Informing the Development of a Regional Water Conservation Plan for the Roaring Fork Watershed

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INFORMING THE DEVELOPMENT OF A REGIONAL WATER CONSERVATION PLAN FOR THE ROARING FORK WATERSHED

by

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ABSTRACT

Regional planning efforts have become increasingly prevalent in resource management initiatives, particularly in water conservation planning. This report informs the development of a water conservation plan for the Roaring Fork Conservancy, Ruedi Water and Power Authority, and the Community Office of Resource Efficiency in Colorado's Roaring Fork Watershed. Six cases of regional water conservation planning strategies across the Western United States are examined. The case studies provide insights and lessons learned about collaborative planning, the Colorado Water Conservation Board planning process, and regional plans with water conservation strategies focused on increasing instream flows.

Several recommendations are offered for those seeking to develop a regional water conservation plan. The planning process should be open and transparent, to encourage various stakeholders to participate. The roles and responsibilities of plan participants should be established clearly and equitably. A plan should be flexible enough to accommodate different interests and needs, while maintaining a unifying mechanism or vision to sustain regional collaboration. Plan developers should maintain outreach to critical stakeholder groups and partner with them on plan development and implementation. Establishing a dedicated regional staff member to coordinate and manage plan implementation is important, as is establishing a dedicated funding source for plan development and implementation. Plan champions should be cultivated, and implementation incentivized.

An overview of education and outreach campaign strategies that could be employed by the clients as part of a regional water conservation outreach campaign is provided. Emphasis is placed on strategies directed at changing individual water conservation behaviors. An analysis of ecological and hydrologic conditions on the Lower Crystal River that could motivate compliance with a regional water conservation plan is also provided.

While the report was conducted for clients in Colorado's Roaring Fork Watershed, many of the lessons and themes should be of interest to others involved in regional water conservation planning.

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EXECUTIVE SUMMARY

I. Introduction

The purpose of this report is to inform the development of a water conservation plan for the Roaring Fork Conservancy, Ruedi Water and Power Authority, and the Community Office of Resource Efficiency. This research explores strategies related to both plan development and plan implementation in other regional water conservation plans across the Western United States, through six case studies. In addition, this report provides an overview of education and outreach campaign strategies that could be employed as part of a regional water conservation outreach campaign. The report also provides an analysis of ecological conditions on the Lower Crystal River that could motivate compliance with a regional water conservation plan.

II. Background

Colorado water law is a strict interpretation of the prior appropriation doctrine, giving priority of use to those who first appropriated the water and put it to beneficial use. Riparian and instream ecosystems in the Roaring Fork Watershed are impacted by development and urbanization, water quality impairment, and loss of natural streamflow due to local and transmountain diversions. However, regional water conservation planning, encouraged by the Colorado Water Conservation Board, could aid water conservation efforts in the region.

III. Municipal Utility and Irrigator Perspectives on Water Conservation Planning in the Roaring Fork Watershed

Interviews were completed in July 2013 with representatives from the five water utilities – Aspen Water Department, Basalt Water Department, Carbondale Water & Sewer Department, Glenwood Springs Water Department, and Snowmass Water & Sanitation District – that have signed the Memorandum of Understanding for the regional water conservation planning effort. Interviews were also completed with several ranchers in the Roaring Fork Watershed and a local consulting firm, SGM, which has developed a number of water conservation plans in the region. The aim of these interviews was to determine each stakeholder groups' interests, perceived challenges, and recommendations for regional water conservation planning in order to better inform case study selection and analysis and to determine interests and the level of support for the planning process in the Roaring Fork Watershed.

IV. Case Study Selection & Cross-Case Analysis

The project team examined six case studies of successful regional planning efforts from across the American West to derive lessons for the Roaring Fork Watershed. The six case studies, found in Part V of the report, are: Steamboat Springs, CO; Grand Valley, CO; Upper Verde River, AZ; Santa Fe County, NM; Blackfoot Challenge, MT; and Deschutes River Basin, OR.

<u>Colorado Water Conservation Board Plans</u>

Two of the case studies, Steamboat Springs, CO and Grand Valley, CO, were selected because they were completed under the same process that the Roaring Fork plan will be developed pursuant to,

the Colorado Water Conservation Board ("CWCB") regional planning process. The hope in studying these cases was to glean information about navigating the CWCB process that could be useful for the clients in developing the plan for the Roaring Fork Watershed.

Traditional Regional Water Conservation Plans

The next two case studies, Upper Verde River, AZ and Santa Fe County, NM, were selected as examples of collaborative regional planning processes. These plans address ecological concerns through regional conservation planning, and were included to develop general recommendations for the clients about developing a regional conservation plan.

Plans that Aim to Increase Instream Flows

The final two case studies are Blackfoot Challenge, MT, and Deschutes River Basin, OR. These plans were selected because they were developed with a goal of increasing instream flows in their respective watersheds, a goal that is shared by the clients in the Roaring Fork Watershed. In selecting these plans, the project team hoped to provide recommendations related to this goal.

Cross-Case Analysis: Facilitating Factors

Facilitating factors enable progress towards plan development and support and enhance successful plan implementation. The key facilitating factors that became apparent in the cross-case analysis of the six selected case studies are:

1. A planning and implementation structure with clearly defined roles and responsibilities
2. A process that recognizes and accommodates entity-specific requirements and needs, but retains a unifying mechanism or vision
3. Relationships that ensured broad-based involvement and support
4. Broad commitment to collaboration
5. Dedicated staff time devoted to coordinating and managing plan participants and plan components
6. Strong leadership by plan champions.

Cross-Case Analysis: Challenges

Challenges are likely to occur in any complex and sustained process, and such challenges can be difficult to overcome. In undertaking a regional planning process, it is helpful to explore the major challenges that similar efforts have encountered. The major challenges shared in common across the cases are:

1. Difficulty achieving and sustaining sufficient support and participation from key groups
2. Limited motivation to implement
3. Inadequate initial or ongoing funding
4. Insufficient or unclear communication

Cross-Case Analysis: Recommendations

Based on the cross-case analysis, the project team identified nine findings and recommendations:

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.

V. Case Studies

The six case studies provide insight into plan development and implementation in the six watersheds examined, including case-specific recommendations.

VI. Water Conservation Education and Outreach Campaigns

In addition to the case study research, the project team reviewed studies of education and outreach campaigns to develop recommendations for the education campaign being developed by the Roaring Fork Conservancy. This analysis concludes with the following recommendations for the education campaign:

1. Recognize that knowledge about and concern for the environment are poor predictors of pro-environmental behavior
2. Determine the barriers that keep Roaring Fork Watershed residents from engaging in water conservation behavior
3. Apply strategies for behavior change that will address local residents' barriers to water conservation behavior
4. Consider targeting specific categories of residents for the campaign, or applying different strategies to different segments of the population
5. Work as closely as possible with water providers to ensure mutual understanding of the plan; and evaluate the success of the campaign
6. Adapt based on these findings.

VII. Lower Crystal River Ecological and Hydrological Data Summary

As one of the clients' goals in developing a water conservation plan is increasing instream flows in the Roaring Fork Watershed, the final portion of the report focuses on determining the potential effects on river health if the Town of Carbondale undertakes water conservation strategies. In order to determine the impacts of water diversions on the biological integrity of the Roaring Fork Watershed, the project team summarized existing ecological information from the Lower Crystal River and completed an analysis using data from a hydrologic model.

PART I: INTRODUCTION

PROJECT DESCRIPTION*

The purpose of this report is to provide analysis and recommendations for three organizations in the Roaring Fork Watershed in Colorado in development of a regional water conservation plan to fulfill the planning requirements of the Colorado Water Conservation Board ("CWCB"). The project team, composed of four Master's students from the University of Michigan School of Natural Resources and Environment, conducted interviews, case studies, and literature reviews to gather information on other regional water conservation planning processes across the American West, education/outreach campaign strategies, and a situation assessment of the Roaring Fork Watershed. Based on this research and analysis, this report concludes with a set of overarching recommendations for the clients as they develop a regional water conservation plan for the Roaring Fork Watershed.

CLIENT SUMMARY

This project was conducted for the Roaring Fork Conservancy, Ruedi Water and Power Authority, and the Community Office for Resource Efficiency (collectively, "the clients"). All three organizations are based in the Roaring Fork Watershed in western Colorado, the geographic setting for the project. Additionally, the clients all participate in the Roaring Fork Watershed Collaborative, an informal working group composed of key stakeholder groups, government agencies, and individuals in the Roaring Fork Watershed.[1]

The Roaring Fork Conservancy

The Roaring Fork Conservancy ("RFC") is a watershed conservation organization in the Roaring Fork Watershed. The RFC was founded in 1996 and its mission is focused on water quantity, water quality, and habitat conservation.[2]

Ruedi Water and Power Authority

The Ruedi Water and Power Authority ("RWAPA") was founded in 1981 by the City of Aspen and Pitkin County to pursue development of hydropower resources at Ruedi Reservoir, and the Authority now includes Aspen, Carbondale, Basalt, Glenwood Springs, Snowmass Village, Pitkin County, and Eagle County as members. RWAPA meets regularly to address matters related to Ruedi Reservoir and the Fryingpan River.[3]

Community Office for Resource Efficiency

The Community Office for Resource Efficiency ("CORE") is a nonprofit organization that promotes renewable energy, energy efficiency, and green building in western Colorado by working cooperatively with businesses, individuals, utilities, and governments.[4]

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* The project was conducted as part of a capstone requirement for the Master of Science degree in the School of Natural Resources and Environment at the University of Michigan.

REGIONAL WATER CONSERVATION PLANNING IN THE ROARING FORK WATERSHED

In March of 2012, the clients, along with numerous other partners operating within the Roaring Fork Watershed, completed a comprehensive Roaring Fork Watershed Plan. The Watershed Plan assessed the conditions of the watershed and local water resources and recommended actions to preserve and improve those resources. The Watershed Plan's 10 most urgent priorities indicated two activities related to water conservation:

1) Developing a water conservation plan to increase instream flows and aquatic and riparian ecosystem health; and
2) Establishing a water conservation education campaign to encourage water use efficiency.

In an effort to meet these goals, the clients and other partners operating in the watershed have begun to develop a regional water conservation plan for the Roaring Fork Watershed. The plan will cover the municipal water supplies for five towns: Aspen, Basalt, Carbondale, Glenwood Springs, and Snowmass Village. Under the direction of CORE, these five municipal providers have signed a Memorandum of Understanding ("MOU") to commit to pursuing a regional water conservation plan. However, before adopting a regional water conservation plan, the clients seek to better understand the process by which other regional or watershed-wide water conservation plans in similar areas have been developed and to identify proven and innovative strategies. This was the task assigned to the project team.

Several critical questions must be answered to help the clients capitalize on the experiences and lessons of water conservation planning processes already underway in other watersheds throughout the American West:

1) What specific water conservation strategies have been adopted in other plans and which have proven effective?
2) What challenges were encountered in these other water conservation planning and implementation processes? How were these challenges addressed and what advice do those involved have for the Roaring Fork Watershed clients?
3) How was collaboration fostered between the various parties at a regional or watershed scale and what factors appear to be facilitating their sustained interaction?

In addition to plan development and conservation strategies, the clients also seek to better understand what water conservation education and outreach programs have been used elsewhere that have effectively influenced the conservation behavior of municipal water users.

OBJECTIVES

The goal of this project is to provide analysis and recommendations for the clients to help guide their efforts to develop and implement a successful regional water conservation plan and water conservation education/outreach campaign. Specifically, the project team will provide recommendations for this multi-jurisdictional initiative based on research and analysis of current Roaring Fork Watershed institutional and ecological conditions, other regional water conservation planning processes including those conducted pursuant to the CWCB planning process, and other water conservation education/outreach programs.

RESEARCH OVERVIEW & METHODOLOGY

The majority of the research conducted for this project can be divided into two main categories–regional conservation case studies and analysis, and education/outreach campaign strategies. A different methodology was used for the two categories. While different in approach, the goal of both methodologies was to find cases and campaigns that bear similarities or had relevance to the Roaring Fork Watershed, thus making the recommendations drawn from these cases and strategies more relevant to the clients.

All research into regional water conservation planning processes was conducted using a case study methodology. Case study methodology is a well-utilized research method within both scientific and social science disciplines, as it is particularly useful for formulating detailed situational assessments and as a means of examining the impact of ideas and methods on real-life contexts. The case studies presented in this report were developed through the following steps:

1) Identify key case criteria that reflect the clients' core planning interests;
2) Identify a set of suitable case studies of potential value to the project;
3) Apply case criteria to select a subset of cases warranting in-depth analysis;
4) Acquire information about each case study from primary and secondary sources;
5) Analyze case study data in a manner consistent across all cases; and
6) Conduct a cross-case analysis to derive overarching recommendations for the clients.

For Step 4, the project team collected data on each case study by conducting interviews with plan participants, reviewing planning and implementation documents, and reviewing related information about the planning organizations, planning locations, and legal contexts in which each plan operates.

To select the cases to be studied, the project team first compiled a list of water conservation planning efforts that occurred west of the Mississippi River, where water law and water scarcity would most likely mirror the context of the Roaring Fork Watershed. The project team developed a set of criteria to help narrow case selection down to those most similar to the Roaring Fork Watershed. The project team relied primarily on four critical characteristics to identify relevant cases: regional planning scale or multi-jurisdictional collaboration, presence of tourism and agriculture, water scarcity impacts on an area, and the similarity of the area's water law to Colorado's. Finally, through discussions with the clients and project adviser, the project team identified six cases deemed most applicable to the Roaring Fork Watershed. The final set of cases selected for analysis were: Steamboat Springs, CO; Grand Valley, CO; Upper Verde River, AZ; Santa Fe County, NM; Blackfoot Challenge, MT; and Deschutes River Basin, OR.

The project team conducted research into education and outreach strategies through a review of existing literature. Project team members met with Dr. Michaela Zint from the University of Michigan School of Natural Resources and Environment, who specializes in education strategies and theories to change human behavior and decision-making on environmental and natural resource issues. Dr. Zint provided initial guidance on appropriate academic studies of effective environmental education and outreach campaigns. The project team analyzed the relevant studies and investigated the literature available on how water conservation education/outreach campaigns applying recommended strategies were implemented.

Geographic Scope

As discussed above, due to the unique nature of water law in the American West, the geographic scope of the case study portion of this project was limited to watersheds in western states. The education/outreach research cast a wider net and included water conservation education/outreach campaigns from around the world, while placing priority on campaigns located in contexts similar to the Roaring Fork Watershed. The ecological component of the report, found in Part VII, focused exclusively on the Lower Crystal River in the Roaring Fork Watershed.

OVERVIEW OF REPORT

This report is divided into eight major sections:

Part I described the clients and the project, as well as the methods used by the project team.

Part II provides a general overview of Colorado water law, regional water conservation planning, and the Roaring Fork Watershed. This section is intended to establish a broad backdrop to the setting of the project.

Part III contains a summary of interviews with irrigators and water providers conducted by the project team in the Roaring Fork Watershed in July 2013. This section highlights recommendations gathered from these interviews and provides context for the cross-case analysis recommendations.

Part IV details the case study selection criteria and methodology. It also contains the cross-case analysis, which synthesizes different approaches to regional water conservation planning and concludes with a set of recommendations derived from the case studies.

Part V contains the six case studies: Steamboat Springs, CO; Grand Valley, CO; Upper Verde River, AZ; Santa Fe County, NM; Blackfoot Challenge, MT; and Deschutes River Basin, OR.

Part VI presents an analysis of water conservation education/outreach campaign approaches. The purpose of this section is to highlight possible education/outreach campaign strategies for the Roaring Fork Watershed.

Part VII contains a summary of hydrologic and ecological data from the Lower Crystal River in Carbondale, CO to determine the impacts of water diversions on the biological integrity of the Lower Crystal River.

Finally, Part VIII presents a summary of the project team's conclusions and recommendations for the clients as they embark on their regional water conservation planning process.

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[1] Roaring Fork Watershed Collaborative, http://www.roaringfork.org/sitepages/pid169.php
[2] Roaring Fork Conservancy, http://www.roaringfork.org/sitepages/pid16.php
[3] Ruedi Water and Power Authority, http://www.rwapa.org/who_we_are.html
[4] Community Office for Resource Efficiency, http://aspencore.org/

PART II: BACKGROUND

COLORADO WATER LAW

Colorado's history, like that of many western states, has been defined by conflicts over competing demands on scarce water resources. In fact, the Colorado River has been called "one of the most used and contested waterways on Earth."[1] Since its inception as a state, Colorado has upheld the Colorado Doctrine, a strict interpretation of the prior appropriation doctrine. Under the Colorado Doctrine, the right to divert unappropriated waters of any natural stream in order to put the water to beneficial use cannot be denied.[2] The doctrine also stipulates that priority of use of water is given to those who first appropriated it and put it to beneficial use.[3] Use of water from the Colorado River is also governed by the Colorado River Compact, an agreement between the seven states in the Colorado River Basin that dictates water allocations for upper and lower basin states. Both the Colorado Doctrine and the Colorado River Compact are bounds within which water management efforts in Colorado must operate. In effect, these two systems often severely constrain water conservation and aquatic ecosystem restoration efforts.

Colorado, unlike many western states, is a water producing and exporting state that has many mountain ranges from which the rivers in the state are supplied. However, much of the flow is seasonal and, despite the occasional heavy snow year, population and development increases in Colorado and other western states combined with drought and rising temperatures due to global warming have strained Colorado supplies. Colorado water use is further complicated because the state's major population centers are located in the most arid part of the state–80% of the state's population lives in the half of the state that receives about 20 percent of the precipitation.[4] These factors will continue to place increasing pressure on water resources in Colorado. A recent Department of the Interior report analyzing supply and demand of Colorado River Basin water resources over the next 50 years projected that water demand will outstrip supply by more than 3.2 million acre-feet by 2060.[5]

At the same time, the health of freshwater aquatic and riparian ecosystems depends on maintaining, and in many cases increasing, instream flow levels. The freshwater ecosystems of the Colorado River and its tributaries, such as the Roaring Fork, are already imperiled due to the long-term presence of dams, the introduction of invasive species, land conversion, and overuse and increasing diversions of river flows.[6]

ROARING FORK WATERSHED

The Roaring Fork Watershed is located on the western slope of the southern Rocky Mountains in Colorado. Two main tributaries, the Fryingpan River and the Crystal River, join the main stem of the Roaring Fork in Basalt and just downstream of Carbondale, respectively. The watershed extends from the headwaters at Independence Pass to the confluence with the Colorado River 70 miles downstream at Glenwood Springs.[7] The watershed drains 1,453 square miles,[8] and contributes 943,000 acre-feet of water per year to the Colorado River.[9] Three large-scale transmountain diversions are located within the watershed: the Twin Lakes-Independence Pass Transmountain Diversion System, the Fryingpan-Arkansas Project, and the Busk-Ivanhoe Project.[10] Diverse ecosystems exist throughout the watershed, including alpine tundra, spruce-fir forests, aspen

groves, oak and sage shrublands, and pinyon-juniper woodlands.[11] Elevations range from 5,717 feet to 14,235 feet. Climate, geology, and land cover vary greatly across the watershed.†

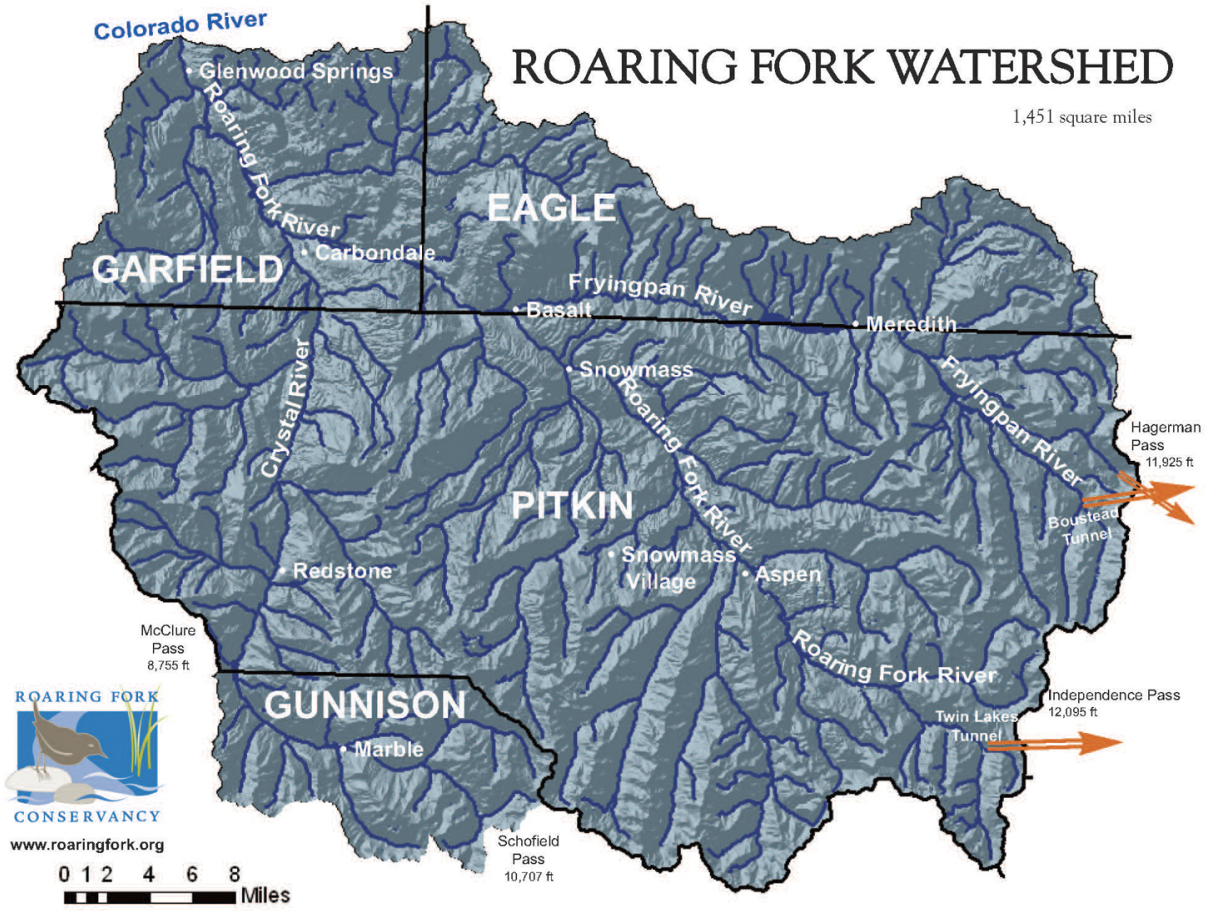

Figure 1: Map of Roaring Fork Watershed (credit: Roaring Fork Conservancy).

