and education.



3.2.1 Coordinated Public Outreach/Communication Campaign

The rationale for increased water conservation in the Roaring Fork Valley is clear. Water supplies are limited and subject to drought, and water efficiency by the entire community can benefit the entire watershed. Potential over-arching themes for a Roaring Fork Watershed Regional Water Efficiency Campaign include, but are not limited to:

- Water is precious, never waste it.
- Water-efficient landscapes are natural and beautiful.
- Water efficiency is doing your part for a healthy watershed and long lasting water supply.

[3] Based on estimated water savings of all 5 municipal water efficiency plans developed during the regional planning process.

Branding with a recognizable image or slogan, such as the Watershed Plan character "Eddy" (shown on the left) is useful for consistent messaging and engaging the public. A regional municipal water efficiency campaign could be implemented by Roaring Fork water providers alone, but would likely be more successful and less costly if implemented in partnership with local non-profits, businesses, schools, and other organizations. For example, a partnership between Roaring Fork water providers and an established organization such as the Roaring Fork Conservancy could leverage funds to provide coordinated public outreach on water efficiency. The Roaring Fork Conservancy and Community Office for Resource Efficiency (CORE) has an ongoing program entitled "Reel in Water Use, Fish Love Water Too" which could be expanded or combined with this effort. Such a partnership would likely be eligible for implementation grant funding from the CWCB and potentially the U.S. Bureau of Reclamation (owner/operator of Ruedi Reservoir), the Colorado River Water Conservation District, and others.

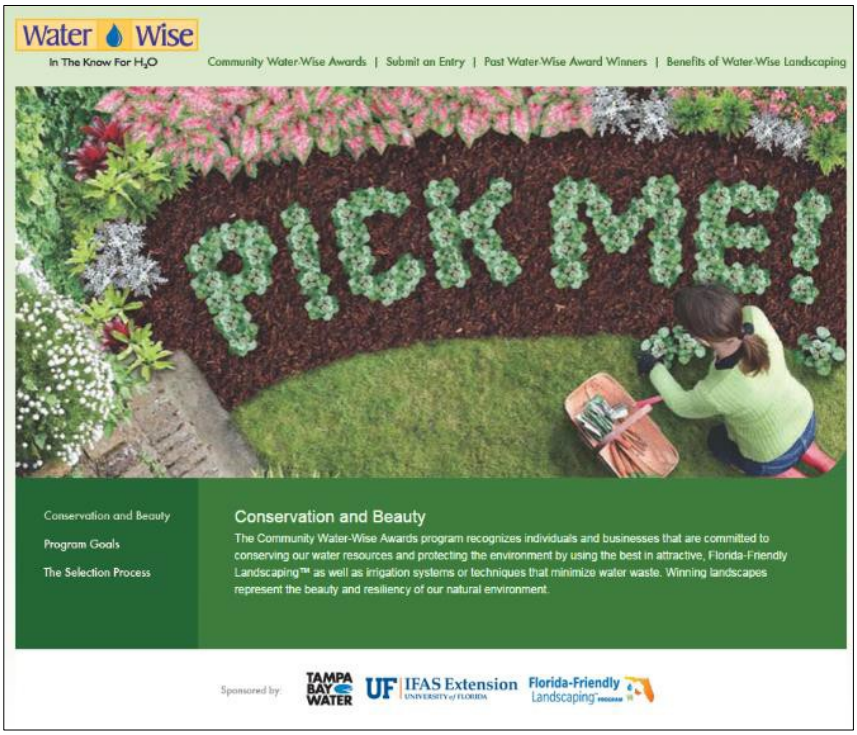
A real-life example of a current collaboration is the Roaring Fork Conservancy's "1% for the Fork" campaign which is partnering with the Roaring Fork Beer Company and other businesses to raise money for the Conservancy.

Leveraging an existing "off the shelf" water efficiency campaign such as the Alliance for Water Efficiency's "Never Waste" could make sense from a cost and effectiveness standpoint, but a locally developed and customized effort would likely have greater success. The new Colorado WaterWise campaign and toolkit "Live Like You Love It" was just announced in October 2014 and should be further considered.

Range of estimated annual implementation costs: For creating and implementing a regional water efficiency campaign: $5,000 – $100,000 (or more).
Range of estimated annual water savings: 90 – 120 AF/yr by 2050.
Potential for CWCB implementation grant funding? Yes, but probably less than 100% of program costs.

3.2.2 Business and HOA Water Efficiency Challenge and Awards

A regional water efficiency challenge and awards program for businesses focused on the tourist sector like hotels and restaurants could invigorate efficient practices and spur adoption of new technologies. Separate indoor and outdoor challenges could be offered for each category.



An example of this type of program is the EPA WaterSense H2Otel Challenge. Launched in February 2014, the H2Otel Challenge encourages hotels to: assess water use and savings opportunities; change products or processes to incorporate best management practices; and track their water-saving progress and achievements. Recognizing particularly well-designed, efficiently irrigated landscapes in the Roaring Fork region could also be an effective way to encourage others to reduce water demands. In Tampa, Florida the collaborative effort between water provider and the University of Florida created the "Community Water Wise Awards" to recognize individuals and businesses that are committed to conserving water resources and protecting the environment by using the best in attractive, locally adapted landscaping as well as irrigation systems or techniques that minimize water waste.

In the Roaring Fork region, including businesses, HOAs, and residential landscape categories in a program that publically rewards those who achieve water savings can help engage water users to incentivize and broaden the appeal.

Range of estimated annual implementation costs: $5,000 - $15,000.
Range of estimated annual water savings: 50 – 75 AF/yr by 2050.
Potential for CWCB implementation grant funding? Yes. Potential for applicability beyond the Roaring Fork region.

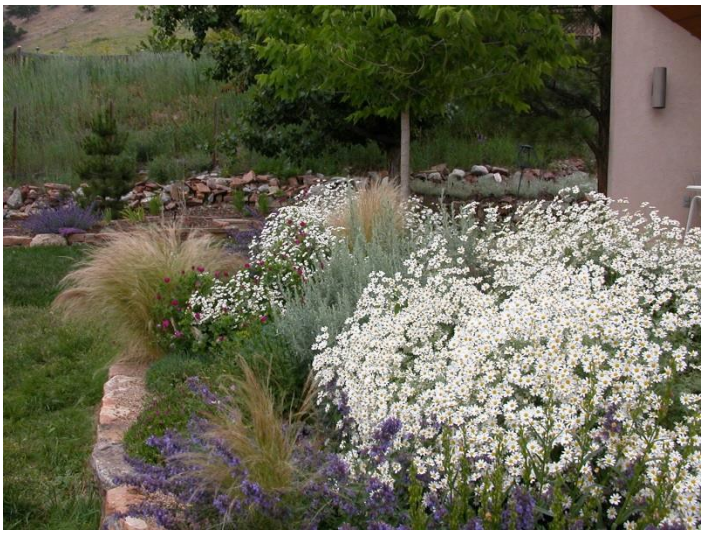
3.3 Reduce Outdoor Water Use

How we design, install, and maintain our landscapes and irrigation systems can greatly impact the amount of water needed to keep the plants alive and healthy. Good landscape management also reduces runoff and pollutants in stream systems. The effort to reduce outdoor water use in the Roaring Fork region should encompass a number of initiatives that will help drive efficiency. Recommendations include: (1) a regional model landscape ordinance for new landscapes to be built smart from the start; (2) a landscape design and management certification program targeted at HOA's, property managers and landscaping professionals; and (3) an effort to install rain shut-off devices on irrigation systems across the region. Existing and

future innovations in technology and management techniques may need to be applied differently by the different water providers throughout the watershed, given variations in altitude, growing seasons, weather patterns, water supplies, and water demands.

3.3.1 Create a Roaring Fork Model Landscape Ordinance with Information on Landscape Water Budgeting

Substantial amounts of water can be saved using existing technology. Management techniques and further innovation in irrigation equipment design present an important opportunity to conserve and maintain the region's water supply. Proper system design, correct installation and consistent maintenance of efficient irrigation systems combined with the selection of climate-appropriate, water-efficient plants and user education on the amount of water needed are the key components of landscape water use efficiency.



A model water efficient landscape ordinance for the Roaring Fork region could promote water conservation, prevent water waste, and protect water quality. The model ordinance could provide a template that could then be formally adopted, used for design guidelines, or used voluntarily; it should include information on landscape water budgeting, soil amendments, plant selection, efficient irrigation practices, and more. The ordinance could be developed in a manner that is adaptable to the variations in altitude, weather patterns, and growing seasons throughout the watershed.