Ecologically, the Roaring Fork Watershed contains essential habitat for many terrestrial and aquatic organisms. Aquatic species include fish such as the Colorado River cutthroat trout, brown trout, rainbow trout, flannelmouth sucker, mottled sculpin, and mountain whitefish. Bird species that utilize the riparian zone include bald eagle, great blue heron, ospreys, willow flycatcher, and many more. Many trout species (e.g. brook trout, rainbow trout) have been introduced to the Roaring Fork Watershed and can impact native species.‡ Biologists have identified rare plants and animals and unique plant communities in the Roaring Fork Watershed, especially within riparian areas.[12]

From an anthropocentric perspective, the Roaring Fork River and its tributaries provide many invaluable ecosystem services to the region, including recreation, maintenance of biodiversity, nutrient cycling, waste decomposition, dissipation of floodwaters, and water for domestic, industrial, and agricultural purposes.

† See State of the Watershed Report 2008, Chapter 1 for additional details.
‡ See the State of the Watershed Report 2008, Appendix 1.3 for a full list of native riparian and instream species of concern.

Riparian and instream ecosystems in the Roaring Fork Watershed are impacted by development and urbanization, water quality impairment, and loss of natural streamflow due to local and transmountain diversions.[13] Historical mining and ranching have had impacts on riparian vegetation and water quality. As a result of ranching, bank instability, degraded riparian habitat, and homogenous instream reaches occur throughout the watershed, especially on lower reaches.[14] Mining impacts are mostly historical, but there is potential for new mining impacts. Mining can have major impacts on water quality by adding non-point source contaminants to surface water. Development and urbanization, mainly to accommodate tourism, have led to an increase in impermeable surfaces, including extensive road building. Piecemeal habitat modifications may be the most significant impact on fluvial and riparian habitat in the valley.[15] There is no single contributor to habitat impairment or destruction, but the impacts are compounded throughout the river catchment area. Additionally, flow regime alteration can impact riparian vegetation that is key in creating shade (which regulates water temperature), habitat, and food for aquatic and terrestrial species.[16] Flow regimes change the inundation cycles of river and stream banks, thereby affecting the type of riparian communities that are able to exist.

Reduced flows are of major concern as the demand for water continues to increase in the Roaring Fork Watershed. Due to diversions and the hot and dry summer of 2012, sections of the Roaring Fork River were running significantly below the levels that are necessary to maintain ecosystem health. Diversions depleted incoming stream flows in some segments by 80%.[17] Dewatering of stream reaches eliminates connectivity, which is problematic for many aquatic organisms, as connectivity can be essential for foraging, reproduction, and survival in general. Almost 140 of the 185 miles of streams surveyed in the Roaring Fork Watershed in 2012 had moderately modified to severely degraded riparian habitat.

Climate change will likely exacerbate many existing issues that impact the ecological health of instream and riparian communities. More extreme drought events in arid regions may intensify low flow conditions.[18] Climate change in the Roaring Fork Watershed may also lead to warmer temperatures, more precipitation as rain, decreased snowpack, earlier snowmelt, and decreased runoff.[19]

REGIONAL WATER CONSERVATION PLANNING

Water conservation planning in the western United States has necessarily taken a variety of forms due in large part to the complicated nature of laws and policies governing water use and allocation and the multiplicity of stakeholders and jurisdictions involved in water management. To overcome these challenges, organizations and government agencies in states across the western U.S. have developed innovative efforts focused on increasing municipal and agricultural water use efficiency. An emerging strategy in water resource management is regional water conservation planning. While relatively few regional water conservation plans have been (or are being) implemented, such plans are becoming more common as a water management tool in watersheds that span multiple jurisdictions because they encourage cross-boundary collaboration by bringing together stakeholders within the entire watershed.

COLORADO WATER CONSERVATION BOARD

The state of Colorado has embraced water conservation planning, including regional scale planning efforts. Colorado's statewide water policy agency, the Colorado Water Conservation Board ("CWCB"), is charged with helping ensure that Colorado has adequate water to meet all of the state's water needs. The Water Conservation Act of 2004 tasked the CWCB with developing minimum water efficiency plan components and required that all water providers selling more than 2,000 acre-feet of water annually develop a water efficiency plan meeting CWCB requirements. The CWCB guidelines support regional planning efforts, thus allowing multiple water providers within a region to jointly develop a plan. In addition, the CWCB helps support plan implementation through funding, planning support, data collection and analysis, and outreach and technical assistance.[20]

The approval process for regional water conservation plans is governed by CWCB guidelines.[21] The CWCB will approve a regional water conservation plan if the plan has met the minimum statutory requirements and meets these guidelines; in these cases, the submitting entity may proceed with the implementation of the Water Conservation Plan as submitted.[22] If the submitting entity's plan has "substantially" met the minimum statutory requirements and "substantially" meets these guidelines, the CWCB will conditionally approve the plan, and the submitting entity may proceed with the implementation of the water conservation plan as submitted, subject to certain required modifications or conditions set forth by the CWCB.[23] Finally, if the plan has not met the minimum statutory requirements and/or is inconsistent with the guidelines, the CWCB will dismiss the plan with modifications, and the submitting entity has 180 days to correct the stated deficiencies and resubmit the plan.[24]

The minimum requirements for a water conservation plan are laid out in Colo. Rev. Stat. 37-60-126, and attached as Appendix A.

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[1]National Geographic, "Eight Mighty Rivers Run Dry from Overuse," accessed Feb. 24, 2013.
[2]Western Rivers Institute, "Pure Appropriation, the 'Colorado Doctrine,'" accessed Feb. 23, 2013, http://westernriversinstitute.org/?page_id=365
[3] Ibid.
[4] Roaring Fork Watershed Plan, Introduction, March 2012.
[5] U.S. Department of the Interior, "Colorado River Basin Water Supply and Demand Study," March 2013.
[6] National Parks Conservation Association, Press Release, "New Colorado River Study Finds Water Uses Impair the Health of National parks in the Southwest," 4/26/2012, http://www.npca.org/news/media-center/press-releases/2011/new-colorado-river-study.html.
[7] Clarke, S., K. Crandall, J.C. Emerick, M. Fuller, M. Katzenberger, D. Malone, Masone, A. Slap, and J. Thomas. 2008. State of the Roaring Fork Watershed Report.
[8] Ibid.
[9] Malone DG and JC Emerick. 2007. Roaring Fork Stream Health Initiative.
[10] Clarke, S., K. Crandall, J.C. Emerick, M. Fuller, M. Katzenberger, D. Malone, Masone, A. Slap, and J. Thomas. 2008. State of the Roaring Fork Watershed Report.
[11] Malone DG and JC Emerick. 2007. Roaring Fork Stream Health Initiative.
[12] Clarke, S., K. Crandall, J.C. Emerick, M. Fuller, M. Katzenberger, D. Malone, Masone, A. Slap, and J. Thomas. 2008. State of the Roaring Fork Watershed Report.
[13] Ibid.
[14] Malone DG and JC Emerick. 2007. Roaring Fork Stream Health Initiative.
[15] Ibid.
[16] Pusey, B.J. and A.H. Arthington. 2003. Importance of the riparian zone to the conservation and management of freshwater fish: a review. *Marine and Freshwater Research* 54: 1-16.; Scott, M.L., S.K. Skagen, and M.F.

Merigliano. 2003. Relating geomorphic change and grazing to avian communities in riparian forests. *Conservation Biology* 17: 284-296.

[17] Ibid.

[18] Poff, N. L., M.M. Brinson, and J.W. Day. 2002. Aquatic ecosystems and global climate change: Potential impacts on inland freshwater and coastal wetland ecosystems in the United States. Pew Center on Global Climate Change.

[19] Clarke, S., K. Crandall, J.C. Emerick, M. Fuller, M. Katzenberger, D. Malone, Masone, A. Slap, and J. Thomas. 2008. State of the Roaring Fork Watershed Report.

[20] http://cwcb.state.co.us/legal/documents/guidelines/guidelinestoreviewevaluatewcplans.pdf

[21] Ibid.

[22] Ibid.

[23] Ibid.

[24] Ibid.

PART III: MUNICIPAL UTILITY AND IRRIGATOR PERSPECTIVES ON WATER CONSERVATION PLANNING IN THE ROARING FORK WATERSHED

INTRODUCTION

Figure 1: Water storage reservoir at the City of Aspen Water Department.

Interviews were completed in July 2013 with representatives from the five water utilities – Aspen Water Department, Basalt Water Department, Carbondale Water & Sewer Department, Glenwood Springs Water Department, and Snowmass Water & Sanitation District – that have signed the Memorandum of Understanding for the regional water conservation planning effort.[§] Interviews were also completed with several ranchers in the Roaring Fork Watershed and a local consulting firm, SGM, which has developed a number of water conservation plans in the region. The aim of these interviews was to determine each stakeholder groups' interests, perceived challenges, and recommendations for regional water conservation planning in order to better inform case study selection and analysis and to determine interests and the level of support for the planning process in the Roaring Fork Watershed.[**] Particularly relevant points are bolded in the following analysis.

INTERESTS OF MUNICIPAL WATER PROVIDERS AND IRRIGATORS

Representatives of the five water providers were asked questions about their level of interest in the regional water conservation plan, their objectives for the plan, and their level of desired involvement in the planning process. Irrigators were also asked about their interest in a regional plan and about the value of the plan. Water provider responses highlighted three overarching interests: regional collaboration, community and ecological benefits, and a focus on outdoor water use. Irrigators indicated that they desire increased leadership by municipalities in water conservation.

[§] The following individuals were interviewed from each water provider:
City of Aspen: Mike McDill, Lee Ledesma, Rob Covington, Jeff Rice, and Valerie Forbes
Town of Basalt: Bentley Henderson (Public Works Director)
Town of Carbondale: Mark O'Meara
City of Glenwood Springs: Jerry Wade
Town of Snowmass Village: Kit Hamby, Chirstie Duckett, and Shannon Ullmann (Consultant)

[**] For the interview protocol used in these interviews, see Appendix B.

Collaboration

All five water providers indicated that they are interested in collaborating to some degree with other utilities in the Roaring Fork Watershed. Aspen is interested in effectively ***delivering consistent water conservation messaging*** in the Roaring Fork Watershed through collaboration with other utilities. Basalt wants to ***show solidarity*** with the region in terms of recognizing the importance of water resources and the demands on water in the region. Carbondale supports cooperation and collaboration among utilities because utilities and other organizations are working on ***similar conservation measures*** throughout the Valley. As Glenwood Springs already has an approved CWCB plan in place, they are mainly interested in collaborating with other water providers to ***provide guidance*** as other utilities develop water conservation plans. Snowmass Village originally signed the Memorandum of Understanding for the regional water conservation plan because they could see the value of collaboration, especially in terms of creating ***more effective education and outreach*** initiatives.

Achieving Benefits of Water Conservation

Carbondale feels an obligation to implement a water conservation plan because they are concerned about the overall ***health of the river systems and of people downstream***. Snowmass Village is interested in a water conservation plan in order to ***show the agricultural community that the municipality is not wasting water***. Aspen feels strongly that the West Slope needs to ***show that the water is being put to beneficial use*** so the Front Range cannot claim that water is being wasted. SGM noted that with a water conservation plan in place, municipalities might be more ***sheltered from claims of abandonment***. Once a municipality incorporates all of its water rights into a water conservation plan, the municipality has the opportunity to implement water conservation measures that protect its water supply from abandonment.

Advancing Xeriscaping and Minimizing Outdoor Water Use

Basalt expressed interest in the water conservation potential of ***xeriscaping***. Carbondale also stated interest in focusing on ***water-friendly outdoor landscaping practices***, such as using drought- tolerant plants and maintaining appropriate lawn heights.

Municipal Leadership Desired by Irrigators

Irrigators in the region have slightly different perspectives on conservation as compared to the municipalities. Some irrigators feel that ***ranchers are more concerned and aware of water conservation measures than the municipalities***. Ranchers use water more conservatively because their livelihood is based on water use and availability. Therefore, if the ***municipalities would take the lead on ditch efficiency***, ranchers may be more likely to cooperate in regional conservation measures. They feel that ***municipal leadership is important***, and the regional water conservation plan would help demonstrate this leadership.

WATER CONSERVATION STRATEGIES

Utilities and irrigators were asked questions about existing water conservation strategies and the effectiveness of these strategies. Their responses were varied but strategies included outdoor watering restrictions, tiered rate structures, outreach programs, implementation of strategies contained in existing water conservation plans, more effective measurement of water diversions, and adoption of construction industry standards for water efficient appliances and fixtures.

Outdoor Watering Restrictions

Carbondale adopted ***watering restrictions*** during the drought of 2012, but they have some reservations about the effectiveness of this strategy because people seemed to utilize a similar amount of water with and without restrictions. Glenwood Springs has a ***water waste ordinance with a fine schedule*** and they have worked to enforce this ordinance. Basalt has ***water use suggestions*** for the summer, such as no watering days, but these suggestions are not enforceable.

Other Water Conservation Strategies

Aspen has existing water conservation plans from 1992 and 1994. They do not have a more recent plan but they are heavily involved in water conservation work. They implemented a ***tiered rate structure*** in 2006, developed an active ***outreach program***, started installing two-way meters, and utilized ***construction industry standards*** to increase efficiency. Carbondale has started ***installing new flumes and automatic headgates*** on some ditches to more accurately gauge the amount of water being taken from surface water bodies. Glenwood Springs meters all water as of 2001, and they have a progressive rate structure for water users. Snowmass Village has been working on a water conservation plan for the past few years. Additionally, Snowmass Village has built a ***new reservoir to meet stewardship goals*** for instream flows; they have also focused on removing leaks from their system and are only losing five percent from the system.

CHALLENGES TO REGIONAL WATER CONSERVATION PLANNING

Water providers were asked questions about the major issues that may arise during the planning and implementation process and what their major concerns were for regional water conservation planning. Municipalities foresaw a range of challenges, including difficulties with regional collaboration, limitations to decreasing outdoor water use, influencing second homeowners and tourists, conflicts with water rights and downstream water users, effects of conservation on revenue, and municipality-specific challenges.

Inhibitors to Regional Collaboration

Interviewees perceive multiple challenges to the collaborative water conservation planning process. These challenges include logistics, jurisdictional concerns, consistent participation, equitable investment, and involvement of the agricultural community.

Two water providers, Basalt and Carbondale, expressed concerns about how to logistically organize the plan because ***getting all of the stakeholders together has proved challenging*** in the past.

Basalt feels that there will be competing interests and territorial interests because there are multiple town councils and other ***jurisdictional issues***. Additionally, based on past experiences with the Roaring Fork Watershed Collaborative††, Carbondale has concerns about all member groups successfully working together because ***people do not consistently attend meetings***. On a slightly different note, Glenwood Springs indicated that they have already approved funds for the plan and are hopeful that ***all member groups will provide an equitable amount of time and money*** across the region. Additionally, Aspen mentioned that there are differences in viewpoints about water conservation in each community, and they feel that some people have negative perceptions about Aspen. Carbondale stated that ***incorporating the agricultural community*** will be a challenge because of the culture of the water rights situation and legislative issues.

Limitations to Reducing Outdoor Water Use

Interviewees expressed that social norms regarding water use, lack of homeowner control, and open ditch systems challenge conservation efforts to limit outdoor water use.

All five municipalities indicated that homeowners throughout the Roaring Fork Watershed want ***green lawns regardless of the monetary cost***. Snowmass Village specifically cited hobby ranches that utilize a lot of water even though those properties are not necessarily being used for agricultural purposes. These ***social norms*** are likely going to be a challenge to effectively creating water conservation strategies to curb outdoor water use.

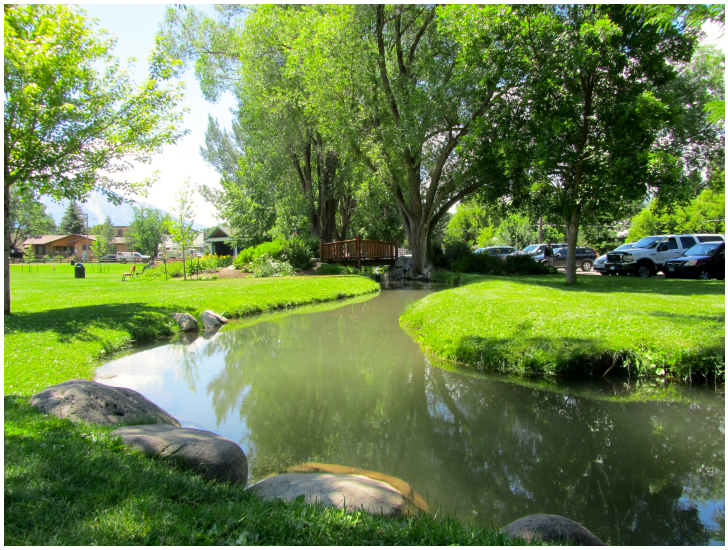

Figure 2: Open ditch system running through Sopris Park in the Town of Carbondale.

In addition, ***many homeowners are not in charge of their own irrigation***; either property managers or landscaping businesses are responsible for lawn maintenance. As a result, communicating water conservation strategies has been a challenge throughout the Roaring Fork Watershed in the past. Carbondale and Aspen both utilize open ditch systems for outdoor watering. These ***open ditch systems are difficult to meter*** or are unmetered, so effectively measuring water conservation will be complex.

Influencing Tourists and Second Homeowners

Effectively getting ***messaging about water conservation to second homeowners and tourists*** is a challenge faced throughout the Valley and was mentioned by multiple water providers, including Aspen, Basalt, and Snowmass Village.

†† Discussed in Part I of this report.

Water Rights, Downstream Water Use, and Conservation

Interviewees noted that ***resistance to water conservation is rooted in users' perceptions that downstream users will benefit from their sacrifice***, and a fear that water rights will be lost. Difficulties in measuring water use and concerns about impact on crop production and ranchland were also expressed.

Snowmass Village mentioned that people are resistant to water conservation because downstream users take the water and the water does not remain in the creek for ecological benefit. Carbondale also noted that they would like to increase instream flows, but they have fears about not utilizing enough water and ***jeopardizing the town's water rights***.

Similarly, irrigators concur that a major problem with leaving water in the river is that downstream users can pull the water out. Due to river geomorphology, it is extremely ***challenging to measure how much water is staying in the river*** and how much people are pulling out in comparison to their rights. Ranchers also noted that people like the concept of increased instream flows, but they are hesitant to decrease water consumption because they may ***incur personal costs***. Irrigators let water through the ditches for downstream irrigators, but they are not willing to conserve water that may lead to ***claims of abandonment*** or to conserve water that will jeopardize crop production or ranchland.

Conflicts between Conservation Objectives and Revenue Needs

Basalt indicated that they have a ***vested interest in increased water consumption in order to generate revenue*** for the utility. SGM, a local consulting firm, stated that every utility cares about the financial piece, and the City of Aspen noted that its budget is tight too, despite its constituents' financial status. They note the importance of including rate evaluations and rate studies as part of the planning process. Municipalities need to know that when they start conserving, they need to have mechanisms to maintain budgets.

Municipality-Specific Challenges

Some municipalities noted specific challenges due to water resource management issues unique to particular areas. Basalt has concerns because the ***town is divided between two water providers***, one of which, Mid-Valley Metro, is not participating in the regional plan. This divide could lead to conservation measures occurring on the east side of town while the west side of town does not have to implement these same measures.

Snowmass Village has had many issues in the past with lawsuits by the Capital Creek Caucus, a local grassroots group. As a result of this ***litigation about instream flows***, the town has serious concerns about the relationship between the water conservation and drought management plans. They are nervous that a regional conservation plan will be tied to a drought plan that will affect the flow triggers. They began developing a municipal-level conservation plan because they have received grassroots pressure from the Capitol Creek Caucus and want to show diligence in the face of public pressure in implementing stewardship goals in the creeks where they draw water.

RECOMMENDATIONS BY MUNICIPAL UTILITIES AND IRRIGATORS FOR THE PLANNING PROCESS

In response to questions about who should be involved in the planning process and what should be included in the regional plan, irrigators, municipal utilities, and SGM responded with a variety of recommendations. Utilities were particularly interested in an inclusive planning process, effective regional outreach and messaging strategies, and targeted marketing strategies for particular groups, such as landscaping professionals. SGM also highlighted the value of inclusiveness and diversity in the planning process. Irrigators recommended that discussing water conservation with the ranching community is essential to create an effective regional plan.

Collaborative Planning Process

All interviewees recommend following an ***inclusive, collaborative planning process***. Aspen recommends that all utilities find common ground so they can ***convey the same message about water conservation*** throughout the Valley. They feel that non-profits, such as CORE and the Roaring Fork Watershed Collaborative are good platforms for collaboration because they can bridge jurisdictional boundaries that municipalities are not able to cross.

SGM notes the importance of ***inclusiveness and collaboration throughout the planning process***. They recommend that water attorneys and elected officials should be involved and public engagement should be part of the planning process. They believe that the ***process is key*** and is more important than the plan. They recommend ***diversity in the participants involved*** in plan development and argue that the plan will be easier to sell if the process works and the municipality has a good plan. SGM also feels that having an ***individual champion of the plan is key***, but that this ***champion needs to stay involved*** throughout the planning process and plan implementation.

Messaging and Outreach Strategies

Interviewees recommended messaging and outreach strategies that embody region-wide branding, target in-home use, and spotlight benefits to river and stream health.

Basalt recommends that water conservation strategies should focus on ***targeting home usage and increasing awareness about leaks***. Specifically, Basalt recommends creating a campaign around in-home use and accounting for water wasted through leaks. Carbondale recognizes that plans will have to differ for each municipality in order to fit with municipal code, but ***the foundation should be the same*** across the region. Carbondale also recommends a ***strong education component that creates a recognizable brand*** across the Valley, and this outreach should be ***marketed toward residents and lawn care industry professionals***. Irrigators suggest that messaging should focus on river and stream health to motivate water conservation because people in the Roaring Fork Watershed are very connected to and concerned about the natural environment.

From SGM's perspective as consultants, they have recognized the ***effectiveness of public education***. Efforts to communicate to the public where water comes from, how water is delivered to a water plant, and how the water system works may help make a connection so people start paying attention to water resources and are more willing to conserve water on a voluntary basis.

Importance of Considering Ranching Community Perspectives

Figure 3: Ranchland in the Roaring Fork Valley is commonly irrigated with sprinkler and/or flood irrigation.

Irrigators feel that paying ranchers to dry up a certain part of their crops is not an effective conservation strategy because most ranchers grow perennial crops in the region. They are more open to leaving more water in the river as long as they ***maintain discretion over where they utilize the water they take***. People need to keep irrigating and keep farming, but irrigators recognize that they should try to ranch with the least impact possible. They recommend that ***talking to ranchers is essential*** if one is interested in water or water conservation.

Ranchers recommend that the ***unintended effects of water resource management*** changes should be considered. They noted that flood irrigation, a practice commonly used in the Roaring Fork Watershed, recharges the groundwater. Several irrigators provided anecdotes about the impacts of irrigators shifting from flood irrigation to sprinkler irrigation. After the transition to sprinkler irrigation, they have noticed that neighbors' wells have run dry, nearby state fish hatcheries have not received adequate spring water, and there have been changes to seasonal water levels in the river.

Other Recommendations

Glenwood Springs recommends ***enforcement mechanisms*** in order to successfully decrease water use. Snowmass Village focuses more on winter conservation, a focus that is different than most other utilities in the region, but they recommend creating more summer water conservation strategies. Aspen noted that ***all five municipalities obtain water from unique geographic areas***, so the regional plan will need to be fairly site specific; however, these differences may be beneficial because water utilities will not argue over water rights or access to water resources.

IMPLICATIONS FOR REGIONAL PLANNING

Broad Support for Collaborative Planning

All five utilities expressed strong support for a collaborative water conservation planning process. This overlapping interest in collaboration is a promising sign for the regional water conservation planning effort. While each municipality has varying motivations for signing on to the regional plan, all utilities recognize the value of working together to share water conservation ideas and to more effectively develop education and outreach strategies for the Roaring Fork Watershed. However, several water providers also indicated that while they value collaboration, the reality of

collaboration might be challenging. Based on past experiences with other collaborative efforts in the region, some water providers are skeptical because people do not consistently participate in meetings or other collaborative events. The organizational structure and planning process will be key to get all stakeholders to work together on a regular basis. Additionally, the differing perceptions among the municipalities and the agricultural community are a challenge that needs to be addressed. Irrigators tend to feel that municipalities are less prone to create effective water conservation strategies as compared to the agricultural community. The regional plan may help irrigators see that municipalities are taking action on water conservation. While the interests of the agricultural community and the municipalities differ, the regional effort may be an opportunity to unite the range of stakeholders in the Valley.

Particular Interest in Conservation Strategies Addressing Outdoor Water Use

Several water providers addressed an interest in similar water conservation strategies, particularly in terms of outdoor water use. While these overlapping interests will likely be helpful for regional planning, all utilities also mentioned outdoor water use and irrigation as a major challenge in the region. People tend to maintain green lawns regardless of the monetary cost. This behavior is a cultural norm that will likely be challenging to alter with the water conservation plan, although outreach initiatives may be a strategy to educate residents about appropriate watering strategies. A further challenge is that many homeowners are not in charge of lawn maintenance because they hire landscaping companies or property managers. The regional plan will need to consider this reality in order to effectively target water conservation strategies to the appropriate people.

Widespread Interest in Delivering Targeted Regional Messaging and Outreach

Many water providers already have existing water conservation education and outreach campaigns. Several municipalities suggested that regional water conservation outreach should be a focus of the plan. However, some utilities noted that water conservation is sometimes challenging because people in the region tend to feel that downstream users will simply remove the conserved water, especially the Front Range, so the water will not remain in the river for ecological benefit. They also noted that reaching out to second homeowners and tourists is a challenge. The regional plan will likely need to consider effective approaches for delivering targeted messaging strategies for different water users throughout the Roaring Fork Watershed.

Recognition of the Importance of Measuring Water Conservation

Ranchers and municipalities mentioned the challenge of measuring conserved water, particularly in the ditch and river systems. Ditches in several municipalities are unmetered or difficult to meter, so savings from outdoor water conservation may be hard to quantify. Additionally, irrigators mentioned that due to river geomorphology, water conserved for instream flow is nearly impossible to quantify. The regional plan will need to consider ways to measure the effects of water conservation strategies

PART IV: CASE STUDY SELECTION & CROSS-CASE ANALYSIS

To provide insights to the clients as they embark on development of a regional water conservation plan in the Roaring Fork Watershed, the project team examined six cases of regional-scale western water conservation planning. Within each case study, the project team focused on three major areas of research: the *motivation* for plan development, the structure of the *planning process*, and *plan implementation*. The following analysis uses information gleaned from the case study research to identify both major factors that facilitated progress in plan development and implementation as well as challenges that confronted plan participants and hindered the planning or implementation process. From this analysis, the project team developed a set of recommendations for regional water conservation planning in the Roaring Fork Watershed. These recommendations will likely be of value to other western regional water conservation planning efforts as well.

CASE STUDY RESEARCH METHODOLOGY

The project team sought to identify cases in similar watersheds in the American West that would provide insights about the clients' questions. Using a case study approach in this manner allowed the project team to research specific planning and collaborative processes and to prioritize cases that are similar to and, therefore, more relevant to the Roaring Fork context.

In order to gain an understanding of what regional water conservation plans are currently being implemented or developed in western states and to gauge their relevance to the Roaring Fork context, the project team conducted a preliminary case study exploration. The project team allocated 17 states that lie west of the Mississippi River among the four project members and tasked each project member with researching water conservation plans and planning processes in the assigned states. The states examined were: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. The preliminary case exploration focused on searches using the following keywords: water + conservation + planning + regional + "state name." The project team also searched the resources of each state agency responsible for water management, water conservation planning, and/or water permitting looking for approved conservation plans, organizations and municipal suppliers that had won awards for conservation efforts, and agency reports detailing water conservation efforts within its jurisdiction. The team also contacted state water agencies and state research universities when appropriate.

Additionally, project team discussions with Andrew Fahlund, Executive Director of the Center for Water in the West at Stanford University, and with project faculty advisor, Dr. Julia Wondolleck, yielded several potential avenues of research. The project team also looked at literature on water conservation, including an American Rivers and Environmental Law Institute report entitled "Water Efficiency for Instream Flows: Making the Link in Practice" and the 2010 School of Natural Resources Master's Project "Fostering Implementation of the Roaring Fork Watershed Plan." Finally, the project team looked to the public resources provided by organizations such as the Alliance for Water Efficiency, American Rivers, and Western Resources Advocates that work in the area of water conservation and efficiency.

The project team developed a set of criteria to guide the case selection process. The ultimate aim of the selection process was to identify 4-6 case studies that were similar to the Roaring Fork

Watershed context in terms of 1) the physical characteristics of the plan coverage and development area and 2) the characteristics, components, and objectives of the plan itself.

Plan Coverage and Development Area Characteristics:

- **Does the region have an agriculture presence?** Over 80% of water used annually in the state of Colorado is for agricultural purposes. Only 2.4% of the Roaring Fork Watershed is agricultural land, but agricultural water diversions still have a significant impact on water levels.
- **Is there significant public land holdings located in the area covered by the plan or within the plan watershed?** Seventy-six percent of the land within the Roaring Fork Watershed is federally owned. The presence of significant portions of public land is an important characteristic of the watershed.
- **Does the region have a tourism industry?** The Roaring Fork Watershed's economy relies heavily on tourism and outdoor recreation. Low instream flows can have detrimental impacts on outdoor recreation activities and hence the local economy.
- **Does the region suffer from water scarcity?** The Colorado River, which the Roaring Fork River feeds into, is one of the most contested and imperiled waterways in the country. The Roaring Fork and Crystal Rivers have seen a dramatic loss of streamflow in recent years.
- **Is the water law regime similar to that in Colorado**? Since its inception as a state, Colorado has upheld the Colorado Doctrine– a strict interpretation of the prior appropriation doctrine.

Plan Characteristics:

- **Are the plan components, objectives, and development process similar to that of the Roaring Fork Watershed clients and the Colorado Water Conservation Board ("CWCB") process and requirements?** To maximize the relevance of the lessons gleaned from the case studies, it would be best if the case study plans had similar components and planning process to that entailed under the CWCB.
- **What is the target audience of the plan?** The clients are specifically interested in municipal water use efficiency, as that is what the CWCB plans cover. However, plans that also address agriculture water conservation are relevant, as agriculture diversions impact stream flow within the Roaring Fork Watershed.
- **Is the plan advisory or is the plan enforceable?** Many water conservation plans are advisory only. The clients expect that elements of the final regional water conservation plan will be binding and other parts will be advisory, and therefore they are interested in examples of both approaches.
- **Is the plan conducted on a regional scale or is there an aspect of collaboration across a broad geographic, multi-jurisdictional area?** The clients wish to implement a regional water conservation plan, so recommendations specific to the dynamics and pitfalls of regional or multi-jurisdictional water conservation planning are critical.
- **Does the plan address instream flows or fluvial/aquatic ecosystems?** One of the clients' aims for the regional water conservation plan is to see conserved water put towards increasing instream flows and improving fluvial ecosystem health. Not all water conservation plans address instream flow maintenance. Plans that do recognize the objective of dedicating conserved water to instream flows can provide a better understanding of how best to achieve this goal within the Roaring Fork Watershed context.

From the preliminary research, the project team identified 28 potential cases, listed in Table 1. Each of the 28 cases was evaluated on how well it met the above criteria. The highest priority was given

to the following criteria: regional planning scale (or multi-jurisdictional collaboration), presence of tourism and agriculture, areas impacted by water scarcity, and the similarity of the relevant water law to that of Colorado. Characteristics that were not included in the case study selection process that were nevertheless important in case analysis are measures and levels of success, monitoring and tracking mechanisms, and means of disseminating information and results.

Table 1: Original 28 case studies considered for analysis.

State	Case Study	Selected or Not Selected?
Arizona	City of Tucson and Pima County Water and Wastewater Infrastructure, Supply, and Planning Study	Not selected – too much focus on infrastructure development
	Upper Verde River Water Conservation Program Development and Recommended Implementation Plan	Selected
California	Santa Clarita Valley Water Use Efficiency Strategic Plan	Not selected – too urban
	Coachella Valley Integrated Regional Water Management Plan ("IRWMP")	Not selected – IRWMP has different focus
	North Coast Integrated Regional Water Management Plan ("IRWMP")	Not selected – IRWMP has different focus
	Salmon Creek Water Conservation Plan	Not selected – water law context too different
Colorado	Grand Valley Water Conservation Plan	Selected
	Steamboat Springs Water Conservation Plan	Selected
	Douglas County Water Conservation Plan	Not selected
Idaho	Idaho-Washington Aquifer Collaborative ("IWAC")	Not selected
Montana	Blackfoot River Basin	Selected
Nevada	Washoe County Regional Water Management Plan	Not selected – too urban
	Truckee Meadows Water Authority Water Resources Plan	Not selected --
New Mexico	Santa Fe County Water Conservation Plan	Selected
	One of the 16 Regional County Water Plans	Not selected – too repetitive with Santa Fe case study

North Dakota	North Dakota Rural Water Systems Association Water Conservation Program	Not selected – no detailed plan or program
Oregon	Deschutes River Basin Program: Deschutes River Conservancy/Deschutes Water Alliance	Selected
	Regional Water Providers Consortium	Not selected – too urban
	Joint Water Commission Water Management and Conservation Plan	Not selected – too urban
	Springfield Utility Board/Rainbow Water District Water Management and Conservation Plan	Not selected – municipality-specific plan
Texas	One of the 16 Texas Regional Water Plans	Not selected – not relevant to RF community
	Lower Colorado River Authority 2009 Management Plan	Not selected – focus region too large
Utah	Salt Lake City Water Conservation Plan	Not selected – municipality-specific plan
	Park City Water Conservation Plan	Not selected – municipality-specific plan
	Mountain Regional Water District Conservation Plan	Not selected – water district plan, not applicable
Washington	Regional Water Forecast and Conservation Plan (Quad Cities Water Right--Kennewick, Pasco, Richland, West Richland)	Not selected – too urban
	Cascade Water Alliance Transmission and Supply Plan	Not selected – too urban
Wyoming	State Water Conservation Planning Program	Not selected – no detailed plan or program

After full review, the project team selected 14 cases located in Colorado, Montana, Nevada, Texas, California, Arizona, Washington, Oregon, and New Mexico from the original list of 28. The project team deemed these cases to be the best matches to the case selection criteria and therefore the most relevant to analyze for this project. These cases are listed in Table 2. For a description of all 14 case studies considered, see Appendix D.

Table 2: Final 14 case studies considered for analysis.

State	Case Study	Selected or Not Selected?
Arizona	Upper Verde River Water Conservation Program Development and Recommended Implementation Plan	Selected
California	Santa Clarita Valley Water Use Efficiency Strategic Plan	Not selected – too urban
California	Salmon Creek Water Conservation Plan	Not selected – water law context too different
Colorado	Grand Valley Water Conservation Plan	Selected
Colorado	Steamboat Springs Water Conservation Plan	Selected
Montana	Blackfoot River Basin	Selected
Nevada	Washoe County Regional Water Management Plan	Not selected – too urban
New Mexico	Santa Fe County Water Conservation Plan	Selected
New Mexico	One of the 16 Regional County Water Plans	Not selected – too repetitive with Santa Fe case study
Oregon	Deschutes River Basin Program: Deschutes River Conservancy/Deschutes Water Alliance	Selected
Oregon	Regional Water Providers Consortium	Not selected – too urban
Oregon	Joint Water Commission Water Management and Conservation Plan	Not selected – too urban
Texas	One of the 16 Texas Regional Water Plans	Not selected – not relevant to Roaring Fork community
Washington	Regional Water Forecast and Conservation Plan (Quad Cities Water Right-- Kennewick, Pasco, Richland, West Richland)	Not selected – too urban

The project team then met with Dr. Julia Wondolleck, the project advisor, and the clients on separate occasions and, based on these discussions, undertook a further narrowing of the list. The clients highlighted the importance of selecting cases with water law regimes similar to Colorado's. The potential cases from Texas were eliminated; it was felt that Texas' water and social contexts were too divergent from Colorado's and would yield conclusions that were largely not transferable to the Roaring Fork Watershed. Additionally, the cases based in larger metropolitan areas were removed as their urban context was seen to be too different from the rural, less populous Roaring

Fork Watershed. Finally, cases from California were removed because California does not follow a strict prior appropriation doctrine and because both cases were situated in less arid regions not regularly confronting water scarcity.

The final set of cases selected for inclusion in the report was: Steamboat Springs, CO; Grand Valley, CO; Upper Verde River, AZ; Santa Fe County, NM; Blackfoot Challenge, MT; and Deschutes River Basin, OR.

The six case studies are presented as the following pairs of cases:

Colorado Water Conservation Board Plans

Two of the case studies, Steamboat Springs, CO and Grand Valley, CO, were selected because they were completed under the same process that the Roaring Fork plan will be developed pursuant to, the Colorado Water Conservation Board ("CWCB") regional planning process. The hope in studying these cases was to glean information about navigating the CWCB process that could be useful for the clients in developing the plan for the Roaring Fork Watershed.

Traditional Regional Water Conservation Plans

The next two case studies, Upper Verde River, AZ and Santa Fe County, NM, were selected as examples of collaborative regional planning processes. These plans address ecological concerns through regional conservation planning, and were included to develop general recommendations for the clients about developing a regional conservation plan.

Plans that Aim to Increase Instream Flows

The final two case studies are Blackfoot Challenge, MT, and Deschutes River Basin, OR. These plans were selected because they were developed with a goal of increasing instream flows in their respective watersheds, a goal that is shared by the clients in the Roaring Fork Watershed. In selecting these plans, the project team hoped to provide recommendations related to this goal.

MOTIVATIONS FOR PLAN DEVELOPMENT

The motivations for developing and implementing regional water conservation plans varied across the six case studies. Further, in many cases there was a separate motivation for pursuing a regional collaborative process. Understanding plan and regional collaboration motivation can highlight the case's applicability to the Roaring Fork Watershed and paint a clearer picture of the factors that shaped and hindered each particular planning process.

Steamboat Springs, CO: Developing a water conservation plan fulfilled the CWCB requirement. Additionally, the plan developer wanted to use the planning process as a means of collecting baseline water quality data that was relevant to the operation of the water providers.
Grand Valley, CO: Developing a water conservation plan fulfilled the CWCB requirement. Grand Valley providers already had regional relationships in place and decided that pursuing a regional plan would be more efficient and effective than individual plans.
Upper Verde River, AZ: The water conservation plan fulfilled a state planning requirement. Plan participants decided to pursue a regional plan because the region is small and they felt it would be the most effective way to convey a unified water conservation message.

Santa Fe County, NM: The water conservation plan fulfilled a requirement for the county to receive a permit for a new diversion project. The plan champion also felt it was important to create a county-level water conservation plan due to frequent droughts in the area.
Blackfoot Challenge, MT: There was no planning requirement, but the area experienced frequent droughts and the only mechanism to deal with low instream flows was a call on junior rights by the Montana Fish, Wildlife, and Parks Department. There was widespread dissatisfaction with this mechanism and the Blackfoot Challenge felt that using a collaborative process to create a watershed-wide response plan would be more effective.
Deschutes River Basin, OR: There was no planning requirement, but various groups were concerned about low flows in the Deschutes River. Because of past experience, the groups were interested in addressing natural resource issues in a cooperative rather than litigious fashion.

Figure 1: Pictures from top left corner: Steamboat Springs, CO; Grand Valley, CO; Upper Verde River, AZ; Santa Fe River, AZ; Blackfoot River, MT; Deschutes River, OR (credits: top left photo: mysteamboatbroker.com; bottom left photo: bigskyflyfishing.com; all other photos from Creative Commons – authors from top right: Donna Boley, Finetooth, John Phelan, and Peteforsyth).

CROSS-CASE ANALYSIS: FACILITATING FACTORS

Facilitating factors enable progress towards plan development and support and enhance successful plan implementation. The key facilitating factors that became apparent in the cross-case analysis of the six selected case studies are:

1. A planning and implementation structure with clearly defined roles and responsibilities
2. A process that recognizes and accommodates entity-specific requirements and needs, but retains a unifying mechanism or vision
3. Relationships that ensure broad-based involvement and support
4. Broad commitment to collaboration
5. Dedicated staff time devoted to coordinating and managing plan participants and plan components
6. Strong leadership by plan champions

These six critical facilitating factors are explained in greater depth below. Key examples from the case studies are used to highlight each factor's role and impact.

1) A Planning and Implementation Structure with Clearly Defined Roles and Responsibilities

In the case studies, planning and implementation processes that took place within a formalized structure and that laid out clearly defined roles and responsibilities for plan participants were more likely to realize success. Having a formalized planning structure with stated roles and responsibilities facilitates stakeholder involvement, can help sustain ownership and engagement in the effort, and enables coordination across the region.

Successful implementation of the Upper Verde River planning process was hindered by a lack of role clarity. The participating groups did not define roles and responsibilities for implementation during plan development, which eventually led to a disproportionate allocation of responsibility for plan implementation, with the bulk of the work falling on one municipality. By establishing from the outset clear guidance on who was responsible for what, the frustrations within the implementation process could have been reduced or avoided. Further clarity can help ensure that planning and implementation actions are undertaken by all participating entities in the region and help sustain regional collaboration.

The establishment of a Drought Response Committee was integral to the development of a drought response plan in the Blackfoot watershed in Montana. Committee participation was open and inclusive and Blackfoot staff actively worked to expand participation so that all critical water user groups had a voice in committee meetings. The Committee was a formalized structure through which all stakeholders could meaningfully inform plan development and revision. Additionally, the goals of the committee and its decision-making process were clear to all involved; consensus-based decision making during committee meetings determined the shape and scope of plan and implementation strategies.

Grand Valley, Colorado benefited from the existence of a suitable planning structure prior to the development of their regional water conservation plan. Instead of creating a new structure or organization, Grand Valley utilized the pre-existing committee that runs the Drought Response Information Project ("DRIP") as the vehicle for plan implementation and monitoring. The utilization

of the DRIP committee facilitated plan implementation largely because the committee already had existing standard operating procedures, understood roles and responsibilities, and had good working relationships.

2) A Process that Recognizes and Accommodates Different Requirements and Needs, but Retains a Regional Mechanism or Vision that is Unifying

Collaboration on a regional scale by nature cuts across jurisdictions and encompasses localities that are different from one another. These differences can include differences in politics, governing structures, water use and access, consumer bases, incentives and motivations, resources, and views on water conservation. By recognizing these differences and building flexibility into the plan to accommodate them, plan participants were able to increase support for plan development and implementation. Broader recognition of issues allows diverse plan partners to overcome conflicts and work together. At the same time, it is important to have a unifying mechanism, such as overarching goals that apply to all participating entities or a joint education campaign, that brings plan participants together and sustains the regional nature of the initiative.

The Grand Valley Water Conservation plan covers three municipal providers—two special water districts governed by boards of directors and one water department governed by an elected town council. The differences in governance structure, consumer base, and views of water conservation across the three providers made the adoption of uniform conservation strategies and implementation metrics difficult. Grand Valley was able to overcome this challenge by tailoring water conservation strategies to each provider. In the end, Grand Valley had one unified water conservation plan covering all three entities, but the specific water conservation actions assigned to each provider differed.

The Blackfoot Drought Response Plan incorporates flexibility by establishing an overarching plan that brings together a hundred individual plans. The individual plans are developed by the irrigator in conjunction with Blackfoot Challenge staff and are specific to each irrigator. Individual plans establish the conservation strategies that each irrigator will undertake when the area experiences drought conditions and these conservation strategies vary from plan to plan. The overarching plan sets out the trigger points that determine when irrigators enact their individual plans. This framework allows for a united response to drought, but also accommodates the different needs and interests of stakeholders involved.