There are good examples of model landscape ordinances that could be utilized in the Roaring Fork region. In 2004, the Colorado Department of Local Affairs created the Colorado *Water Efficient Landscape Design Model Ordinance* (DOLA, 2004). Numerous examples of landscape ordinances implemented in California can be found here: http://www.water.ca.gov/wateruseefficiency/landscapeordinance/. Water providers are already engaged in similar regional cooperation regarding energy through CORE, which could be a good candidate to facilitate the investigations needed to determine how a model water efficiency landscape ordinance should be structured in this region.

A landscape water budget provides a reasonable target level of water use that is tailored for each customer and landscape. Water budgets help water users better understand their consumption patterns and make sound decisions about how to best manage irrigation. Water budgets also provide utilities with a powerful tool for identifying which customers are over-irrigating and could most benefit from efficiency improvements. Water budgets can be

incorporated into a utility rate structure as has been done in Castle Rock, Centennial Water and Sanitation District, and Boulder, but they are also useful as a tool for assessing water use. Information on landscape water budgeting should be included in the Roaring Fork model landscape ordinance. Information on appropriate drought-tolerant plantings for the local climate (which varies across the watershed), and associated water demands, should also be incorporated.

If desired, this approach can also be integrated into land use regulations, through limiting landscape water budgets for new development. The model ordinance can be designed in a way that provides information and tools for all communities, and is adaptable for those who wish to tie it to future ordinances and regulations. This program would require engaging the planning and building departments from local jurisdictions as well as outreach and education to those involved in planning and installing landscapes. Local landscape architects, nurseries and landscape installation and maintenance professionals should be consulted at the beginning so that any ordinances, regulations or other tools are developed in a way that is practical, cost-effective, and supported by local providers of landscape services.

Range of estimated annual implementation costs: Up to $10,000. These are one-time costs.
Range of estimated annual water savings: 80 – 100 AF/yr by 2050.
Potential for CWCB implementation grant funding? Maybe. A model landscape ordinance for Colorado already exists, but needs to be adapted for local conditions.

3.3.2 Certification Program Targeted at Property Managers and Landscaping Professionals

This program encourages creation and maintenance of water efficient landscapes through education, information, and an awards program. Participants receive a rating (e.g. gold/silver/bronze) based on landscape appearance and level of water use. Winners in various categories such as business, school, condo/apartment, and residential receive substantive positive publicity.

Programs such as the Tampa, Florida "Community Water Wise Awards" (described above) are examples of the type of measure than could be implemented in the Roaring Fork region. The programs in this section are good candidates for pilot projects, and will require more effort to identify how to best engage contractors and property owners. The landscape industry should be consulted and involved in identifying effective ways to implement these and other similar programs.

Performance Contracts. The certification program could form the basis for landscape efficiency

performance contracts in which landscape professionals receive a monetary incentive for achieving water efficiency targets.

In the 1980's, landscape management was typically organized using labor-based contracts with fixed hours and material costs unrelated to results. Today, landscape companies are moving towards performance-based contracts which provide monetary incentives for tangible results such as improved landscape appearance and water management. Providing these incentives encourages landscapers to adopt practices which emphasize water efficiency in conjunction with plant selection and physical design.

Target Heavy Irrigators. The certification program could also form the basis for an audit program for highest outdoor users, in which a list of heavy irrigators in the region is developed each year. These customers are then approached directly and offered free or subsidized landscape and irrigation management services in an effort to reduce water use. There are organizations such as the Center for Resource Conservation that provide free irrigation system inspections by trained water auditors for residents, HOAs, and commercial properties located within participating Colorado water providers' service areas. The Regional Plan could establish a budget to pay for audits of the highest water users across the watershed.

Targeting is essential because program budgets are limited and not all customers can achieve measurable water savings. This approach offers water providers the opportunity to work with their highest use customers to achieve meaningful demand reductions.

Range of estimated annual implementation costs: $5,000 - $15,000.
Range of estimated annual water savings: 80 – 100 AF/yr by 2050.
Potential for CWCB implementation grant funding? Possibly. An awards program concept that could be utilized elsewhere in the State has potential.