In the Upper Verde River, plan participants were keenly interested not only in implementing water conservation strategies, but also in launching a water conservation education campaign to better inform consumers about water use and scarcity. The plan participants recognized that specific conservation strategies, such as tiered rate structures and incentive credit programs, were often more effective when established on a municipal rather than regional scale due to differences in municipal code and resources. However, the plan participants also saw the benefit of having a consistent, shared education message across the region and worked collaboratively on a unified, regional education campaign called Water Smart™.

3) Relationships that Ensure Broad-Based Involvement and Support

In several cases it was clear that focusing on building relationships and partnerships with divergent stakeholders was important to the successful development of a plan and implementation of specific

conservation strategies. When solid relationships are developed with direct water users, such as irrigators, and/or organizations that have decision-making influence over water users, such as property managers or landscape companies, there is more buy-in and support for water conservation within the covered region, which can help drive a change in behavior by water users.

In Steamboat Springs, domestic water conservation can be difficult to achieve because of the abundance of second-home owners in the region. In most cases, the second-home owner hires a property manager to maintain and oversee the property in the owner's absence. Mount Werner Water has partnered with property managers to help decrease water consumption through simple water conservation strategies. Mount Werner Water has also used its relationship with property managers to tackle water use within the subdivisions and multi-family housing units that are controlled by homeowners associations. Finally, Mount Werner developed a certification program that awards property managers a bronze, silver, or gold rating depending on the extent of the manager's water conservation. This certificate program has incentivized property manager's involvement in water conservation.

The landscape industry is also a key stakeholder group in the context of domestic outdoor water use. In the Upper Verde River in Arizona, plan participants targeted the majority of their education material to outdoor water use. Developing a collaborative working relationship with the landscape industry and nurseries in the area was key to boosting education of consumers on outdoor water use. This partnership drove a successful effort to inform consumers about water budgeting.

The Blackfoot Challenge in Montana has augmented its programmatic success through a focus on building trust and relationships with stakeholders. The Challenge uses the "eighty-twenty" rule as a guiding principle to developing trust. The "eighty-twenty" rule fosters collaboration by having stakeholders work together on less divisive issues involving common goals (the 80%). Trust is built up through this initial collaboration and then that trust is leveraged to tackle the more difficult and divisive issues (the 20%). Through this process the Challenge has been successful at identifying common goals and developing successful initiatives.

The work of the Deschutes River Conservancy ("DRC") is premised on the idea of collaboration and consensus-based decisions on projects by all relevant stakeholder groups within the region. With a board made up of thirty representatives from a wide variety of interest groups affected by water use and conservation, the DRC can understand and take into account all the interests affected by a potential project. The board also provides established lines of communication and sometimes influence with these key stakeholder groups.

4) Broad Commitment to Collaboration

The Deschutes case demonstrates what can be achieved when collaboration is placed front and center in a group's work. Despite having a large board composed of varied interests and a requirement to agree unanimously on all projects, the DRC has been in existence for close to 20 years and has been widely recognized for its success at restoring instream flow to the Deschutes River and its tributaries. The group's early, explicit and enduring commitment to work collaboratively is no doubt one key to its success.

This broader commitment to collaboration can also be seen in the Grand Valley and Blackfoot cases. Within Grand Valley, the three water providers already had a collaborative relationship in place prior to the development of their regional water conservation plan. Through prior efforts the

providers had seen how effective it could be to work together to find solutions to common problems. And while the providers were required by the state to each complete a water conservation plan, they decided to develop a regional effort in part because collaboration had worked for them in the past. The Blackfoot Challenge is founded on an ethic of collaboration and sees collaboration not only as an effective means to an end, but as an end in and of itself. Blackfoot has worked since its inception to foster collaborative working processes in the watershed. The process of developing and implementing the Drought Response Plan was based on the Challenge's understanding of collaboration and much of the success it saw around the Drought Response Plan was due to the use of proven mechanism that facilitate collaboration.

5) Dedicated Staff Devoted to Plan Coordination and Management

In many case studies, it was clear that having dedicated staff time devoted to coordinating the collaboration of plan participants and managing plan and program tasks was a key ingredient to success. The value of a dedicated staff coordinator is most evident during plan implementation when multiple critical plan actions are undertaken simultaneously. A plan coordinator who devotes time to plan or program implementation, coordinating among plan participants and stakeholder groups, organizing meetings, and coordinating plan updates and revisions helps ensure that implementation actions are carried through in a thoughtful and deliberate manner. Additionally, sustained collaboration on a regional scale is greatly facilitated when a staff person is directly responsible for keeping plan participants engaged by organizing regular meetings or through other mechanisms.

One of the key lessons learned in the Upper Verde River planning process was the need for one regional coordinator to take on the task of managing plan implementation. In that case study, implementation suffered because the new tasks of implementation coordination fell on existing staff with heavy workloads who were unable to devote sufficient time to the new tasks.

The Blackfoot Challenge recently changed their existing Water Coordinator position into a Water Steward position, re-focusing the position on increasing one-on-one interactions with water users. Blackfoot Challenge staff knowledgeable about the Drought Response Plan credit much of their success to having a dedicated Water Steward tracking implementation of individual plans and building relationships with landowners and water users. Additionally, because approximately 100 individual plans comprise the Blackfoot Challenge, the task of working with irrigators to update and maintain those plans would be untenable without dedicated staff time.

The Deschutes River Conservancy is in a somewhat different position than the other cases examined here, as it runs a series of programs rather than dealing with one water conservation plan. However, much of the DRC's work is facilitation and coordination of projects that other entities are carrying out, such as piping irrigation ditches or helping arranging water leases. Some of these activities could in principle take place without the DRC's involvement, insofar as the right laws and economic incentives are in place, but the involvement of dedicated DRC staff appears to be an important driver in the actual implementation of these projects.

6) Strong Leadership by Plan Champions

Several cases benefited from the motivational strength of a plan champion. A champion is someone who has taken ownership over the plan, advocates for the plan, builds support for it, and gives his

or her time and energy to shepherding it through the development process. Championing the plan can necessarily involve taking on a lot of responsibility early on in the planning process. However, champions can be critical for both bringing regional plan participants together initially and for keeping them together. While there might be overlap in roles between a plan champion and a plan coordinator, the plan champion often had the greatest impact during the plan development and approval process. Often champions were a key motivating factor for starting and maintaining the plan development process, helping to overcome hurdles during the planning and approval process, and pushing plan participants to adopt strategies that go beyond minimum requirements.

Jay Gallagher from Mount Werner Water was responsible for the majority of the plan analysis and development in the Steamboat Springs case study. Gallagher was the driving force behind the water conservation plan, and is a good example of the benefit of having a plan champion who is employed at one of the participating water providers. His role as the General Manager at Mount Werner Water enabled him to utilize his relationships with the City of Steamboat Springs and his access to providers' data and information to keep plan development on track. This role also gave Gallagher motivation to keep the plan on track, since Mount Werner Water has a vested interest in controlling the growth of water demand over time so as to defer the expansion of infrastructure and the need to develop raw water resources.

It can also often be helpful to have many plan champions situated within the different groups or governing bodies involved in a planning process. In Steamboat Springs, Gallagher stressed the importance of having plan champions within city governments—elected or appointed officials who are committed to advocating for plan approval and implementation. Because regional plans cross many jurisdictions it can be particularly difficult to navigate competing political interests. Advocates within city government can help surmount jurisdictional and political hurdles.

Laurie Trevizo spearheaded the planning process in Santa Fe County. Trevizo was personally interested in having a successful water conservation plan for the region, and her dedication led to the creation of a plan that went beyond state requirements. Trevizo took the initial critical steps of applying for funding for plan development from the Bureau of Reclamation and bringing together local water conservation professionals to help create the plan. These initial efforts helped to establish and promote the planning process.

CROSS-CASE ANALYSIS: CHALLENGES

Challenges are likely to occur in any complex and sustained process, and such challenges can be difficult to overcome. In undertaking a regional planning process, it is helpful to explore the major challenges that similar efforts have encountered. In analyzing each case study, the project team investigated what challenges arose during either the planning or implementation process. The major challenges in common across the cases are:

1. Difficulty achieving and sustaining sufficient support and participation from key groups
2. Limited motivation to implement
3. Inadequate initial or ongoing funding
4. Insufficient or unclear communication

1) Difficulty Achieving and Sustaining Sufficient Support and Participation from Key Groups

Having sufficient and sustained support and participation from critical stakeholder groups helps create a sense of ownership over the plan and increases the likelihood that groups will support its implementation. However, it can be challenging to keep participants involved throughout the entre process and to ensure that the voices of all stakeholders are adequately represented in the process.

For example, in Steamboat Springs, the plan developer had some difficulty getting all the necessary political leaders to support the plan. In a regional plan, the area addressed by the plan necessarily spans many districts with different governing bodies. The political leaders in a township or city handle many issues, and water use and conservation is only one among many. Due to this divided attention as well as other factors, some political leaders in Steamboat Springs did not feel strongly about water conservation. Overcoming these hurdles and finding ways to change the minds of political leaders was crucial to the adaptation and implementation of the plan.

During the Santa Fe County plan development, the plan's champion initially sought involvement from local water conservation professional and experts. Her intention was to establish a working group composed of experts from across the region. However, often the experts who were contacted had busy schedules that impeded their participation. The relatively small number of people involved in plan development meant that fewer people were aware of the plan and its specific requirements, which limited support for and interest in plan implementation.

The Blackfoot Challenge is built on collaboration and multi-stakeholder participation, but even with these principles at the forefront, the Challenge has had limited success engaging critical water user groups. The bulk of the Drought Committee's initial efforts around plan development and implementation focused on engaging pivot irrigators. As a result, several key stakeholder groups–including outfitters, larger irrigators, and flood irrigators–were not as involved in the process. The Challenge is currently undergoing an effort to update the plan and is working to increase participation from these missing groups.

2) Limited Motivation to Implement

In almost all the case studies, plan development was at least partially motivated by a state or local planning requirement; the adoption of a regional water conservation plan would satisfy a statutory duty and free up funding or other incentives. However, the plan development requirement does not always come with a corresponding implementation requirement. Jurisdictions then have a limited motivation to actually carry through and implement the plan.

Santa Fe County, New Mexico saw first-hand the barrier to implementation that arises when there is no mechanism or motivation to ensure that a plan is implemented. State permitting requirements called only for the completion of a plan. Partially as a result of this limited requirement, the plan has not been implemented in any significant way to date.

3) Inadequate Initial or Ongoing Funding

Securing funding both for plan development and implementation helps spur plan success; however, when adequate funding to develop and implement programs or pay for staff time is not assured, acquiring such funds can often be a difficult endeavor.

For example, in Steamboat Springs, the plan developer noted difficulty in securing money to fund development of the plan. Part of the reason the plan took four years to develop was because Gallagher was the sole plan developer, analyzing data and navigating the CWCB process on his own in addition to his regular duties at Mount Werner Water. However, once the plan was approved by the CWCB, the region became eligible for CWCB grant money to implement the plan.

Plan implementation in the Upper Verde River in Arizona suffered because of cuts to program funding. The City of Prescott, which shouldered much of the implementation burden, reduced its funding for water conservation largely because of the success of the education and outreach campaign. Due to the funding cut, there will be limited personnel to manage the program going forward, putting its long-term sustainability into question.

4) Insufficient or Unclear Communication

Communication and clarity are key ingredients to the success of any initiative. Insufficient or unclear communication often results in confusion and limited motivation or support. In the case of Upper Verde River, a lack of role clarity in implementation led to an unequal and ineffective distribution of responsibilities. Blackfoot Challenge ran into a different communication problem. That plan is voluntary, so there is no easy way to know who is participating and who is not. The Challenge had trouble motivating people to participate or implement conservation strategies because non-participant could not easily see the full reach and scope of the plan. Currently, the Challenge is considering erecting signs on the properties of participating irrigators so neighbors and passersby know that irrigators are taking action to conserve water.

RECOMMENDATIONS FROM CROSS-CASE ANALYSIS

The project team developed a set of overarching recommendations based on the analysis of the facilitating factors and challenges present in the case studies. Each recommendation is followed by suggestions that highlight ways these recommendations could be implemented.

Recommendation #1: *Establish a transparent and open plan development structure that allows divergent stakeholders to actively participate*. This can take many forms, but common examples are issue committees, collaborative coalitions, or simply hosting regular, open meetings or forums.

Recommendation #2: *Establish clear and equitable roles and responsibilities in a formal manner.* This is often most easily done through a Memorandum of Understanding or language written into the plan itself, but it can also be achieved through a clear and explicit job description for a plan coordinator or through shared funding agreements. This step is most effective if done at the outset of plan development and should cover all aspects of the planning process from development to implementation.

Recommendation #3: *Build flexibility into the plan to accommodate differences in interests and needs.* This could mean establishing provider- and irrigator-specific plans, or, retaining a unified plan, but tailoring conservation strategies to each water user.

Recommendation #4: *Sustain regional collaboration by retaining a unifying mechanism or vision.* While tailoring plan specifics can be important to achieve buy-in and cement support, it is also critical to have a mechanism, such as a shared brand for an education campaign or an overarching plan, that brings together plan participants behind a common goal.

Recommendation #5: *Maintain outreach to critical stakeholder groups and partner with them on plan development and/or implementation.* Building relationships with property management companies, landscapers, and irrigators can help boost awareness and interest in water conservation. Partnering with these groups on certificate programs or working with them to create individual conservation plans can be effective methods to conserve water on a broad scale. Neighbor-to-neighbor communication can also help bring diverse interests together. Finally, this outreach should not end when the plan is developed, since the effectiveness of these outreach efforts is often only seen over the long term.

Recommendation #6: *Dedicate staff time to coordinating and managing plan implementation.* This can be effective either in the form of one regional coordinator or through a division of implementation responsibility across the regional partners.

Recommendation #7: *Establish a dedicated funding source for plan development and long-term implementation.* Although often difficult to achieve, having an established dedicated funding source will help sustain coordination and implementation into the future. Shared ownership of the plan and implementation can be further cemented by creating a collective payment system in which each participating partner contributes an agreed-upon amount.

Recommendation #8: *Cultivate plan champions.* Committed advocates are often needed to facilitate plan development. Finding supporters at water providers, in the irrigator community, or within governing bodies can help to overcome planning and implementation challenges.

Recommendation #9: *Incentivize implementation.* Even in cases where implementation is required, incentivizing it through a certificate program or through a public media campaign can help augment the motivation to implement.

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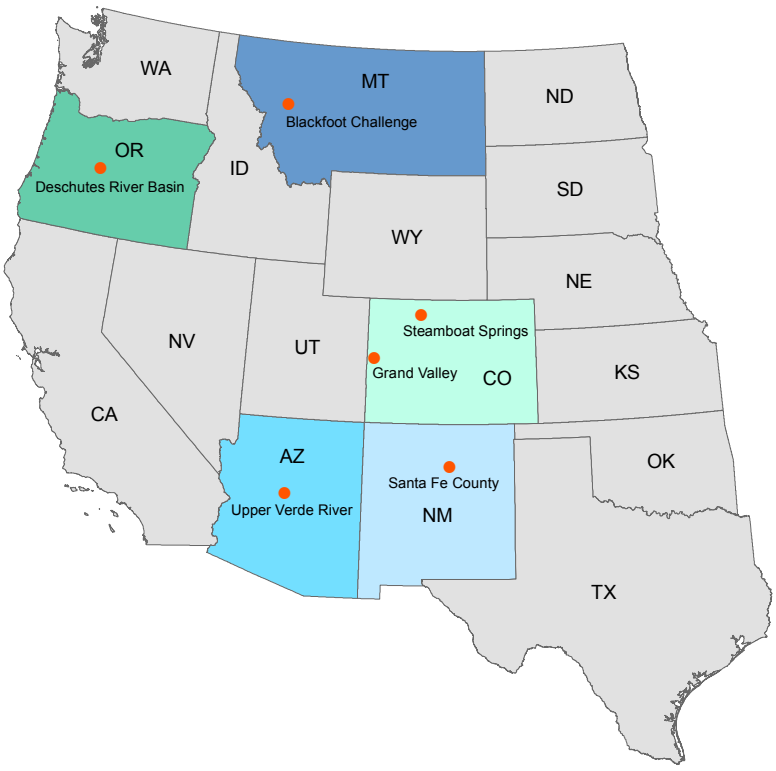

Figure 1: Map of the six case study locations.

STEAMBOAT SPRINGS, COLORADO

Prepared by Liz Och

Introduction

This case study analyzes the water conservation plan of Steamboat Springs, Colorado. The plan was approved by the Colorado Water Conservation Board ("CWCB") in 2011, and is currently being implemented. Steamboat Springs has many key similarities to the Roaring Fork Watershed, including the same water law regime as well as many geographical and land use parallels. Therefore, this case study provides insights into developing a regional water conservation plan, particularly in the context of Colorado water law, the CWCB planning process, and the inherent challenges of implementing water conservation strategies in a ski resort region.

Description of Context

Geography

Steamboat Springs is a city located in the Yampa Valley in northwest Colorado, north of the Roaring Fork Watershed. The area is situated at 6,728 feet above sea level,[1] has a semi-arid climate and receives approximately 24 inches of moisture per year, though precipitation varies greatly month-to-month and year-to-year.[2] The area is located near the headwaters of the Yampa River, but though the municipal water providers have relatively senior water rights within the basin, the basin itself has relatively junior water rights.[3] Like much of Colorado, most of the water use in the region relates to agriculture and ranching, with only 5-6% of total water use attributable to municipal water usage.[4]

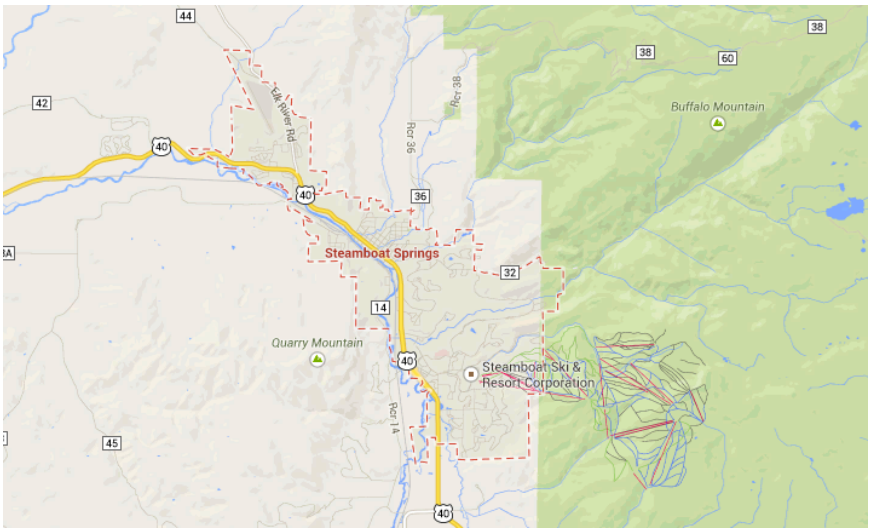

Figure 1: Map of Steamboat Springs (credit: Google Maps).

Demographics

Steamboat Springs is a rural region, home to just 12,170 permanent residents in addition to approximately 40,000 tourists[5] annually; the permanent population is expected to grow to 21,178

by 2035.[6] The area is home to a popular ski resort, and approximately 19% of the homes in Steamboat Springs are vacation homes.[7] The median household income of the city in 2011 was $62,243, and the median age of residents is 36.5 years old.[8]

Water Providers & Water Use

Two water providers serve the community. Water and sewer services have been provided to the city since 1903 through various service providers, but all had been absorbed by the City of Steamboat Springs by the mid-1990s.[9] In the late-1950s, a ski resort opened outside of the city limits at Storm Mountain (later renamed Mount Werner), and the Mount Werner Water & Sanitation District ("Mount Werner Water") was created to serve that area. Although the ski resort has since been annexed by the city, the two water providers remain separate, though they share two sources of treated water.[10] The City accounts for 48% of the community's water usage and Mount Werner Water 52%, with Mount Werner Water providing more water during the ski season.[11]

Similarities to Roaring Fork

Steamboat Springs is under the same state water law regime as the Roaring Fork, and the city's water conservation plan was developed under and approved pursuant to the Colorado Water Conservation Board ("CWCB") process. Steamboat Springs faces a number of similar water challenges to the Roaring Fork Watershed: it supports a seasonal tourism industry, has an agriculture presence, and many of the homes in the area are second homes to non-permanent residents.

Plan Overview

The Steamboat Springs water conservation plan is an adaptation of the city's previous drought management plan to meet CWCB requirements.[12] The reconfiguring of the plan began in 2007 and was completed in 2011. The primary reason for turning the existing plan into a water conservation plan was to take advantage of funding available for conservation measures from the CWCB.[13]

The plan is a collaboration between the Mount Werner Water & Sanitation District and the City of Steamboat Springs. Under the Colorado Water Conservation Act of 2004, neither entity is required to develop a water conservation plan; but combined, the two providers supply over 3,000 acre-feet to their customers, making them eligible to create a CWCB regional water conservation plan.[14] In the interest of being proactive about water conservation and helping the residents of Steamboat Springs to live within their means,[15] the two providers formed this regional water conservation plan.[16] The plan is comprised of two separate but inter-related components: a water conservation plan and a drought and emergency response plan.

Planning Process

The first stage of developing the water conservation plan was documenting water use and trends in the region. Because this had never been done before in the Yampa Valley, and because a single person (Jay Gallagher from Mount Werner Water) did much of the analysis, this process took several years. Much of this documentation focused on water quality analysis, using data from the United States Geological Service from 50 years back to establish a baseline. Water quality was of

particular interest to the municipal water providers of Steamboat Springs, since all the municipal water supplied is first put through a filtration system. This makes water quantity in the region fundamentally linked to water quality, inasmuch as they both have strong effects on the cost of supplying water to customers.[17]

Once the water quality baseline was established, the development of the water conservation plan could begin in earnest. This plan was developed primarily by Jay Gallagher of Mount Werner Water, with help from the Public Works Director, Utility Systems Superintendent, and Water Resources Technician from Steamboat Springs. The City of Steamboat Springs and Mount Werner Water also hired a consultant to assist in the drafting of the plan. The plan focuses on both short- and long-term water conservation strategies, including an educational component. The plan was approved by the CWCB in 2011, was adopted by both the Steamboat Springs City Council and the Mount Werner Water District board, and is in the process of being implemented.[18]

The City of Steamboat Springs and Mount Werner Water's experience working with the CWCB signals that the CWCB process is largely pro forma, and if a plan meets the CWCB plan requirements, it is likely to be approved, although it took four years for the Steamboat Springs plan to fulfill the CWCB requirements.[19]

Plan Content

The purpose of the Steamboat Springs water conservation plan is to manage municipal water demand to meet short- and long-term needs. The water conservation plan has four main goals:

- To raise awareness about the need for and benefits of water conservation and create a conservation culture in the region;
- To foster the understanding that water choices made by consumers directly correlate to future investment of public funds;
- To convey how every user can benefit from implementing a conservation ethic; and
- To prepare the community for responding effectively to a drought or other water emergency.[20]

The plan aims to save 270 million gallons of produced water, or 15% of the total produced water, by 2035.[21]

To achieve these goals, the plan outlines existing water conservation strategies and provides a list of best management practices along various facets of water conservation.[22] The plan then develops potential water conservation strategies within four categories: utility programs, education programs, rebate programs, and residential/commercial audits.[23] Finally, the plan uses cost-benefit analysis to select from this list the most cost-effective methods for water conservation in Steamboat Springs.[24]

Table 1: Existing water conservation strategies to be continued with the new plan.

Item	Annual Water Savings (gallons)	Current Program Cost
Distribution system, infrastructural repair/replacement	1,244,625	$613,000 annually
Tiered rate structure (City & Mount Werner Water)	14,806,170	$21,775 annually
Meter enhancements/software (City & Mount Werner Water)	14,747,000	$326,287 3 years City 2 years MWW

The resulting water conservation strategies fall into two categories. First, the plan identified existing strategies that should be continued—infrastructure repair, tiered rate structure, and meter enhancement/software—amounting to an estimated 3% reduction in produced water demand. The total savings from these existing strategies is outlined in Table I. Second, the plan identified new water conservation strategies, including raw water conversion for city irrigation, website enhancements, park irrigation monitors, bill stuffers, and a homeowners' association and lodging property program. These additional strategies will result in an estimated 3% reduction in produced water demand, and are listed in Table 2.[25]

Table 2: New water conservation strategies.

Item	Annual Water Savings (gallons)	Current Program Cost
Website enhancements	49,354	$1,552
Bill stuffers	12,225,875	$2,080
Park irrigation monitoring (City)	1,097,810	$3,125
Raw water conversion for irrigation (City)	3,000,000	$52,750
HOA and Lodging Property Program (MWW)	10,261,000	$8,850
Appliance and/or irrigation component rebate programs R1-R4 with residential & commercial audits as necessitated	5,468,965	$61,738
Hydrant flushing quantification	0	$2,220
Meter testing	96,000	$24,906
Annual public education event	498,135	$1,850

Finally, the plan recognized the need for continued improvements in water conservation to meet the growing demands of a growing population, and recommended adding one new water conservation technique each year that the plan is in place.[26] This additional reduction in water usage each year will help the providers achieve a 15% reduction by 2035.[27] These strategies are irrigation education, irrigation training, indoor and outdoor residential audits, commercial education, and leak detection.[28]

Plan Implementation

The Steamboat Springs plan was approved by the CWCB in 2011 and adopted by both Mount Werner Water and the City of Steamboat Springs. Because the plan has only been in place for two years, the success of the plan is largely undetermined. However, because of the plan, both water providers have been able to take advantage of state grants for water conservation measures, including rebate programs.[29]

Partnering with Property Managers

During the course of the interviews, Mr. Gallagher repeatedly stressed the challenge of changing behavior of consumers, particularly that of second-home owners who might not feel as connected to the community or the ecosystem.[30] The cooperation of property owners is crucial in tackling water conservation challenges in Steamboat Springs, since most of the utility bills for second homeowners go directly to property managers.[31] One strategy that Mount Werner Water has used with some success is partnering with property managers (and, to a lesser extent, landscapers) of these second homes to ensure that these homes take simple water conservation measures.

Figure 2: The ski industry draws in many second homeowners and seasonal tourists in Steamboat Springs (credit: Creative Commons by CarTick).

In Steamboat Springs, subdivisions and multi-family dwellings (such as townhouses and duplexes or multiplexes) are usually controlled by homeowners associations. These homeowner associations typically have a governing board as well as a property manager. The property manager is either one of the five large property managers in the area, or an individual or resident property manager. Although it is difficult for the water providers to gain access to the homeowner association boards, they have been able to partner with property managers to get discussion of conservation measures into the boardroom.[32]

In 2007, to incentivize water conservation by property managers, Mount Werner Water developed a campaign to certify property management companies as either gold, silver, or bronze, depending on the extent of the property manager's conservation level.[33] The certification is based around the following 12 standards for certification:[34]

- Plumbing fixtures are examined for leaks at least annually and leaks are repaired.
- Irrigation system is examined for leaks at least annually, and all leaks are repaired.
- All sprinkler heads are monitored at least weekly and aligned to minimize waste in non-landscaping areas such as sidewalks and driveways.
- Irrigation system is timed to operate after 8 p.m. and before 6 a.m.
- Irrigation system uses rain or soil moisture sensors to regulate system operation.
- Spas and pools have covers to reduce evaporation.

- No outdoor fountains; no water features.
- Grass is mowed no shorter than three inches to reduce soil moisture loss and promote deeper roots.
- More than half of established flower and shrub beds have a "drip" irrigation system.
- More than half of the landscaped property is xeriscaped (landscaping method developed for arid or semi-arid climates)
- The homeowners' association has adopted a policy encouraging the use of low-flow showerheads (<2.5 gallons per minute).
- The homeowners' association has adopted a policy encouraging water conservation measures in capital improvements undertaken by the association.

To receive bronze certification for a property, a property manager must display compliance with at least five of the standards; for silver certification, seven standards; and for gold certification, nine standards. Each property receives a rating, and the property manager is then given a rating based on the weighted average of all properties, taking into account the number of units in each property.[35] The first property manager enrolled in the program was ResortQuest, which has since been acquired by a large national property manager.[36] Each property and property manager must reapply for certification each year.[37]

At the onset of the program, property managers had an incentive to join the program so they could brand themselves as being "green." Certified property managers received a certificate to display in their place of business and help promote this reputation. Today, many of the large property managers have a corporate policy of conservation, so these water conservation measures are more of a standard practice than a differentiator among property managers.[38]

Today, about 2,000 residential units and about 200,000 square feet of commercial space are enrolled in the program.[39] This includes four of the five large property managers in the region. Mr. Gallagher noted that the program demands steady attention to ensure that properties under new property managers are given the option of certification.[40]

Challenges

Mr. Gallagher identified some of the challenges of creating and implementing a regional water conservation plan as:

- Getting political leaders to support water conservation planning (especially when working across multiple districts, enclosed within city limits)
- Getting another political entity to change its perceptions about water conservation (especially when working across jurisdictions); and
- Getting money to fund the development and implementation of the plan.[41]

Mr. Gallagher recommended finding advocates, especially within city government, to help bypass these inherent challenges, and noted that having allies made the development of the Steamboat Springs plan run smoothly.[42]

Additionally, Mr. Gallagher noted that economic effects as a driver seemed effective in changing behavior of consumers, but noted that despite education, the majority of people seemed to not take part in water conservation measures. This challenge is exacerbated in the case of second homes in the resort area, which are especially challenging for Mount Werner Water.

Mr. Gallagher did note, however, the success of working with property managers for this region to develop a "green" mindset in second homeowners, as discussed in the previous section. This seems like a particularly attractive strategy for the ski resort communities in the Roaring Fork. Some of the challenges with this strategy are the constant attention that such a program demands, as well as the challenge of getting busy property managers (particularly those unaffiliated with corporations) to commit to conservation measures.[43]

Recommendations

Recommendation #1: *Form relationships with property managers to encourage second-home owners to take water conservation measures.* One possibly effective way to do this is through a certification program.

Recommendation #2: *Find advocates within city governments to help facilitate the development of the plan.* This is especially important for regional plans that span many political jurisdictions.

Recommendation #3: *Use economic drivers (rather than education) to change behavior.* Education alone did not encourage behavior change in Steamboat Springs; although residents of the region are generally aware of water challenges, water conservation efforts still lag.

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GRAND VALLEY, COLORADO

Prepared by Charlotte Jameson

Introduction

In 2009, The City of Grand Junction, the Clifton Water District, and the Ute Water Conservancy District began developing a regional water conservation plan to meet Colorado Water Conservation Board ("CWCB") requirements. The providers completed the plan in 2012 and began the implementation process. Inclusion of this case selection was originally based on a desire to glean lessons learned and understand challenges that arose during the CWCB planning and approval process. However, upon further study it became apparent that the CWCB process was not overly taxing for Grand Valley; more interesting observations could be made from Grand Valley's experience around the impacts of varied provider governance structures on regional collaboration, facilitation of implementation through existing relationships, and conservation strategies applicable to Colorado.

Description of Context

Case Study Area Description
The Grand Valley is located in Western Colorado primarily in Mesa County. The main population centers in the valley are the City of Grand Junction, the City of Fruita, and the Town of Palisade; unincorporated areas of Clifton, Loma, and Mack are also located within the valley.[1] The Colorado River runs through the valley and joins with the Gunnison River mid-way through the valley.

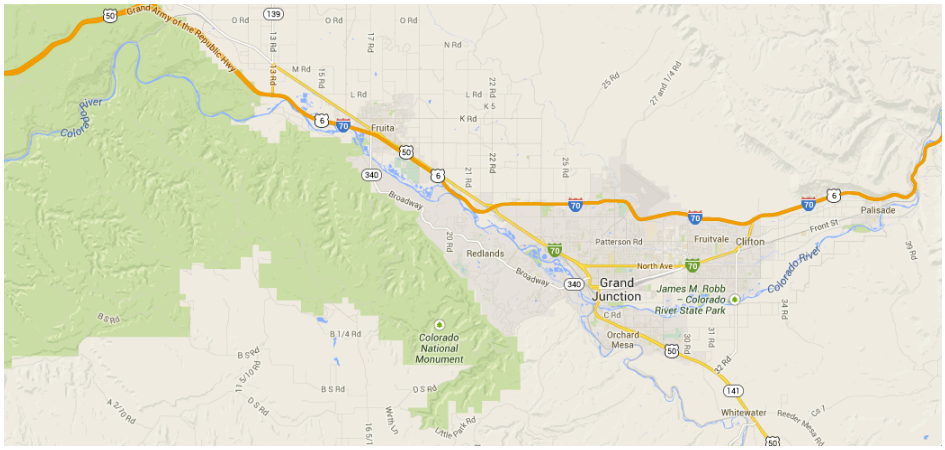

Figure 1: Map of Grand Junction, CO and the major population centers in Grand Valley (credit: Google Maps).

The valley was originally settled in the late 1800s, and water for irrigation in the valley was first diverted from the Colorado and Gunnison Rivers then.[2] Prior to these original diversions and permanent settlement, the Grand Valley was an arid, high desert landscape, originally part of the Ute Indian Reservation[3] and described by early explorers as a "flat, desert-like, valley unsuited for agriculture."[4] The annual average precipitation in the valley is 9 to 10 inches or less. However, the Colorado and Gunnison River diversions and numerous subsequent diversions brought thousands

of acre-feet of water to the valley, allowing settlers to transform the desert-like lands into fertile acres of farms and orchards. The Bureau of Reclamation established the Grand Valley project to provide a consistent source of irrigation water for thousands of acres of farmland in the area.[5] The project is a diversion from the Colorado River that supplies water to four canals covering over 90 miles.

Agricultural production remains an important part of the Grand Valley economy today. The east valley is especially well known for its productive fruit orchards, including apple, peach, and pear. More recently, these orchards are giving way to vineyards. Producers on the western side of the valley also grow corn, alfalfa, wheat, beans, and sugar beets.[6] Cattle ranches and the accompanying livestock industry round out the valley's agricultural production.[7] Recently, due to population growth, some of the farmland has given way to residential development.[8] The agriculture industry remains the leading water user in the valley, but population growth has increased municipal and domestic water use and placed more pressure on this scarce resource.

Figure 2: Agriculture, particularly fruit production, is a predominant part of the economy in Grand Valley (credit: Hermosa Vineyard, tripadvisor.com).

Plan Motivation

The City of Grand Junction, the Clifton Water District, and the Ute Water Conservancy District each draw from a distinct water source.[9] However, the communities serviced by these water providers blend together, with residents living in one providers' coverage area but working in another. A significant drought in the late 1970s caused the water providers and their governing bodies to place restrictions on people's water use.[10] According to David Reinertsen, the Assistant Manager of Clifton Water District, as a result of both that drought and the overlapping nature of the communities serviced, the three water providers decided to collaborate to unify their response to water shortages.[11] They remained three distinct entities, but successfully established interconnections between their distribution systems. In essence, these interconnections meant that if one provider experienced a water shortage, it could get water from one of the other two providers.[12]

Around the year 2002, there was another severe drought in Colorado. The 2002 drought motivated the providers to develop a cooperative drought response plan.[13] This drought response plan further formalized the water sharing system established in the 1970s. The plan contained trigger points that determined when a water provider was in a drought condition, and if those triggers were hit, the other two providers would likewise declare themselves in a drought condition,[14] setting in motion the emergency rate system for all three providers. In short, the drought response plan ensured a uniform response and message across all of the coverage areas for the three providers.

In 1996 the City of Grand Junction, the Clifton Water District, and the Ute Water Conservancy District each developed a water conservation plan in accordance with the CWCB's requirements. Under the Water Conservation Act of 2004, retail water providers that annually sell 2,000 acre-feet or more are required to develop a water efficiency plan.[15] The City of Grand Junction, the Clifton Water District, and the Ute Water Conservancy all meet the 2,000 acre-feet threshold for required plan development, but the individual plans developed in 1996 sufficed to meet state requirements. However, the 2004 statute also stipulated that plans developed to meet the requirement must be updated at least every seven years.[16] According to Reinertsen, when the time came to update the individual water provider plans, the three entities decided to "pitch the idea to the CWCB to…combine for a regional plan."[17] Because the three providers had a history of working cooperatively to address water shortages and because "they all have the same message," a regional plan could better address the needs of the community as a whole.[18]

According to the planning document, the goal of the plan is to "provide unified water education and community outreach programs that will aid the public in developing meaningful water conservation practices."[19]

Planning Process

The Grand Valley Water Conservation Plan was developed by the City of Grand Junction, the Clifton Water District, and the Ute Water Conservancy District and covers the water use and provisioning of those providers.[20] In 2009, the three entities began working on the regional water conservation plan. Representatives from each water provider contributed to the development of the plan. They secured a $50,000 grant from the CWCB and hired a consultant to coordinate putting the plan together.[21]

The first phase of the plan development focused on information gathering. The representatives of each provider submitted information necessary to establish a provider profile, including descriptions of water systems, water rights, delivery systems, general population served, current water use, and forecasts of future demand.[22] Additionally, the representatives and the consultant assembled information on current water conservation strategies employed in the valley.[23] This list of water conservation strategies was not limited to the three plan providers. Instead, it included "all programs developed by both of the domestic water purveyors and the irrigation water providers, as well as institutional interests that include the Mesa County Government and the Colorado State University research center."[24]

The second phase of the planning process entailed the formation of water conservation goals and the identification and selection of water conservation measures.[25] Goals were selected based on fit with the overall mission of the plan, measures of cost-effectiveness, and an assessment of benefits.[26] The planning document lays out the following water conservation goals:

- Goal 1: Continue to educate the community, landscape contractors, and customers regarding codes and ordinances that promote xeric landscapes and water conservation.
- Goal 2: Continue to create public awareness of wise water use and conservation.
- Goal 3: Reduce residential sector water demand in the Grand Valley by 10% over the next seven years.
- Goal 4: Promote water saving awareness in the commercial/industrial sectors.[27]

Under the Water Conservation Act of 2004, water conservation plans must contain certain minimum plan elements. As of July 2005, the minimum required water conservation plan elements include: water efficient fixtures & appliances, low water use landscapes, water-efficient industrial & commercial water-using processes, water reuse systems, distribution system leak identification & repair, dissemination of information regarding water use efficiency measures, water rate structures & billing designed to encourage water use efficiency, and regulatory measures designed to encourage water conservation, and incentives to implement water conservation techniques.[28]

Through frequent meetings and discussions between representatives of the water providers and the hired consultant, the parties established a list of possible water conservation strategies that satisfied the required plan elements.[29] A steering committee was created composed of representatives from each water provider and the Governing Board of Directors for the City of Grand Junction, the Clifton Water District, and the Ute Water Conservancy District. According to the planning document, the steering committee was tasked with determining the relative importance of each water conservation strategy and prioritizing them for implementation based on that determination.[30] Additionally, the group created a plan budget and schedule that named prospective funding sources for each measure.[31]

Plan Content

The providers have a dual system that services both potable water and raw water for irrigation. Reinertsen stated that this unique dual system allowed them to focus the plan on implementing water conservation for issues "directly effect[ing] just the potable water" and thus largely stay away from exterior use.[32]

Plan elements can be divided into two categories: conservation strategies that existed prior to the regional planning process and conservation strategies developed to meet current CWCB requirements.[33]

Existing Water Conservation Strategies

Drought Response Plan

The City of Grand Junction, Clifton, Ute and the Town of Palisade developed a drought response plan after the 2002-2003 drought.[34] The plan is comprised of a set of options for water providers to consider implementing when the area experiences a drought. The plan also created the Drought Response Information Project ("DRIP") to provide information to the public and to media outlets on why water consumption reductions are important and how best to achieve them. DRIP also runs public media campaigns through videos presentations on local public access channels, interviews with DRIP members in local news outlets, and weekly water conservation columns in local newspapers.‡‡

Children's Water Festival

The City of Grand Junction, Clifton, and Ute have sponsored the Children's Water Festival annually over the last 20 years. During the festival over 1,800 fifth graders attend a two-day program to

‡‡ For additional information regarding DRIP, see the Plan Implementation section of this case study.

learn about local and regional water issues, including water rights, water conservation, water pollution, water treatment and distribution, the water cycle, and water and wildlife.[35] Over 300 water experts participate by hosting workshops and exhibits indoors and outdoors.[36]

Low Water Use Landscape Programs

The City of Grand Junction installed a Maxi-Com Irrigation Program that runs and monitors all the irrigation systems in the city.[37] The program receives estimated evapotranspiration rate information from a satellite and sets the clocks for each irrigation system based on that rate data.[38] The irrigation systems also have rain gauges that stop irrigation if precipitation is detected.[39] Additionally, in 2008 the City converted a park football field from grass to sports turf.[40]

Leak Detection Programs

The City of Grand Junction, Clifton, and Ute use listening devices, visual observations, usage evaluations and customer notification to detect and resolve leaks.[41] Additionally, all three entities have pipe replacement capitol plans to cover the replacement of older pipes.[42] The providers have meter-reading software that allows for high/low meter reading comparisons with existing historical data sets and monthly meter readings are used to evaluate system-wide trends. The providers' billing staff conducts month-to-month comparisons for customers with atypical usage increases.[43]

Increasing Block Rate Structure

All providers have increasing block rate structures in place.

Strategies Developed to Meet Current CWCB Requirements

Regional Toilet Retrofit Program

The providers established a regional toilet retrofit program to target high residential water users.[44] The program is based on a $75 rebate for toilet replacement with the goal of replacing 50 high water use toilets annually. The providers estimate that 560,000 gallons per year will be conserved if they met the 50 toilets goal.[45] Most of the retrofits will take place in Grand Junction and Clifton.[46]

Annual Landscape Audits

The providers will offer landscape audits annually to the ten highest water use residential customers that use potable water for outdoor irrigation.[47] The providers estimate that these ten audits would save approximately 250,000 gallons per year.[48] Most water irrigations will take place in the City of Grand Junction.[49]

Annual Water Audits

The providers will offer water audits to the 10 highest commercial and industrial water users annually. It is unknown how much water is conserved through commercial and industrial audits, but the providers estimate that it could fall between 16.4 mg and 27.4 mg annually.[50] It is expected that most of the commercial and industrial audits will occur in the City of Grand Junction and Ute.[51]

Plan Implementation

The vehicle for plan implementation and monitoring was a pre-existing entity called the Drought Response Information Project ("DRIP"). DRIP is an education and information campaign established by the three water providers to assist consumers with drought response.[52] DRIP is run by a committee composed of representatives from each water provider, the Colorado State University Extension, and the Governing Board of Directors for the City of Grand Junction, Clifton Water District, and the Ute Water Conservancy District.[53] The DRIP Committee meets monthly to discuss local and regional water issues, including storage levels and potential water shortages.[54] Additionally, each entity provides $5,000 per entity per year to fund DRIP.[55]

Reinertsen stated that it was clear that the DRIP was the "natural place for the operation of the regional conservation plan" because it was already established and contained representatives of the critical groups.[56] Reinertsen sees the existence of the DRIP group prior to plan development "as a huge plus…because we already had a relationship on how to work together."[57]

The primary responsibility of DRIP during plan implementation is to collect data and evaluate the effectiveness of each water conservation strategy and plan goal. DRIP is also tasked with writing an annual progress report to CWCB, including what activities have been undertaken, what the providers have learned through implementation, what is working and what is not, and any trends that they are seeing.[58] The DRIP will then use those annual progress reviews to help guide future efforts to update and/or modify the plan.