3.3.3 Encourage Installation of Rain Sensor Devices on all Roaring Fork Valley Irrigation Systems

Rain sensors and shutoff devices are inexpensive add-ons for an automatic irrigation system. Products like the Hunter Mini Clik can be purchased for under $50 and installed on just about any automatic irrigation system. During summer months when rain occurs, these devices have the potential to substantially reduce irrigation demands by shutting off automatic irrigation systems based on the availability of natural moisture. Rain sensors (also referred to as a rain

switch) immediately interrupt irrigation. Some irrigation controllers can be connected to a weather service that causes the controller to enter a rain pause mode to incorporate rainfall into irrigation scheduling. Recent research in Florida found that the combination of a rain switch and rain pause devices reduced irrigation 41% compared with the use of no rain sensor features, whereas the rain pause feature alone saved 25% (Rutland and Dukes, 2012). Rain sensors like the Mini Clik (shown here) are not difficult to obtain or install. A technician with basic training and clear guidance could successfully install these products. A program aimed at broad application of rain sensor/shutoff technology could be implemented through a regional partnerships with college students, trade organizations, leadership groups, and others.

The program could be implemented with the coordinated public outreach campaign. The goal should be to equip every (or most) automatic irrigation system in the Roaring Fork region with a rain sensor device. This program will likely take a number of years to complete, but once rain sensors become a standard feature or incorporated into local landscape codes, it is anticipated that adoption will be more rapid. Purchase and installation of the rain sensor could be subsidized by the program or paid for entirely by the owner of the irrigation system.

While not a perfect solution, rain sensors and shutoff devices are included in this plan for the following reasons:

1. They have been shown to be an effective method of reducing excessive outdoor use by 25 – 40% in recent scientific studies (Rutland and Dukes, 2012).
2. They are inexpensive (under $50 per unit is some cases) and can be installed as a retrofit on just about any automatic irrigation system. Soil moisture sensors and other technologies are significantly more expensive and complicated to install, particularly as a retrofit.
3. They are an effective way to assist part-time residents from irrigating unnecessarily when it is raining.
4. Rain events in the Roaring Fork Valley are frequently isolated to specific areas. Rain sensors only shut off irrigation if sufficient local precipitation is received.

Soil moisture sensors should also be considered and may be more effective in a dry climate where rain is useful in replenishing soil moisture and reducing runoff. While soil moisture sensors may be a preferred option, they are more expensive and require more skill to properly install. It can be difficult to retrofit existing systems with soil sensors, but they should be considered with any new irrigation system installation. Other irrigation technology such as

weather-based irrigation system controllers should also be considered and may be feasible and cost effective for certain types of users such as institutional and commercial customers.

Range of estimated annual implementation costs: $5,000 - $25,000.
Range of estimated annual water savings: 100 – 150 AF/yr by 2050.
Potential for CWCB implementation grant funding? Yes.

3.4 Improve Water Resource Management

In the Roaring Fork Valley, water utilities and other water rights holders and water users can help create long-lasting benefits through efficiency and improved water resource management. Exploration of four program measures is recommended in this area: (a) linking water savings to environmental benefits to spur savings and fund water efficiency; (b) short-term leases and instream flow dedication; (c) improved water accounting for raw water systems; and (d) climate resiliency measures and additional research on climate change impacts on water supplies in the region.

3.4.1 Linking Water Savings to Environmental Benefits

People in the Roaring Fork Valley are concerned about the health and sustainability of local riparian ecosystems and the natural environment. The linkage of personal water use reductions to direct environmental benefit is a powerful motivating factor that encourages people to participate in water efficiency programs. Some ideas for taking the next step in linking personal water savings of Roaring Fork Valley citizens to environmental benefit are discussed here.

The Colorado Healthy Rivers Fund (http://cwcb.state.co.us/LoansGrants/colorado-healthy-rivers-fund-grants/Pages/main.aspx) helps support local watershed organizations in their efforts to provide clean water, protect habitat, and improve recreation and accessibility. This is an avenue that could be explored. Another example of a program (or type of program) that seeks to link water efficiency and environmental benefits that could be implemented in the Roaring Fork Valley is the Conserve to Enhance (C2E) program (www.conserve2enhance.org). This is one of the first programs in the United States that seeks to link water savings and environmental benefits and could serve as a model or could itself be implemented in the Roaring Fork Valley.

The C2E program was developed by the Water Resources Research Center at the University of Arizona and is available for implementation in the Colorado River basin region. The innovative approach of C2E provides a direct connection between water users' voluntary water conservation actions and local environmental projects. Development of a C2E program can be driven by a water utility, a local environmental organization, or both. The program shares important similarities to the water bank described in the University of Michigan case study of

Blackfoot Challenge Montana and the In-stream Leasing Program/Allocation of Conserved Water Program by Deschutes Oregon.

Regional implementation of a water savings type of and donation program could be accomplished by a consortium of water providers, through a collaboration with a local environmental organization (such as the Roaring Fork Conservancy), or a combination of both.

Range of estimated annual implementation costs: $25,000 - $75,000.[4]
Range of estimated annual water savings: 50 – 75 AF/yr by 2050.[5]
Potential for CWCB implementation grant funding? Yes.

3.4.2 Mechanisms to Protect Water Rights and Enhance Instream Flows

Improving the health of riparian ecosystems in the Roaring Fork region is an important goal of the regional watershed and efficiency planning efforts that are broader than this plan. Significant volumes of water are diverted from the top of the Roaring Fork valley via the Fryingpan-Arkansas Project and the Twin Lakes Canal Company, which provide water to cities and towns on the eastern slope of Colorado. While altering the operations of the transbasin diversions to benefit streamflow in the Roaring Fork Valley and other measures to enhance streamflow by means not associated with water conservation are beyond the scope of this planning process, there may be potential to enhance instream flows through planned Ruedi Reservoir releases, interruptible and short-term water supply agreements with the CWCB, and other water management mechanisms within the control of local water providers and water rights holders.

The MOU includes several points on this topic:

- "Conserved water that is subject to a water conservation program established through formal written action or ordinance by a municipality is not subject to abandonment under Colorado law, Colorado Revised Statutes § 37-92-103(2)"
- "Water conservation established through formal written action or ordinance by a municipality does not reduce the "historical consumptive use" (quantity) of water, Colorado Revised Statutes § 37-92-305(3)(c)(I)(B)"
- "Conserved water can benefit instream flows, rafting, kayaking, recreational in channel diversions, gold medal fisheries, and aquatic life."
- "Conserved water can be loaned or leased to the Colorado Water Conservation Board ("CWCB") for instream flows to preserve or improve the natural environment to a reasonable degree, Colorado Revised Statutes "C.R.S." §§37-83-105(2) and 37-92-102(3)."

[4] Scale of program implementation in the driver of cost.
[5] Savings could be significantly higher if program proves successful and gains wide adoption.

The above-cited statutes have not yet been widely tested and proven as safeguards against the loss of water rights due to conservation actions. As a result, there may be reluctance on the part of some providers to implement programs which may be seen as opening their water rights to legal challenge. The following examples are intended to illustrate actions that have been taken locally to improve instream flows within the context of existing Colorado water law. New or different programs may require legislation to improve flexibility in water rights administration aimed at facilitating water efficiency actions while maintaining existing water rights.

- Since the 1990s, the City of Aspen has consistently operated its water rights to protect instream flows, even though its water rights are senior.
- In 2001, Pitkin County and the Colorado Water Trust began discussing how the County could utilize its water rights to improve flows in the Roaring Fork basin. After the passage of House Bill 08-1280, Pitkin County and the Colorado Water Trust signed an innovative Trust Agreement whereby the CWCB may use the County's Stapleton Ditch water right to improve streamflows on lower Maroon Creek and the Roaring Fork River. (CWT, 2014)
- In 2012, the Colorado Water Trust in coordination with the CWCB and Division of Water Resources issued a Request for Water soliciting short-term leases from water rights holders in response to drought conditions. A 2003 statute provided the legal mechanism and the process was an opportunity to gain experience in implementing the statute. In addition to enhancing instream flows during a critically dry period, the program increased public awareness about the impacts of drought on instream flows. (CWT, 2014)
- In 2013, the City of Aspen and the Colorado Water Trust conducted a "nondiversion agreement" pilot program, to increase flows in the Roaring Fork River. The agreement describes conditions under which the City would forego diversions of one of its senior water rights, during periods when such diversions would otherwise reduce flows to below the CWCB minimum instream flow right in a critical reach of the Roaring Fork River. The City accomplishes this reduction in diversions by leasing less water to third parties, reducing outdoor water use, and redirecting other water supplies to meet the City's needs. The City also operates its Castle Creek rights in a manner that protects the instream flow on Castle Creek.