The Grand Valley plan secured CWCB approval in 2012. And even though it is a relatively new effort—the first full year of plan implementation will be 2014—Reinertsen believes that implementation is progressing much as they expected it would.[59] Implementation, up to this point, has focused on developing programs to enact water conservation strategies. Developing and starting new programs has taken a lot of effort mainly because those involved are focused on making the process "as painless as possible for everyone."[60] During implementation, Reinertsen says they are trying to come to grips with how to develop and establish new programs that will meet CWCB requirements and plan goals, while at the same time not overly taxing limited staff time and budgets.[61] Recommendations on program development are formulated by the DRIP committee, while the Board of Directors for Clifton and Ute and the Town Council of Grand Junction have final approval.[62]

Challenges

The three providers each have a governance structure that makes decision impacting water provisioning. Clifton and Ute are special district providers and are therefore governed by an elected Boards of Directors, whose sole purpose is to oversee the running of water provision and revenue generation at the two entities. Grand Junction Water Department, on the other hand, is a municipal water provider and is overseen by the elected town council of the City of Grand Junction.[63] The Town Council has a broader jurisdiction than the Ute and Clifton Board of Directors–one that is not circumscribed to water provision. Additionally, the providers differ on the scope and scale of their water operations and the characteristics of their customer base.[64] These difference lead to disagreement in the planning process over which conservation strategies would be most appropriate in order to meet CWCB plan element requirements. David Reinertsen expresses the difficulty, saying they "had to try to come up with a water conservation plan that addressed the requirements of the Colorado Water Conservation Board, but at the same time [ensure] it reflects

what our Boards are dictating what we will and what we won't do for water conservation."[65] In short, there was a disconnect between what is required by the CWCB and what the boards and Town Council were willing to agree to. In the end, this resulted in the three entities being unable to adopt all of the same conservation strategies.[66] For example, in order to fulfill the plan requirement to consider water efficient fixtures and appliances, the CWCB strongly encourages the development of a toilet change-out program whereby providers incentivize or assist in swapping current toilets for low-flow ones. However, the Ute Water Conservancy District's Board of Directors did not think that a toilet change-out program was an appropriate water conservation strategy for their customer base.[67] According to Reinertsen, a toilet change-out program was identified as a water conservation strategy that they would include in the plan, but Ute was exempt from this provision.[68]

In the end, the providers found the easiest way to overcome conflict around plan elements was to tailor each specific conservation measure to the entity.[69] At the same time, the overall metrics used to gauge implementation would apply to the group of providers as a whole; the providers agreed to conduct a set number of toilet change-outs as a group annually, but that number would be met only through the actions of the City of Grand Junction and Clifton, not Ute. The CWCB, however, wanted all providers covered under the plan to adopt the same conservation strategies, to agree to all the points in the plan, and all contribute to meeting all plan implementation goals.[70] Reinertsen said, "it was hard to get CWCB to buy-in to [entity specific water conservation strategies] because they wanted everyone to have an equal sharing" in implementation of plan elements.[71] The plan went through several iterations and through the editing and approval process, CWCB made its views clear. In the end, Reinertsen believes that the CWCB "got tired of the back-and-forth edits and the attempts at compromise" and finally approved a Grand Valley Water conservation plan that varied water conservation strategies based on provider.[72]

Recommendations

Recommendation #1: *Use pre-existing relationships and pre-existing entities to aid with program development and implementation.* Reinertsen expressed his belief that using pre-existing relationships around water as well as pre-existing working groups such as the DRIP committee allowed plan and program development and implementation to run smoothly.

Recommendation #2: *Tailor conservation strategies to each specific entity, but preserve the group commitment through overarching goals and implementation metrics.* The three providers were able to overcome differences that arose during plan development by adopting differing strategies and programs for each entity. At the same time, the regional, collaborative nature of the overall plan was preserved through implementation metrics that covered all three entities.

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UPPER VERDE RIVER, ARIZONA

Prepared by Kara Steeland

Introduction

This case study showcases a water conservation plan that has been implemented at a regional level. Planning process, plan content, plan implementation, and lessons learned are presented to provide the Roaring Fork Watershed with ideas for the entire water conservation process from planning to implementation.

This case analyzes Arizona's Upper Verde River regional water conservation strategies. The relatively small geographic region of the Upper Verde River is similar to the Roaring Fork Watershed, in that people often travel between multiple municipalities on a daily basis. Frequent travel between towns or cities may necessitate a regional planning initiative in order to convey consistent water conservation messaging to water consumers. In the Upper Verde River region, four municipalities have collaborated to create a regional water conservation plan, with a focus on education and outreach initiatives. Shaun Rydell, the Water Conservation Coordinator from the City of Prescott, introduced the regional project in 2006, and her experiences provide insights into both the challenges and successes for regional water conservation efforts. While groundwater, as opposed to surface water, is the main water source in the Upper Verde River region, the planning steps and lessons learned from the regional water conservation initiative are directly applicable to the Roaring Fork Watershed.

Description of Context

Case Study Area Description

The Verde River is located in Yavapai County in Central Arizona with its headwaters in Paulden, AZ. This case study focuses specifically on the Upper Verde River Basin in Central Yavapai County, which contains the Town of Prescott Valley, Town of Chino Valley, Town of Dewey-Humboldt, and City of Prescott. The population of the Verde River Basin is growing rapidly and has more than doubled in the city centers over the last 20 years; for example, the City of Prescott's populations has increased from approximately 20,000 in 1990 to 40,000 at present.[1] Agriculture is a predominant land use in the region that accounts for the majority of surface water diversions (16,000 acre-feet annually) and a portion of groundwater pumping (11,100 acre-feet annually). The primary groundwater basin used is the Little Chino Subbasin (Figure 1).[2,3] In the Verde River Basin, an estimated 6,400 acres are in production for agricultural purposes.[4] Additionally, tourism and recreation are major drivers of the economy in the basin, accounting for an estimated $87.5 million annually.[5]

The Verde River is a major tributary of the Salt River, which flows into the Colorado River. Over 70% of the Verde River Basin is located in National Forest land, including the Prescott, Kaibab, Coconino, and Tonto National Forests.[6] The Verde River Watershed covers roughly 6,622 square miles, with the Upper Verde River Watershed covering approximately 2,500 miles.[7] Elevation ranges from 3,056 feet to 12,617 feet, and the average annual precipitation is 18.6 inches.[8] The landscape varies from mountainous regions to alluvial valleys and semi-arid grasslands.

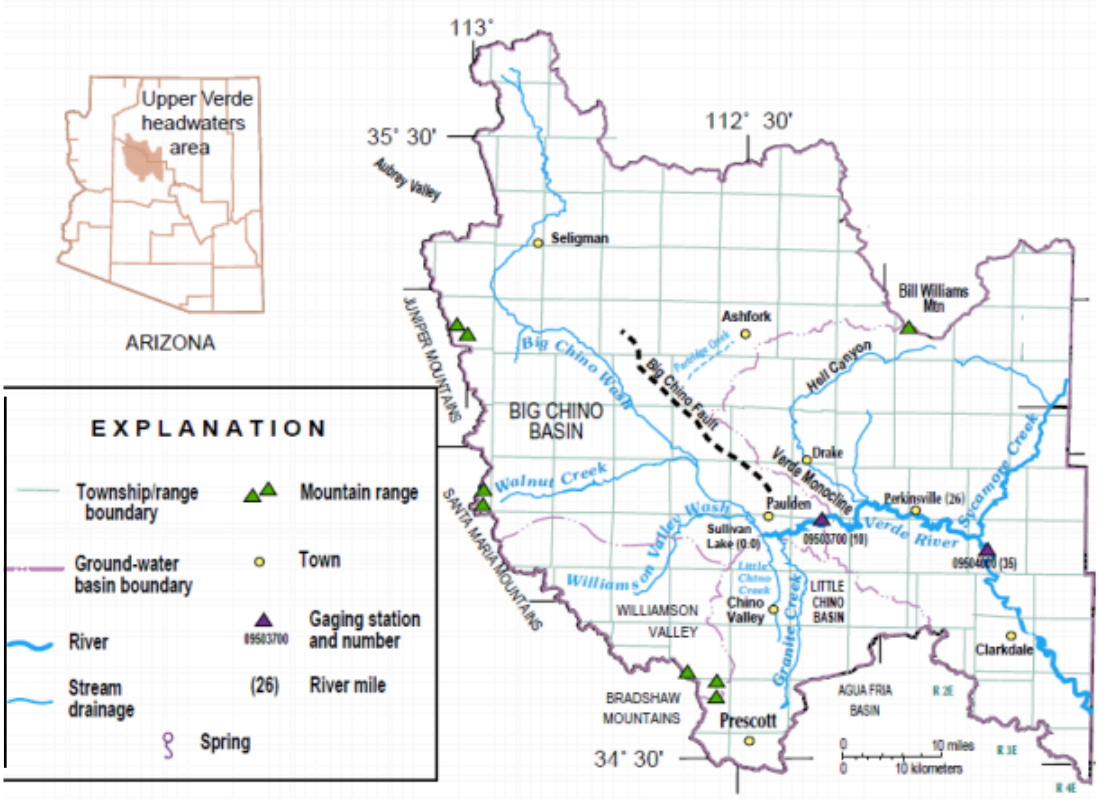

Figure 1: Map of the headwaters of the Verde River and associated hydrologic features. The Prescott AMA, which includes Prescott, Prescott Valley, Chino Valley, and Dewey-Humboldt, is located toward the bottom of the map (credit: Writ and Hjalmarson 2000).

Organizations

Many collaborative organizations, locally and nationally, strive to protect the Verde River, but this case study will mainly focus on the efforts of the Central Yavapai Regional Partnership and the Upper Verde River Watershed Protection Coalition ("UVRWPC"). The Central Yavapai Regional Partnership consists of Yavapai County, The City of Prescott, and the Towns of Chino Valley and Prescott Valley. The Partnership was loosely formed in 2006 to address regional environmental and planning issues. UVRWPC members include Yavapai County, the Yavapai-Prescott Indian Tribe, the City of Prescott, and the Towns of Chino Valley and Prescott Valley. The Coalition is comprised of Board of Directors and a Technical Advisory Committee ("TAC"). UVRWPC aims to protect the Upper Verde River by balancing the reasonable water needs of the residents of the area with protection of the Upper Verde River to the maximum extent possible by developing best management practices that incorporate science-based planning and utilization or conservation of all water resources in the region.[9] The Coalition was created in 2006 to identify water resource issues in the Basin. Members of the UVRWPC pay dues to the organization based on the size of the community they represent.

Arizona Water Law

Water from the Upper Verde River and associated aquifers is part of the Prescott Active Management Area. Five Active Management Areas ("AMAs") have been created by the state of Arizona and the Arizona Department of Water Resources ("ADWR") to ensure that groundwater supplies are not depleted in areas with increasing development. The Prescott AMA needs to achieve "safe yield" for groundwater by 2025; safe yield occurs when no more groundwater is being withdrawn than is being replaced.[10] Another important component of Arizona water law is the Assured Water Supply Rule, meaning that conserved water cannot be used for new development. The Assured Water Supply Program was created to address severe groundwater declines. This program is part of Arizona's 1980 Groundwater Code and only applies to AMAs.[11] Most notably, the program mandates the demonstration of a 100-year water supply for new subdivisions.

Plan Motivation

The ADWR First Management Plan, created in 1980, set water use targets for communities in the Prescott AMA in gallons per capita per day (GPCD).[12] Private water companies and small municipal water providers challenged the per-capita process because reasonable reductions in per-capita water use often are not feasible for small water providers. Therefore, the ADWR Third Management Plan allows water providers to create Non-Per Capita Conservation Programs ("NPCCPs").[13] Providers regulated under the NPCCP are required to implement residential and non-residential conservation programs for interior and exterior water use. This regulation requires water providers to comply with several requirements, including having a public education program related to water conservation, utilizing tiered rate structures, and creating programs to meter service area connections. The municipalities in the Basin decided to coordinate these water conservation strategies regionally, although regional collaboration was not a requirement of the ADWR.

Planning Process

The planning process, outlined in Figure 2 and described below in detail, had several steps: surveys of stakeholders and customers, analysis of historical and current water use data, and identification of regionally appropriate conservation strategies.

Shaun Rydell, the current Water Conservation Coordinator for Prescott, started with a vision for a regional water conservation program in 2006 when she began working for the City of Prescott's Water Conservation Department. Rydell identified a grant opportunity from the U.S. Bureau of Reclamation, and she reached out to partners through the Central Yavapai Regional Partnership and UVRWPC for support. All partner agencies and organizations were supportive of the grant application, although no agreement about regional water conservation was signed between partner groups at that time.[14] After receiving the grant in 2007, the Partnership created a survey to determine customer opinion about water conservation and a survey to assess what conservation strategies were already in place in the region.

The survey to determine water conservation programs already in place in the region was sent to stakeholders including the City of Prescott, Town of Prescott Valley, Town of Chino Valley, Town of Dewey-Humboldt, ADWR, Yavapai County Water Advisory Committee, Yavapai Prescott Indian Tribe, Prescott Water Conservation Committee, and the University of Arizona Cooperative

Extension Office–Yavapai County. Meetings were also held with survey participants to clarify responses.[15] The results of this survey indicated that existing water conservation programs consisted of public education efforts, conservation device giveaways, ordinances, and customer financial incentives.[16]

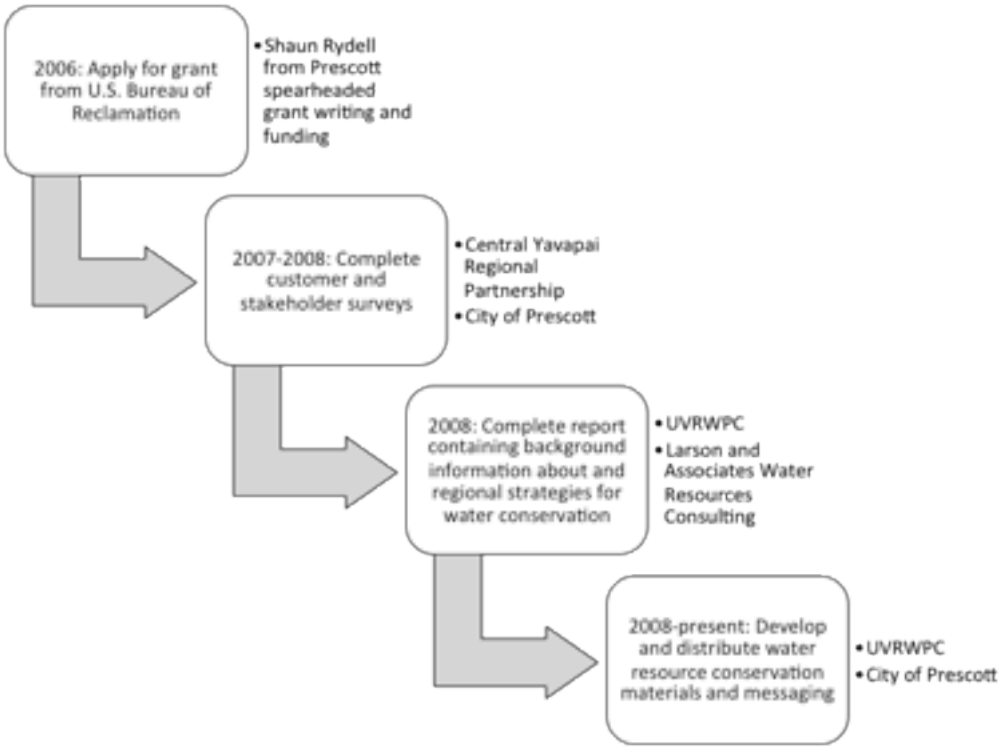

Figure 2: Planning process for the Upper Verde River regional water conservation program.

The City of Prescott, in conjunction with the Central Yavapai Regional Partnership, sponsored a regional water conservation opinion survey that was sent to water customers throughout western Yavapai County in the fall of 2007. Approximately 3,000 homeowners responded to the survey.[17] See Appendix E for a copy of the survey. The key findings of the customer survey included:

- Water providers were a key source of information, as private or municipal water providers served over 80% of respondents;
- Direct mail, utility bill inserts, and newspaper were the preferred method of communication;
- People did not know how to budget water for indoor and outdoor watering, and educational opportunities existed for demonstrating more efficient outdoor watering practices;
- The majority of respondents lived in homes older than 10 years, indicating opportunities for fixture retrofit and replacement programs;
- School programs represented a long-term investment to educate the next generation (i.e. water use would not decrease significantly in the near future as a result);
- Potential existed to educate the public on the low irrigation needs of native plant species.[18]

The key findings of the surveys were originally tabulated by Prescott and were further analyzed by Larson and Associates Water Resources Consulting. Larson and Associates created a water conservation development plan in 2008 entitled "Regional Water Conservation Program Development and Recommended Implementation Plan." The consulting firm also assessed the

feasibility, costs, and benefits of financial incentive programs and water conservation ordinances. Results from the surveys and the analysis of water use guided the recommendations in the plan. The partner organizations determined three areas where additional opportunities existed for water conservation: incentive programs, conservation ordinances, and public education and awareness campaigns.

Plan Content

The final report by the consulting firm has eight sections. Sections One through Seven provide background information to inform the recommendations presented in the final section. The sections are:

1) Coalition Area Water Use Rates and Trends
2) Existing Coalition Area Water Conservation Programs and Comparison to Programs in other Jurisdictions
3) Results of Regional Water Conservation Opinion Survey
4) Analysis of Residential and Commercial Customer Financial Incentive Programs
5) Evaluation of Potential Regional Water Conservation Ordinances
6) Customer Outreach (Audit) Programs
7) Public Education and Information Programs
8) Recommendations for Phase 1 Conservation Program Implementation

Background Information

The plan extensively discusses water-use rates and trends in the region, including historic water use from golf courses, agricultural, industrial, small water providers, exempt well users, and large water providers.[19] Additionally, the plan analyzes existing water conservation programs in the region, including the results from the aforementioned water conservation survey of stakeholders. Also considered in the plan are case studies of other regions in the American West that have implemented water conservation programs. These comparisons are used to assess the feasibility and benefits of implementing particular water conservation strategies in the Upper Verde River Basin.

Plan Recommendations

The plan serves as a guide for Upper Verde River region water providers to determine conservation strategies based on public opinion and other analyses. None of the components of the plan are binding or enforceable at a regional level. The plan emphasizes the importance of education programs: "Public education and information programs are the backbone of a comprehensive, balanced utility water conservation program."[20] The UVRWPC recognizes the importance of communicating to all water use sectors the need for conservation, informing water users about financial incentives and audit programs, and educating water users about outdoor water budgeting and irrigation practices. The plan focuses on creating a balanced water conservation program that includes an array of strategies (Figure 3).[21] Within the plan, there is a Phase 1 Implementation Plan that budgets for the implementation of financial incentives, customer outreach (audits), information and education, ordinances, and program administration costs. The implementation plan includes several alternatives based on funding availability scenarios.

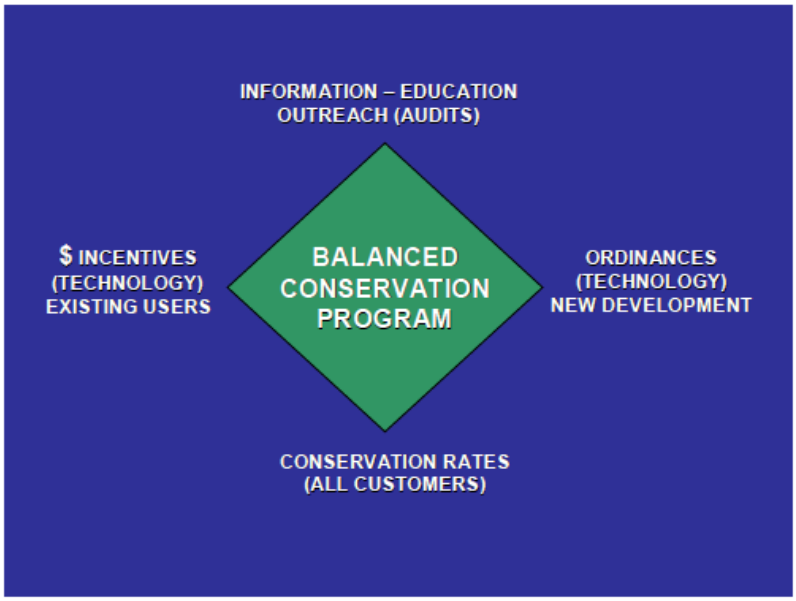

Figure 3: Elements of a successful water conservation program as recognized in the water conservation plan. Programs should provide financial incentives for water savings, include public education and outreach, require water efficiency in new development, offer customer audits, and have a highly tiered rate structure (credit: Larson and Associates).

Plan Implementation

Municipal water providers in the AMA are required to have tiered rate structures by the ADWR, and municipalities chose to set these rates at the local level. However, the Partnership recognized the importance of having consistent messaging across the region because many water customers travel between municipalities on a daily basis. Therefore, the municipalities involved chose to cooperate on a regional education and outreach campaign. In 2008, the City of Prescott began developing a new water conservation messaging campaign entitled Water Smart™.[22] After development, the Coalition agreed to utilize the Water Smart™ campaign on a regional level to create a recognizable brand across the region.

With the grant from the Bureau of Reclamation and other funding sources, Coalition members and partner organizations have implemented and/or created:

- Radio spots and newspaper ads about water conservation practices;
- An 84-page Regional Water Awareness Handbook[23], available free of charge in print and online[§§];
- Water Smart™ rack cards about irrigation practices, landscape design, native plants, xeriscaping, and many other topics (distributed at public libraries, businesses, other public buildings, and online)[***];
- Project WET (Watershed Education for Teachers) trainings and grants for student projects to ensure that students are learning about water conservation.

[§§] http://www.cityofprescott.net/_d/water_aware.pdf;
[***] See Appendix F for examples

About 80% of education and outreach materials have been targeted toward reducing water use outdoors.[24] The region identified partners in the landscaping industry and collaborated with these businesses to better inform consumers about outdoor water conservation strategies. Rydell indicated that these partnerships with landscaping companies and nurseries have been a major driver of the region's success in educating residents about water budgeting to reduce use.[25]

Regional members also attend tradeshows and other relevant events in order to provide direct information to water consumers. John Munderloh, the Water Resources Manager for Prescott Valley and a Chairman of the UVRWPC Technical Advisory Committee, indicated that roughly 30% of attendees actively seek out information about Water Smart™ at public events.[26] Additionally, educating people about Arizona water laws, particularly the Assured Water Supply Rule, has been important. People expressed concerns that conserved water would be utilized for new development instead of remaining in the aquifers or surface water flows.[27] Effective messaging about water law was accomplished through letters and ads in local newspapers and tabling at local events.

Figure 4: Logo for the Water Smart education and outreach campaign, which is now promoted by the Bureau of Reclamation.