These are just some local examples of mechanisms that have been implemented to enhance instream flows while protecting water rights. In the coming years, municipal water providers and other water rights holders, such as counties and valley ranchers and farmers, should work together to investigate opportunities to enhance and protect instream flows while also protecting water rights. These programs may need to be implemented individually to accommodate individual water rights and preferences; but having a regional discussion is likely to create ideas and opportunities that would not be identified otherwise. Such a concerted

effort could result in a series of mechanisms that successfully improve instream flow levels adequate water to users throughout the valley.

It is not possible to estimate associated costs and potential water savings associated with this recommended action until more specific projects are identified.

3.4.3 Improved Water Accountability for Raw Water Systems

Throughout the Roaring Fork watershed, raw water ditches are used to provide non-potable water to golf courses, parks, subdivisions, agriculture, and a variety of other users. Providing non-potable water for these types of uses can have many benefits. Reduced impacts to the stream system can result from better understanding the associated water demands and identifying ways to increase the operational efficiency of these systems. Carbondale is seeking to improve measurement and accountability for its raw water supplies. Some of the new technologies and ideas being explored could be of interest to other municipal water providers (and irrigators) in the Roaring Fork Valley.

For Carbondale, the river headgates are the only locations on the ditch system where water demand is currently measured on a routine basis. The Town is aware that a significant amount of tail water can result from current operations used to maintain pressure head throughout the ditch system. Better data and more operational control could reduce the amount of flow necessary to push water through the ditch system. Some of the improvements Carbondale is considering include:

- Mapping delineation and analysis of irrigated area and raw water demands.
- Metering of tail water in ditches to provide improved measurements of customer usage.
- Telemetry and additional metering to monitor and manage the raw water ditch system.

There may be opportunities for collaboration and cooperation between Carbondale and others on the issue of raw water measurement and accountability, sharing costs and potentially increasing water savings beyond that estimated in Carbondale's Water Efficiency Plan. Funding mechanisms and barriers for sharing costs outside of local jurisdictions would need to be further explored.

When considering changes to raw water management and efficiency, impacts on return flow volume and timing need to be understood so that streamflow enhancements at a particular location or time of year are not made to the detriment of another location or critical period. Impacts to return flows often need to be investigated on a case-by-case basis, as there are

many variables that can affect the timing and impact to streamflows. Pilot programs are a good way to learn whether results from a specific location can be extrapolated to other locations.

3.4.4 Expand Regional Climate Resiliency Measures

Temperature increases and climate change pose real and significant threats to water supplies in the Roaring Fork region and across Colorado. Current modeling and research indicate that some level of temperature increase is inevitable. The relationship between energy use and water efficiency needs to be carefully analyzed and better understood. Many of the water providers in the Roaring Fork have energy-related initiatives to help address impacts of current and future uses. CORE works with utilities, businesses, and individuals to create improvements in energy and water efficiency to benefit the environment and develop a more sustainable local economy. Water providers, water rights holders, and water users in the region should continue and expand action to improve resiliency and ability to manage through extended periods of drought, changes in precipitation and runoff patterns, more frequent forest fires, and other related changes.

As part of the Regional Water Efficiency Plan, it is recommended that a list of recommended climate resiliency actions be developed. Distinct actions should be recommended for water providers, water rights holders, and water users and information on these measures should be disseminated to the public, potentially through the water efficiency education and messaging campaign discussed earlier in this plan. Planning and implementing water efficiency programs such as this Regional Plan and the associated individual water efficiency plans are examples of distinct climate resiliency actions. Tracking ongoing climate variability and collaborating on methodologies that can be used to apply findings from climate change research to potential impacts on local water supplies and demands is another example of a resiliency action. A united effort will improve the effectiveness of these actions.

Additional research on climate change impacts to water supplies in the region should be supported and undertaken. Recent studies indicate reduced precipitation is a real possibility. *The Climate Change in Colorado* report (CWCB, 2014) recently released by the CWCB is a synthesis of climate science relevant for management and planning for Colorado's water resources. The report finds temperatures are likely to go up by several degrees by 2050 which could mean changes in timing and less water supply and higher landscaping demands. A recent climate report for the Aspen region indicates that temperatures in Aspen have increased during all seasons since 1940, summers have lengthened, temperatures are projected to continue rising into the future, and changes in precipitation patterns are projected to result in more precipitation in the form of rain rather than snow (AGCI, 2014).

Tracking climate changes and impacts, and evaluating potential future changes will help Roaring Fork water providers and users prepare for what may be in store. As recommended in the 2014 Aspen Global Climate Institute report, increasing climate resiliency requires an iterative

approach of assessing, planning, engaging stakeholders, implementing, monitoring and evaluating, and can be more effective through regional collaboration.

3.5 SUMMARY OF WATER SAVINGS AND COST ESTIMATES

A summary of water savings (reductions in water demand) and costs for each of the proposed regional program measures is shown in Table 2, below. For utility programs like enhanced water loss control, the estimated savings are based on the five recently completed municipal water efficiency plans in the Roaring Fork Valley. Fostering the implementation of improved water loss control in the region appears to be one of the most cost effective and important objectives of the regional conservation plan.

The savings projections in Table 2 take into account the level of efficiency already being achieved in each of the five participating communities. It is estimated that approximately 50% of the water savings shown in Table 2 overlap with savings estimates from the five individual water provider efficiency plans. However, all of these regional efforts are expected to enhance and expand upon water efficiency savings from the local plans. Furthermore, the regional efforts are likely to impact other communities and water users not covered under the five individual plan yet those additional savings are not included in the Table 2 estimates. The high savings estimate in Table 2 includes the potential impacts on users across the region, regardless of jurisdiction or water provider.

Table 2. Summary of Estimated Water Savings and Costs.

	Estimated Water Savings at 2050 (AF/yr)		Estimated Annual Cost ($)		Estimated One-Time Cost ($)	
Program Measure	**Low**	**High**	**Low**	**High**	**Low**	**High**
Water loss control technical assistance	400	600			$ 5,000	$ 20,000
Regional Water Education and Information Campaign	90	120	$ 5,000	$ 100,000		
Business and HOA Challenge and Awards	50	75	$ 5,000	$ 15,000		
Model landscape ordinance	80	100			$ 0	$ 10,000
Certification program	80	100	$ 5,000	$ 15,000		
Rain sensor device program	100	150	$ 5,000	$ 25,000		
Link Efficiency and Environmental Benefits	50	75	$ 25,000	$ 75,000		
Total	**850**	**1,220**	**$ 45,000**	**$ 230,000**	**$ 5,000**	**$ 30,000**

4. IMPLEMENTATION AND MONITORING PLAN

This Regional Water Efficiency Plan provides a foundation for implementing coordinated cost-effective regional municipal water efficiency programs in the Roaring Fork Valley. The programs listed in Table 2 are the top candidates for implementation at this time. Implementation will require an ongoing effort and adaptive strategies to allow the plan to grow and change. Additional stakeholders should also be engaged through the implementation process. The specific programs included in the plan provide a menu of alternatives and it is understood that *every* program will not be appropriate for every participant, nor will every participant be capable of participating in all of the programs. Some programs may benefit from feasibility research and pilot implementation prior to broader application. Other programs could be implemented relatively quickly upon acquiring funding.

The following actions are recommended as next steps for implementing this Regional Plan:

1. Maintain a Regional Plan Implementation Workgroup with representatives of each major stakeholder group (e.g. municipalities, counties, schools, landscapers, agriculture, recreation, etc.) to meet regularly (e.g. monthly/quarterly) to report on and assist with regional plan implementation. Provide updates at other forum meetings (e.g. RFC, CBRT) and/or host regular open forms. Include annual reporting around the plan for all participants including:
    - Annual program implementation,
    - Program impact estimates including estimates of program costs/avoided costs and water savings,
    - Lessons learned,

- Public feedback on program,
- Periodic weather data and local trends,
- Water supply concerns,
- Recommendations for studies or pilot programs,
- Recommended plan modifications, and
- Ongoing implementation plan.

2. Develop a funding plan for the Regional Plan implementation. Create lists of potential annual and one-time funding sources (e.g., contributions from individual providers, CWCB implementation grants, Colorado Basin Roundtable funding, U.S. Bureau of Reclamation, other sources). Establish funding commitments and submit grant applications.

3. Assign a Regional Plan Coordinator and divide responsibility for implementing the plan across multiple individuals and organizations. To successfully implement this plan, committed people must step forward and work together. Identifying a plan coordinator and "plan champions" across jurisdictions and stakeholder groups is a critical step in the process. Potential lead organizations include: RWAPA, CORE, or the Roaring Fork Conservancy.

4. Create a MOU for implementation that details shared objectives, roles, and responsibilities. An MOU was beneficial in defining goals, expectations, and roles of individual providers in forming the partnership to create this Regional Water Efficiency Plan. A similar type of agreement would be useful for establishing the roles and responsibilities of participants in the implementation phase.