Success has been challenging to measure on a regional scale, as each water provider has chosen to use additional water conservation strategies on a municipal level. The City of Prescott has been very successful in decreasing water use with a 14% reduction since 2008, even with increasing numbers of utility customers.[28] Conservation measures have removed the pressure on the public utility to meet peak summer demand. The cost of the water conservation program in Prescott is about $945 per acre foot of water, which is more cost effective than treating more water to meet higher demand.

City of Prescott Water Conservation Program Components

- Tiered rate structure
- Water audits
- Conservation incentive program
- Installation of low-cost water saving devices (e.g. drip irrigation)
- Regional education and outreach campaign (as outlined above)

Challenges and Lessons Learned

Unequal Distribution of Duties

A challenge with plan implementation was expanding the city-level outreach campaign created by Prescott to the regional level, largely due to differences in financial and human resources between municipalities. Each municipality has a range of staff time to devote to water conservation. The City of Prescott has a full-time water conservation coordinator, but the other municipalities do not have these resources. For example, the Water Resources Manager from Prescott Valley has less than 10% of his time dedicated to water conservation initiatives.[29]

Rydell, from Prescott, indicated that if one municipal government has more resources, they might be burdened with the majority of the responsibility of a regional program. As the Water Conservation Coordinator for Prescott, Rydell has a Water Conservation Committee comprised of city staff that she has been able to bounce ideas off throughout the regional planning and implementation process. She also has the time to devote to creating and distributing outreach materials and attending events. The bulk of the work has fallen upon Prescott even though the program is regional in nature, especially in terms of program maintenance. Rydell stated, "The city with the strongest resources may end up taking charge of the program. It's one thing to have a program, but someone actually has to do the work."[30]

Role Clarity and Lack of Ownership

Both Munderloh and Rydell cited personality clashes as an impedance to effectively accomplishing some tasks. To overcome these challenges, Rydell felt there should have been a stronger focus before plan implementation about the responsibilities of each member group.[31] Additionally, there were ownership issues about the ideas and implementation of the regional outreach strategy because Prescott originally created the idea for WaterSmart™. Rydell expressed frustrations about the amount of time and energy Prescott devoted to developing the outreach strategy while other communities did not contribute to the initiative. After brand development, Rydell initially had some hesitations about expanding the program to other communities. Rydell noted that these frustrations might have been avoided if all participating organizations had regionally agreed upon an outreach strategy and collaborated to create a brand prior to plan implementation.

Sustainability of the Program

Prescott has cut funding for water conservation because the outreach campaign has been so effective. Therefore the regional focus of Rydell's work has been reduced, and she will work part-time on water conservation issues only in the City of Prescott.[32] While there are adequate physical resources available, such as rack cards and water conservation handbooks, the personnel to manage the program will likely be lacking in the future. The lack of personnel puts the sustainability of the program into question unless more regional collaboration occurs.

Sustained Regional Collaboration

Rydell feels that having a champion for the water conservation cause is necessary, but a collaborative planning process is possibly more important for long-term success. The region does not have a signed agreement, and she feels that establishing an MOU between partners could have been critical to maintaining collaboration.[33] From her experiences, she stated that there are many components of the program she would have done differently. If she could re-do the regional effort, she would have assigned one regional coordinator and set up a monthly meeting with water resource professionals from each community. Instead, the regional collaborative simply assigned new tasks to someone already overloaded with work. She suggested that the regional partners could pay this coordinator collectively. She also stated that having a job description for the regional coordinator and having a mission statement for the regional collaborative is essential. These steps would ensure that planning and implementation are completed regionally, not by one member group.

Consistent Messaging

In an interview, John Munderloh stated that the combination of tiered rate structures in conjunction with a consistent regional education and outreach campaign has been essential in decreasing water consumption in the Upper Verde River region.[34] Additionally, he feels that branding is the most important part of a water conservation outreach campaign in a small region; providing water customers with consistent messaging about water conservation practices is essential.[35]

Recommendations

Recommendation #1: *Coordinated regional action should be ensured.* An MOU that explicitly details shared objectives, roles, and responsibilities is one way to ensure coordinated regional action. Distributed responsibilities can help sustain ownership and engagement in the effort, so the bulk of regional work does not fall onto one municipality or member group.

Recommendation #2: *A regional coordinator position that is funded by all partner groups may be an effective strategy to engage all participating groups.* This person could possibly have the task of completing regional conservation initiatives, such as creating and distributing outreach materials and attending public events.

Recommendation #3: *Varied strategies to promote water conservation are helpful in creating behavior change.* Collaborating with local businesses, such as the landscaping industry, is one way to effectively spread water conservation messaging so customers are not ignorant of water management in their communities.

Recommendation #4: Some components of a program can be completed on a regional level, but certain aspects of the program (e.g. incentive credit programs, tiered rate structures) will likely need to be *implemented on a municipal level due to differences in municipal codes*.

Recommendation #5: *A consistent message or brand* may be essential to successfully convey water conservation information to water users in a small region where people cross municipal boundaries on a regular basis.

Recommendation #6: *Identifying consumer need is an important initial step to efficiently target water users.* Regional surveys of water consumers may be useful for understanding how to distribute information to water users and what type of information is lacking. These surveys may indicate that a range of outreach strategies ensures more people will be informed about water conservation.

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SANTA FE COUNTY, NEW MEXICO

Prepared by Emma Maack

Introduction

The Santa Fe County Water Conservation Plan and the process that generated it provide several valuable lessons for the Roaring Fork Watershed related to who creates a plan, for what purposes, and with what implications for plan implementation. Santa Fe County resembles the Roaring Fork watershed in its proximity to public lands, identity as a destination for tourism and outdoor recreation, and substantial water use by agriculture. Unlike in the Roaring Fork context and the other case studies presented in this report, Santa Fe County's plan, though regional by nature of its county-wide scope, was developed by only one entity, the county. Nonetheless, the experience in Santa Fe County provides important and relevant lessons related to the challenges of going from plan creation to plan implementation. Specific issues discussed in this case study are the challenges associated with a plan requirement that does not emphasize implementation and the value and limitations of having a single plan "champion." Additionally, analysis of the planning process in Santa Fe County suggests that seeking broader and deeper engagement during plan creation might better facilitate plan implementation.

Description of Context

Geographic and Ecological

Santa Fe County covers 1,911 square miles of north-central New Mexico. Major geographic features of the county include the Rio Grande River to the northwest, the Sangre de Cristo mountains to the east, the Santa Fe River valley in the central county, and the lower hills and flatlands in the south. The highest peak in the county rises 12,622 feet, lowland areas in the south are primarily in the 6,000-7,000-foot elevation range, and the lowest elevation in the county is 5,250 feet at the Rio Grande.[1]

Figure 1: Santa Fe National Forest is a major land use in Santa Fe County (credit: Creative Commons by Zereshk).

Landscape types in the county range from conifer forest to ponderosa pine forest to piñon/juniper woodland to grassland.[2] Precipitation in this semi-arid region varies from 10-19 inches per year among the different watersheds that lie within the county. The groundwater hydrology of the area is complex, and groundwater is a major water source for municipal and some agricultural purposes. Public land in and adjacent to the county is extensive, including U.S. Forest Service, Bureau of Land Management and state lands. Tribal lands also make up a portion of the county land area.[3]

Demographic and Economic

Santa Fe County, which includes the City of Santa Fe, New Mexico's capital, had a population of approximately 144,000 as of the 2010 Census. In that year nearly 68,000 residents lived in the City of Santa Fe, by far the largest city in the county.[4] The population of the county has increased steadily over the last century,[5] with a yearly growth rate of 1.3% from 2000 to 2008.[6] The current growth rate is predicted to continue until around 2020 and then to decline gradually until 2030.[7]

Government is one of the main employers in the county, along with education and health services and tourism-related employment. The County's 2010 Sustainable Growth Management Plan ("SGMP") promotes diversifying the area's economic base and includes among its five "target industries" both green industry, specifically energy and water conservation technologies, and ecotourism and outdoor recreation. Tourism, focused on both outdoor activity and arts and culture, is identified in the SGMP as a major current and future economic driver for the county, and the protection of natural resources is recognized as contributing to a healthy tourist economy.[8]

Figure 2: Map of Santa Fe County, represented in the dotted line (credit: countymapsnewmexico.net).

Municipal Water Sources

The first sentence of the Santa Fe County Water Conservation Plan notes that "Santa Fe County is prone to extended and severe drought and regularly experiences water shortages."[9] One recent effort to address water shortages was a shift to using surface water from the Rio Grande as the

primary source for municipal water in the City of Santa Fe and adjacent areas served by the county water utility. This shift was made possible by an engineering project called the Buckman Direct Diversion ("BDD"), which diverts water from the Rio Grande in the northwest corner of the county, pumps it 11 miles to a regional water treatment plant near the City of Santa Fe, and then pumps the treated water to the city and county drinking water systems. Rights to the water provided by the BDD were already owned by the city and county.[10] Prior to this shift, these areas were served by a combination of groundwater and diversions from the Santa Fe River and its tributaries. County residents outside the City of Santa Fe and its immediate vicinity depend on groundwater wells.[11]

New Mexico Water Law and Institutions

As in other western states, New Mexico water law is based on the principle of prior appropriation. The state requires water conservation planning as a condition for some new water diversion permits. The permit for the BDD project came with this requirement, and the result was the plan discussed here. State legislation in 1987 also provided for the creation of 16 regional water plans, which address water conservation among other topics;[12] however, according to those involved with the plan,[13] the two regional plans that cover Santa Fe County appear to have only a minimal connection to the Santa Fe County water conservation plan.

Since 1996, Santa Fe County has enacted a number of ordinances related to water conservation; these are summarized in the water conservation plan. These ordinances apply primarily to new construction and retrofits, and address rainwater harvesting, instant hot water devices, low-flow fixtures, public education, domestic well metering, emergency water restrictions and water supply plans for new development.[14]

Planning Process

Motivations and Participation

The primary objective for the county in creating the Santa Fe County water conservation plan, which was completed in 2010, was to comply with permit requirements from both the Bureau of Reclamation and the State Engineer's Office associated with the Buckman Direct Diversion project.[15] The Interstate Stream Commission, which communicates with neighboring states to ensure that New Mexico is complying with interstate compacts regarding river flows, was also interested in ensuring that water conservation was occurring at the local level. However, Laurie Trevizo, the Santa Fe County staff person who spearheaded the planning process, notes that in addition to these requirements, there was also an inherent need for a countywide water conservation plan given the droughts that the region regularly faced. The county's water conservation ordinances were important, but their requirements only applied to new construction and they did not encompass the full range of strategies for generating water conservation. Furthermore, having a plan in place would qualify the county to apply to the Bureau of Reclamation for funding to implement water conservation measures. Similarly, Trevizo anticipated that having a plan would be helpful in securing funding from the county's general fund for water conservation projects.[16] Trevizo's view of the importance of a countywide plan for a drought-prone area seems quite reasonable, but it is not clear how widely this view was shared.

Trevizo's role as a champion of the plan was clearly a facilitating factor in its creation, and likely led to a more robust plan than would have been created by someone who was only focused on meeting the permit requirement. One of her first steps was to apply to the Bureau of Reclamation for additional funding to support the planning process. Trevizo aimed to gather a group of local water

conservation professionals and experts to craft the plan, but initially found it difficult to recruit participants. She reached out via a listserv for people who were professionally involved or interested in water conservation, but found that many people were too busy to participate. There were also limitations on who participated, e.g. Trevizo aimed to have one representative from each region of the county. Nonetheless, she was able to sign up a few working group members this way, and she also engaged staff members from other relevant county departments.[17] Whatever the reason, the relatively limited participation in the planning process almost certainly contributed to the eventual lack of plan implementation that will be discussed later.

Three main targets for implementing water conservation efforts are identified in the plan: customers of the county's own water utility, customers of community water systems, and individual domestic well owners.[18] The water utility, as a county department, was involved in the planning process from the outset. The community water systems and individual well owners were to be approached once the plan was completed.[19] Community water systems draw on groundwater wells to supply water to multiple residences or businesses. There are dozens of these systems in Santa Fe County and they vary in size; some serve less than 50 people while others serve up to 8,500 and are established as water and sanitation districts.[20] Trevizo reports that the working group felt it would be most effective to approach these water providers with a finished plan, arriving with a specific purpose and a proposal for what the providers might do to promote water conservation.[21]

Although agriculture accounted for 69% of the water used in the county in 2010,[22] agricultural water use was not a central focus of the conservation plan. This may be related to the plan's basis in the BDD permitting requirements: the water from this new diversion is not destined for agriculture, which uses groundwater and local surface water sources. The plan does describe the area's traditional "acequia" system of irrigation ditches, but agriculture receives only a few brief mentions in the plan's conservation strategies section.[23]

Planning Process Approach and Major Steps

The working group organized the descriptive portion of the conservation plan by looking at the five main watersheds that fall within the county boundaries: the Cundiyo-Santa Cruz River, Pojoaque-Nambe-Tesuque, Santa Fe River, Galisteo, and Estancia Basin watersheds. The plan describes the basic geographic, ecological, and social conditions within each watershed. The implementation activities outlined later in the plan are assigned to one or more of the watersheds, although most activities are applicable countywide.[24]

The Bureau of Reclamation planning grant that Trevizo received was used in part to hire a consultant to determine the best opportunities for water conservation (e.g. fixing leaks, reducing outdoor water use, etc.) in the county's own facilities. According to Trevizo, this was a good place to start because they had access to the county facilities; the data on these facilities was then extrapolated to determine what conservation measures to focus on county-wide.[25]

The planning team also coordinated with a master planning effort occurring simultaneously, the county's Sustainable Growth Management Plan ("SGMP"), which was also completed in 2010. One of the county planners was a member of the water conservation plan working group, and an effort was made to ensure that both plans complemented each other and reflected the same goals. Coordination with the SGMP process also enabled the water conservation planning group to conduct outreach to local community members through public meetings organized by the SGMP planners. This saved the conservation plan money and provided valuable direct feedback from the

public on topics such as the desirability of a regional water utility.[26] However, this public involvement was relatively limited in both time and scope.

A member of the county's economic development department, Duncan Sill, was also involved in assessing the costs of plan implementation, possible sources of funding, and how the plan might contribute to economic development in the area. Sill believes that including this "business justification" was an important part of the water conservation planning effort. He notes that the mechanisms and impacts of water conservation can be hard for people to understand, and communicating how conservation will mitigate certain costs and contribute to an improved quality of life is valuable. He also observes that estimating the costs of programs and investigating potential resources to cover those costs enables specific recommendations to be made to policymakers.[27]

Santa Fe County: A "Political" Water Conservation Plan

The fact that the Santa Fe County plan is bounded by a political jurisdiction rather than a watershed complicates things from an ecological perspective, insofar as the county includes portions of multiple watersheds. However, the plan's creation by a government entity also provided some opportunities that would not be available to a non-profit organization or even a set of government entities or utilities creating a plan together. The planners in Santa Fe County had easy access to other county staff and their activities, as well as county data. Additionally, they had legal jurisdiction over the entire area that the plan was covering. However, due to the lack of implementation of the Santa Fe County plan to date, it is difficult to draw any conclusions about the relative pros and cons of a regional government-based water conservation plan.

The major water conservation effort already in place at the time the plan was developed was the county's set of water conservation ordinances discussed above. The ordinances were incorporated into the conservation plan as part of the county's current water conservation effort and overall plan for future water conservation.[28] Trevizo notes that some of the larger community water systems may also have water conservation initiatives in place, if these were required for their permitting. She reports that these tend to be drought-focused and are generally non-binding "guiding principles."[29] Existing water conservation by community water systems was not addressed in the county's plan.

Plan Content

The Santa Fe County water conservation plan includes significant contextual and background information on the county in addition to the water conservation program details. Following the introduction, the main sections of the plan are:

- A primarily physical description of the county, with some cultural information;
- Basic physical, cultural and demographic descriptions of each watershed within the county;
- An overview of the Santa Fe County Water Utility;
- A description of the water conservation program components, schedule and funding plan; and,
- Information on the federal, state and local agencies involved in water management and conservation in the area.[30]

Plan Strategies

The first strategy listed in the plan is continued implementation of the county's water conservation ordinances. New strategies are divided into two sections, one on expansions of existing programs and one on future activities. Expansions of existing programs include strategies such as new incentives, using meters to test for leaks, and establishing a program to reuse greywater. Future activities are categorized as outreach, technical assistance, regulation, and planning and research. These activities cover a wide range of water conservation approaches, such as school-based education programs, rebates for efficient fixtures and appliances, and promotion of and assistance with xeriscaping.[31] These approaches involve engagement with a range of water users and providers, from individual homeowners to schools to businesses to other county departments. Although the county water utility uses a tiered rate structure, this common conservation strategy is not proposed for other water providers; it is, however, discussed in the plan as an effective means of promoting conservation.

Plan strategies are organized into an implementation schedule, which is divided into three phases: working on ordinances and activities that can be done internally, development of rebates and incentives, and working with community water systems and other stakeholders.[32]

As noted earlier, the plan also includes information on funding for these activities. Strategies in the plan were designed in part to match the types of activities that the Bureau of Reclamation funds in its regular grant cycles.[33] The other main sources of funding identified are the county's General Fund and Utility Enterprise Fund. Additional potential funding sources are also discussed, as well as the financial benefits of conserving water.[34] Sill, who worked on this section of the plan, observes in retrospect that they could have done more to investigate what conservation strategies would be both appropriate and feasible for different parts of the region. That information could have been combined with what the Bureau of Reclamation sought in terms of permit requirements and potential future grant-giving.[35]

Ecological Focus

Instream flow is not mentioned in the conservation plan, possibly because the plan is oriented around a political boundary with several river systems rather than one watershed, and/or because groundwater rather than surface water was until recently the major source of water for the area. However, the plan expresses interest in the ecological benefits of water conservation. The executive summary states that "The intention of the Plan is for long-term heightened awareness and active stewardship of our County land and resources,"[36] and considerable space is devoted to the geography and ecology of the region, including lists of threatened and endangered species. The plan also notes that, "Given the invaluable nature of [the county's] wetlands and streams, great care should be taken to protect them from environmental changes."[37] Therefore, although instream flow is not the primary focus of this plan, neither is the plan focused exclusively on human water needs.

Plan Implementation

Despite completing a plan that was described as "non-controversial" by Karen Torres, a county staff member who participated in the planning process, to date the plan has not been implemented in any significant way beyond the ongoing applicability of the pre-existing county ordinances.[38] This circumstance highlights the fact that plan creation and plan implementation are two different things, and successful creation of a plan is not a guarantee of successful implementation.

There are several likely reasons for the lack of implementation. First, Trevizo, the plan's leader and biggest champion, left the county not long after the plan was completed. She does not know whether the person who succeeded her was not tasked with implementing the plan, or simply did not make it a priority.[39] Torres, who still works at the county water utility, is not aware of anyone who is in charge of implementation of the conservation plan at this point.[40] The next steps for plan implementation would involve applying for Bureau of Reclamation funding for one or more projects, as intended in the plan, and/or carrying out some of the internal activities that do not require additional funding.[41]

A second explanation for lack of plan implementation is that the BDD permit requirements called for creating a plan but not explicitly for plan implementation. Sill reports that the general approach to the plan by higher-level county staff was to focus on getting it completed and to worry about how implementation would work at a later date.[42] Trevizo, who now works for the City of Santa Fe's Water Conservation Program, says her impression from colleagues who work more closely with the Bureau of Reclamation is that the Bureau has some limited ability to keep the county accountable for conserving water due to their control over water releases from reservoirs. However, she notes that while they try to "flex their muscles" when they can, the Bureau has no strict enforcement role.[43] Trevizo also observes that the Bureau was quite happy with the Santa Fe plan and provides it as a template to others who receive funding to write water conservation plans.

The fact that the Santa Fe County plan has not been implemented despite the requirement to create it points to the limitations and even possible disadvantages of a required plan. While requiring the creation of water conservation plans may have appeal for those who want to see more such planning, it is important to remember that the ultimate goal is more water conservation, and this requires that a plan be not only written but implemented. Sill's comments suggest that the county's focus on creating the plan in order to meet the BDD permit requirements may have actually lessened the likelihood of it being implemented, by putting the emphasis on the creation stage and leaving implementation as a secondary concern. Unless those requiring that the plan be written also have the ability to enforce its implementation, other motivations beyond the requirement will have to come into play for implementation to occur.

Trevizo believes that implementation of the Santa Fe County plan could be spurred by a citizen-led, grassroots effort by county residents who are concerned about water use and conservation. Alternatively, the next time a drought hits she expects that someone will resurrect the plan or the county's elected officials will decide it is time to revive it. Although she is disappointed that the plan is not being implemented yet, Trevizo seems optimistic that it will be put to use eventually.[44]

Trevizo reports that if she were to do it again, she would have taken the plan to the county's board of commissioners for approval via a resolution. This step was not a requirement, but she believes it would have made implementation of the plan a higher priority for the commissioners, as well as simply making them more aware of the plan and more likely to follow up on how it was being implemented. At the time she chose not to take this step because she wanted the plan to be a living document that could adapt and change if necessary, and this would have been harder if changes had to be approved by the board. But she believes this challenge could have been avoided by adding language specifying that the plan was subject to change, with annual reports describing what activities were being implemented, what was and was not working, and in what ways the plan was being altered.[45]

Involving the board of commissioners is one way that internal involvement with and commitment to the plan (i.e. involvement by county staff and officials) could have been increased. Because the plan belongs to the county government and is designed to be implemented by the county, in partnership with other groups as applicable, this internal implementation is the first stage of implementation. However, if and when the county achieves this stage, external implementation—getting other people or groups to engage, partner or take action as called for in the plan—will be the next step.

The fairly small number of people involved in the creation of the plan may have also contributed to the lack of implementation. If nothing else, more involvement, either through additional working group members or greater public outreach, would have meant more people would be aware of the plan and might urge implementation of its provisions. Similarly, although Trevizo and her colleagues undoubtedly had reasons for wanting to wait to involve the community water systems and individual well owners, it is possible that involving these stakeholders in the planning process might have generated a broader sense of plan ownership that would have facilitated implementation.