5. Dedicate resources and pursue implementation of the plan.

5. CHALLENGES TO SUCCESS

Effective water demand management depends on water user participation. Water providers can incentivize efficient use and penalize water waste, but actual reductions in usage depend upon the actions of individual water users. Identifying potential challenges to success is useful so that education and outreach programs can be designed to address the issues in advance and concurrently to program implementation.

Some of the potential and real challenges to implementation of the Roaring Fork Watershed Regional Water Efficiency Plan identified during this planning process and in previous watershed planning efforts include:

- Social norms regarding water use – "we've always done it this way," wanting green lawns regardless of monetary cost, and/or not understanding how to implement alternatives.

- Disconnect between those who control the water demands and those who pay the bill – property managers and landscaping businesses are responsible for maintenance of many landscapes throughout the Roaring Fork Watershed. Frequently these managers are not responsible for paying the water bill and may never see the bill or get any information on actual water usage at the sites they manage.
- Influencing tourists and second homeowners – short-term visitors and those that spend only part of the year in the Roaring Fork Valley must be engaged in the effort for water efficiency, a challenging task.
- Open ditch systems are often unmetered and/or difficult to meter and manage – improved management and accountability for water in open ditch systems could help improve minimum streamflows.
- Potential for water rights to be lost. "Use it or lose it" is many people's understanding of Colorado water law. While some alternatives exist and should be promoted, water rights laws also need to be reinforced to expand opportunities and reduce legal challenges that may result when conservation programs are effective at reducing demands.
- Downstream water rights could take any water left in the stream that results from conservation.
- Geomorphology makes it difficult to quantify the amount of water conserved and maintained instream. Furthermore, the water rights system does not protect "saved" water (e.g. reductions in water use due to conservation/increased efficiency) from being diverted by another user.
- Potential revenue impacts of decreased demand. This issue is addressed in the individual municipal water efficiency plans prepared by ELEMENT and WaterDM.
- Misconceptions about being a headwaters area with plentiful water supply.

6. PUBLIC REVIEW OF WATER EFFICIENCY PLAN

This Regional Plan was prepared through a collaborative stakeholder process, supported through numerous workshops and draft plan reviews by the groups listed below prior to a public comment and review process:

- City of Aspen;
- City of Glenwood Springs;
- Colorado River District;
- Colorado Water Conservation Board;
- Community Office for Resource Efficiency;
- Roaring Fork Conservancy;
- Roaring Fork Watershed Collaborative.

- Ruedi Water & Power Authority;
- Snowmass Water and Sanitation District;
- Town of Basalt; and
- Town of Carbondale.

Feedback received during over a dozen meetings, summarized in Table 3 below, was incorporated and utilized to reflect local stakeholder interests. Project updates, meetings, and notice of the public review period (attached) were publicized through local media including the Aspen Daily News, Aspen Times, and Post Independent. Links to the draft plan and information on how to submit public comments were also publicized on the RFC, RWAPA, and water provider participant websites.

Table 3. Summary of Stakeholder Meetings.

Date	Stakeholder Group
1/28/2014	Participant Kickoff Meeting
3/21/2014	Roaring Fork Conservancy Community Forum
8/26/2014	Roaring Fork Watershed Collaborative Workshop
10/8/2014	Sustaining Colorado Watersheds Conference
12/3/2014	Participant Workshop
1/6/2015	Participant Workshop
3/31/2015	Public Meeting
5/14/2015	Roaring Fork Watershed Collaborative Workshop
5/14/2015	RWAPA Board Meeting
5/19/2015	Carbondale Town Council
5/20/2015	Snowmass Water and Sanitation District Board
6/1/2015	Snowmass Town Council
6/9/2015	Basalt Town Council
6/15/2015	Aspen City Council
7/1/2015	Glenwood Springs City Council

A copy of the draft plan was submitted to the CWCB Office of Water Conservation and Drought Planning prior to the public comment period, and feedback was incorporated. A 60-day public comment period was held between March 10 and May 9, 2015. No comments were submitted in writing. The draft plan was presented to each of the Boards and Councils of the water provider participants, resulting in positive discussions and interest. Currently the Plan has been accepted by the CWCB and has received positive responses from the providers and other interested local parties.

7. REFERENCES

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