Initially it might seem that Santa Fe County was fortunate in its sole ownership of the water conservation plan, able to avoid the challenges faced in other cases discussed in this report of bringing multiple municipalities or water providers into agreement. However, although this probably made it easier to decide what went into the plan, more diverse involvement might have helped when it came to implementation. A broader sense of ownership and deeper commitment to the plan, both internally by other county staff and elected officials as well as externally by stakeholder groups and the general public, might have countered the setback the plan experienced when Trevizo left. Broader involvement could also have helped put more focus on plan implementation, given that many stakeholders would not be concerned about the BDD permit requirements but rather be interested in seeing the actual provisions of the plan put into action.

Recommendations

Recommendation #1: *Embed implementation considerations and strategies in development of the water conservation plan in order to enhance the likelihood that plan implementation will occur.* Implementation becomes less likely if plan development is considered the primary focus and goal.

Recommendation #2: *Recognize the value of having a plan "champion" to lead plan creation and/or implementation, but do not let the plan's ultimate success depend primarily on one person.* Remember that staff can and do leave!

Recommendation #3: *Broad support from an array of invested stakeholders may help a plan go from creation to implementation.* Think about who should be engaged in the planning process and how. What are the needs, interests and motivations of these groups? How can they be compelled to get involved? A variety of invested stakeholders may help keep implementation a priority when a plan champion leaves.

Recommendation #4: *As feasible, try to coordinate water conservation planning with any municipal or county master plans, to ensure concordance.*

Recommendation #5: *Consider thinking ahead to where funding for various plan activities will come from, and incorporating that into the plan.* However, be careful not to let funding opportunities outweigh a focus on what is actually most needed and most feasible.

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BLACKFOOT CHALLENGE, MONTANA

Prepared by Charlotte Jameson

Introduction

In 2000, the Blackfoot Challenge completed a voluntary drought response plan.[1] The plan was developed through the work of the Blackfoot Drought Committee – a voluntary, informal coordinating body composed of a variety of Blackfoot River water users that inform the development of the plan and oversee its implementation. While the contexts surrounding water conservation differ significantly between the Blackfoot and Roaring Fork Watersheds, several important aspects of the Blackfoot Drought Response plan may prove informative to water conservation efforts underway in Colorado. First, the Blackfoot Drought Response Plan is an example of how to effectively create a voluntary, collaborative process that promotes water conservation through the ethic of shared sacrifice. This collaborative process has allowed water users to more fully "buy in" to plan development and implementation, making the plan more effective because different interests and views have been heard and represented. Second, the Plan has established a framework that has applied a standard set of rules to a diverse group of water users, while at the same time providing a space for individuals' situations to inform their response to drought.

Description of Context

Case Study Area

The Blackfoot River Watershed is located in west-central Montana covering Lewis and Clark, Powell, and Missoula counties.[2] The free flowing Blackfoot River carries water westward from its headwaters located in the Continental Divide to its confluence with the Clark River outside of Missoula. The river runs 132 miles and the watershed covers approximately 1.5 million acres.[3] Nearly half the land in the watershed is federally owned (49 percent), while the ownership of the rest is comprised of a mix of state (5 percent), Plum Creek Timber Company (20 percent), and private (24 percent).[4] By and large, the watershed remains relatively undeveloped with limited divisions of the land for residential construction.[5] The land cover in the watershed ranges from high-elevation glaciated alpine meadows to timbered forests at the mid-elevations to prairie pothole topography on the valley floor.[6]

The river and its drainage system support a wide variety of beneficial uses and economic activities. Ranching is the primary component of the local agricultural economy.[7] However, the Blackfoot watershed economy also has traditionally relied upon timber harvesting, mining, and recreational and tourist activities.[8] River flows are critical to these economic drivers and to the health of the local ecosystem. The river drainage provides habitat for fish and wildlife, water for irrigation of farm and ranchlands, water for household and commercial purposes, and outdoor recreation opportunities.[9] Mean annual discharge in the watershed is 1,607 cubic feet per second.[10] Stream dewatering has occurred in the Blackfoot Watershed and is primarily due to human activity, most significantly diversions from the Blackfoot and its tributaries for agricultural irrigation.[11]

Blackfoot Watershed contains an extensive network of streams of which 1,900 miles of perennial streams that are capable of supporting critical fish populations.[12] The Blackfoot River is a "Blue Ribbon" trout river and supports wild trout populations, including native west-slope cutthroat

trout and bull trout.[13] However, decreased water quality as well as flow alterations, elevated water temperatures, and periods of prolonged drought are impacting the continued health of local fisheries.

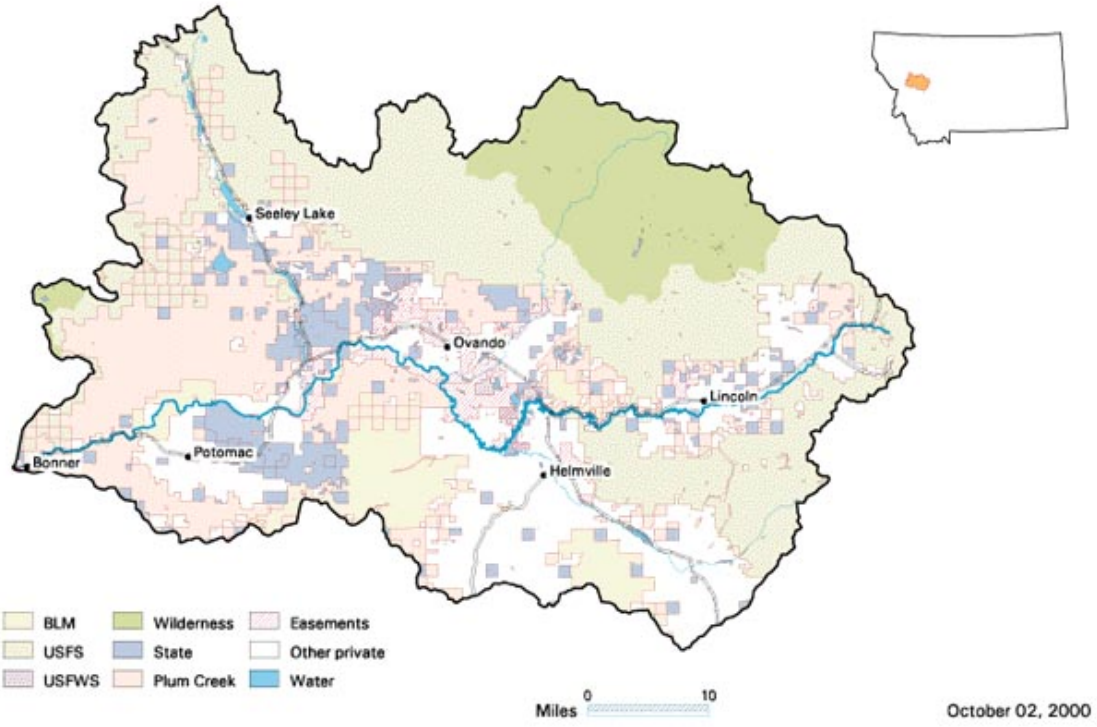

Figure 1: Map of the Blackfoot River Watershed, including land cover and river extent (credit: fws.gov/mountain-prarie/pfw/montanta/mt5b).

Water Law

The Murphy Right Reach

As in Colorado, Montana follows the prior appropriation doctrine for surface water rights guided by the principles of "first in time, first in right" and beneficial use. Beneficial uses are defined as "a use of water for the benefit of the appropriator, other persons, or the public, including but not limited to agricultural (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses. Other beneficial uses include instream flow to benefit fish, aquifer recharge, mitigation, or an aquifer storage or recovery project."[14] In the 1970s, Montana began a process of updating and streamlining their water rights system by creating a centralized records system. [15] The work around water rights at that time also included the state's first attempt to engage on the growing issue of minimum stream flow. In 1969, the state legislature granted the Montana Department of Fish, Wildlife, and Parks ("FWP") the right to appropriate unappropriated water to maintain minimum instream flow on reaches of 12 rivers in the state.[16] The priority dates for the minimum instream flow on those 12 river segments were set at either 1970 or 1971 depending on the river stretch.[17] These rights were termed "Murphy Rights" after the State Representative, James E. Murphy, who sponsored the legislation to establish the rights.

After an extensive study period, the Montana FWP determined that 700cfs is the minimum stream flow required to protect the "Blue Ribbon" fisheries in the Blackfoot.[18] The FWP appropriated a 700cfs water right for instream flows in the Blackfoot protecting the stretch of the river starting at

its mouth and flowing to its confluence with the North Fork.[19] The priority date of the Blackfoot River Murphy Right was set at 1971.[20]

Organizational Structure

Fostering Trust and Enabling Broad Participation

In the 1970s, landowners in the Blackfoot River Basin began having more formalized conversations about sharing and protecting the abundant resources of their watershed.[21] According to Gary Burnett, the Executive Director of the Blackfoot Challenge at that time, people in the watershed were very interested in coming up with effective ways to "share access to the river and the surrounding land."[22] These conversations led eventually to the official founding of the Blackfoot Challenge in 1993.[23] The Blackfoot Challenge is a non-profit organization that focuses on community-based conservation. It drives its mission of conserving and enhancing "the natural resources and rural way of life in the Blackfoot Valley" through consensus and collaboration amongst landowners, other Valley residents, and state and federal public entities.[24]

Over the organization's long history, building trust through the "eighty-twenty rule" has augmented its programmatic and collaborative success. As Jennifer Shoonen, the Blackfoot Challenge Water Steward, put it, under the eighty-twenty rule when you walk into a meeting "you make the assumption that you have 80% of goals and thoughts in common" and those are what you work on first.[25] Working on the common goals builds trust, so that when you get to the more divisive remaining 20% there is a base of respect and understanding established amongst the participants. This trust and understanding has increased the effectiveness and fluidity of the work the Challenge undertakes.[26]

Additionally, the Blackfoot Challenge is organized around different issues committees and subcommittees – the conservation strategies committee, the education committee, the forestry committee, the drought response committee, etc.[27] These committees are a key tool to foster participation from critical constituencies, to increase their commitment to the end product, and to enable their continued regular participation thereafter. Users of all categories are invited to participate in the committee and in planning and/or program development and implementation. If representatives from key groups are not present on the committee the Blackfoot Challenge staff will conduct outreach to encourage their participation so that all views are represented.[28] In essence, the Valley community develops conservation strategies and helps carry them out. The committees, apart from allowing and encouraging community "buy-in," create a formalized structure and process for long-term participation.

Drought Response Committee

The meetings addressing water use continued in the Blackfoot Valley through the 1980s and 1990s. But by 2000, no agreement had been reached and droughts and low flows were still threatening the Blackfoot River and the agricultural and fishing interests that it supports. The need for a formalized response plan became increasingly clear. That same year, the Blackfoot Challenge established the Drought Committee to "coordinate the development and implementation of a voluntary drought response effort in the Blackfoot Watershed."[29]

Like other Blackfoot Challenge committees, the Drought Committee was open and inclusive. According to Burnett, "anybody that wanted to participate in the discussion of the drought plan

would have been welcomed into the discussion."[30] The Challenge and its partners made a concerted effort to inform the public of the Committee formation and to encourage the participation of a wide variety of water users. All meeting minutes are posted on their website and open to public view.

The Committee is coordinated by Blackfoot Challenge staff but is comprised of local landowners and water users, members of the Blackfoot Challenge, representatives of the Big Blackfoot Chapter of Trout Unlimited and the Montana Council of TU, as well as agency staff from Montana FWP, the Department of Natural Resources and Conservation ("DNRC"), and the U.S. Fish and Wildlife Service.[31] More recently, outfitters have begun to engage in the committee's work. Also, the Challenge and the Committee recognize that more large irrigators, especially flood irrigators, need to be involved.††† From the start of the Committee there have been senior and junior water rights holders, large and small irrigators weighing in equally on plan development and sharing their advice and expertise around water issues.[32]

Dedicated Drought Response Staff

Much of the success of the drought response plan is reliant on having a dedicated staff person to oversee its implementation, coordinate meetings and outreach, and build relationships with landowners and water users. Shoonen says, "as much as it is a committee effort you [have to] have somebody coordinating and really putting time and effort into it constantly to maintain those relationships to make people feel like they have a place to share their feedback and ask their questions."[33] The drought response staff is key to increasing the amount of one-on-one communication and will be integral in overseeing the development and implementation of individual plans.[34] In total, Burnett estimates that during drought the Water Steward will spend a day or two a week managing the drought program.[35] When drought is less severe, the Water Steward might only spend half a day or less and would mainly be focused on sending email communications or calling and/or meeting with water users.[36]

Plan Motivation

Figure 2: Anglers and outfitters are concerned about the health of fish populations and the river (credit: flyfishingfrenzy.com).

Although a minimum instream flow right had been established in the Blackfoot in 1971, it wasn't until low flow years in the 1980s that the Murphy Right was acted upon. According to Gary Burnett, it was the handling of the response to drought by the FWP in the early 1980s that motivated water users in the Valley to seek out their own solutions.[37] A severe drought hit in the early 1980s, and FWP put out a call moving up the river on water rights junior to the Murphy Right.[38] Burnett stated that valley water users saw the response to drought in the 1980s as unorganized and felt that they could come up with a much better way of dealing with low flows and drought than "randomly calling on juniors."[39]

††† See more in the "Challenges" section of this case study.

The landowners and water users organized two meetings early on that paved the way for the Drought Response Plan. The first meeting was a broader community meeting focused on shared water use, and the second meeting was comprised of the large irrigators in the Valley who are both senior and junior to the Murphy Right. The community wanted a collaborative, shared way of "keeping irrigators irrigating and keeping water in the river for fish."[40] It became clear through these meetings that the 258 water users junior to the Murphy right [could not] by themselves solve the low-flow problems and that cooperation was the best way to minimize the impacts of low stream flows and ensure a more equitable distribution of water in low flow times.[41] Harry Poett, chairman of the Blackfoot Drought Response Committee and president of the Big Blackfoot Chapter of Trout Unlimited, echoed this by saying, "our ability to successfully maintain survival flows for fish and still have water for irrigation depends heavily on cooperation among landowners and anglers."[42] These meetings developed a sense of "shared sacrifice" – all water users depend on the river flows and only by working together could they hope to maintain the health of the system and their own livelihoods.[43] As a result of these efforts, the senior water right holders agreed to voluntarily participate in a water conservation plan.[44]

Plan Development

Consensus Strategy, Iterative Process

The Drought Committee operates by consensus in its decision-making and derives most of its success from a group of dedicated participants who give feedback, debate, and do outreach to other water users.[45] When the Committee began meeting, its members discussed strategies for dealing with drought conditions and, through those discussions, came to a consensus agreement on the final plan components. Plan strategies that were agreed on by the Committee were then compiled and written up by the Committee coordinating staff and distributed widely throughout the community to encourage feedback from all river users. After community comments were addressed, the Committee reviewed and approved the final version. Jennifer Shoonen estimates that there are currently 50 names on Drought Committee distribution list.[46] The distribution list members get alerts for meetings and updates on the conditions of the river. However, Shoonen believes that of that 50 there are probably 20 core people who regularly attend meetings and weigh in on Committee decisions.

Plan development did not stop there, however—it is ultimately an iterative process, working to constantly adapt and improve the plan. The plan already underwent one update in 2010, and the Drought Committee is currently organizing discussions for another update based on responses to 2013 implementation.[47] A subcommittee of the larger Drought Committee will spearhead the current plan update; volunteers for the subcommittee were found by a simple show of hands of interested individuals at the end of year meeting.[48] However, Shoonen was quick to point out that if representatives from critical groups–irrigators, outfitters, etc.–were missing from the subcommittee, Blackfoot Staff and Drought Committee members would work to fill those gaps, so that all voices are included in the plan revision process.[49]

Again revisions to the plan follow a similar process to the original plan development. In order to begin the process of plan revision, the Blackfoot Challenge coordinating staff will pull together an initial set of revisions that have been proposed by Committee and other participants. These proposed revisions will then be distributed widely via the Challenge's normal outreach channels. Everyone would be asked to look at the revisions and make comments, and these comments would then inform and guide the subcommittee's updates. Burnett stresses that they work to make plan

revision an open and transparent process because this eases the approval of the revised plan.[50] When "you get to the point of having folks approve a revised plan there are no surprises"–everyone has been a part of the process and feels that their voices and concerns have been raised and addressed.[51]

Development of Individual Plans

Individual drought plans are a huge component of the overall drought response. The approximately 90-100 individual drought plans were created directly by the water user in consultation with Drought Committee Staff; they worked with the "water users to identify opportunities for water conservation based on individual needs and conditions."[52] According the Burnett, the Water Coordinator on staff at Blackfoot at the time would go out and talk to the irrigator, together they would explore a variety of strategies for water conservation, and the irrigator would determine what actions were most feasible in a drought situation.[53]

Plan Components and Implementation

According to Gary Burnett, there were not many water conservation strategies in place before the Drought Response Plan.[54] Since the development of the plan, Blackfoot Challenge has been working to build off its success by launching an irrigation efficiency program focused on water scheduling and the efficiency of the irrigation systems.[55] But, the Drought Response Plan is the first formalized document targeted at water conservation.

The Drought Response Plan is comprised of two main components:

1) An overarching plan that details flow and temperature triggers and responses
2) A set of approximately 90-100 individual drought plans that detail how individual irrigators will respond to low flows.

Overarching Drought Response Plan

While the Murphy Right only holds for a segment of the Blackfoot River, the Drought Response Plan covers the entire Blackfoot River and its tributaries.[56] The plan is completely voluntary, but there is an incentive for individuals with water rights junior to the Murphy Right to participate. Under an agreement with the Montana FWP, during drought no call is placed on the rights of juniors if they participate in the Drought Plan.[57] The Drought Plan allows participants to continue irrigating at a decreased amount, whereas junior non-participants under a call on the Murphy Right would have to stop diverting completely.

The broad plan attempts to establish a water bank. Under that system seniors and juniors would voluntarily cut back on water use when flows drop to a predetermined level. The conserved water is pooled to create a "water bank account" that is used to maintain stream flows and allow junior irrigators to continue irrigating at a reduced level. This shared conservation would ideally leave enough water in the river to sustain the river fisheries, while also lessening the burden juniors would carry under a Murphy Rights call. Mike McLane, field staff manager for the Blackfoot Drought Committee, explained the idea saying, "If we can prevail on enough water users to reduce their use and share in the shortage, we might be able to limit fishery damage and impacts to junior irrigators."[58]

The Drought Committee actively monitors drought indicators on the river year round in order to determine when drought triggers have been reached. These indicators include, snow pack, precipitation, soil moisture, and the Surface Water Supply Index ("SWSI").[59] In the winter and early spring the drought committee meets monthly to conduct these reviews of river conditions.[60] In the late spring and summer, as temperatures rise and drought becomes more likely, the committee begins meeting on a weekly basis and shifts its monitoring focus to stream flows, precipitation, water temperature, and biotic conditions.[61] Staffs from Montana DNRC and FWP pull information on drought indicators and the Coordinator compiles the information and sends it out prior to the Drought Committee call. On the call, the DNRC or FWP staff report on flow and temperature. They also look at trends and project ahead to try to determine future river conditions.

The committee continuously shares updates with the community via email or via letter on their monitoring efforts and on river flows and temperatures.[62] In early spring if drought looks likely, the committee increases its outreach efforts to the community (see "Outreach" section below).

If the river hits one of the predetermined flow triggers, the committee decides to implement the Drought Response Plan and sends out notices to alert plan participants to begin following their individual water conservation plan. Montana FWP, in consultation with the Committee, will also place a call on non-participating juniors that requires them to halt water withdrawals. If temperature triggers are hit, the Montana FWP will put in place predetermined fishing restrictions on the river. These restrictions start with afternoon fishing restrictions (2pm to 5pm) on critical reaches and, if water temperatures continue to rise, move towards all day fishing restrictions on the main-stem of the river and all critical bull trout streams. See Appendix G for full list of drought temperature and flow triggers and responses.

Individual Drought Response Plan

The 90-100 individual drought response plans comprise the bulk of the drought response effort. The most common water conservation strategies included in these plans are: "pooling water rights and using them in rotation, reducing overall use, reducing instantaneous use, or shutting down."[63] Shutting off a set number of pivots was a strategy that was referenced most in conversations with Blackfoot staff.

The individual plans are important because they are an opportunity for water users to sit down and proactively think about how they would act to conserve water. Burnett states, "The individual plan is developed with the irrigator and agreed upon by the irrigator."[64] Having the water user craft the plan makes the strategies more realistic and increases the likelihood that participants will implement. In the Blackfoot they have seen an added benefit – plan participants acting proactively on water conservation. Shoonen noted that in 2013, the most recent year the Drought Response Plan was implemented, there was a lot of voluntary participation without contact from Drought Committee members or staff.[65] Many landowners were watching the stream gauges and implemented their plans before the Challenge notified them.[66] Blackfoot Drought Committee laid the groundwork for water user action with a history of good communication on what drought conditions looked like and when to put in place individual plans. But having an individual plan on hand gave participants concrete direction and specific strategies they could act on by themselves in response to worsening river conditions.

Outreach

In addition to the Committee distribution list, the Drought Committee maintains a full list of all drought response participants. The information housed within the participant roster includes

"water user name, contact info, and water rights data (flow rate, priority date, and water sources)."[67] The roster also contains copies of the participants' drought response plans and an initial estimate of how much water is expected to be conserved through the implementation of the individual plan.[68] In addition to information on participants with conservation plans, the roster also includes contact information for non-consumptive river users, such as anglers and outfitters.

The Drought Committee and Blackfoot Challenge more broadly engage in extensive outreach both to the people listed in the participant roster and to the larger community. This outreach is conducted with the specific purpose of keeping the community and targeted water users informed about river conditions. The Committee sends out at least one letter or email per season to their distribution list and participant roster about the conditions on the river and projections for drought. If drought looks imminent then the Committee increases its outreach efforts by sending, "notices (letter or email) to water right holders on potential for low flows and need for the Drought Response, notices to outfitters and anglers on the potential for high water temperatures and need for the Drought Response." The Committee also makes an effort to "get some news coverage...about the plan before drought hits," says Shoonen, in order to ensure the community is aware of the worsening river conditions and allow them time to prepare to respond.[69] Apart from emails and letters the Committee can issue press releases, put up posters and flyers, make updates to the Blackfoot Challenge hosted "Drought Information" website, and, if necessary, host a public meeting focused on the drought conditions and need for meaningful participation in the plan.[70]

Personal communication with water users is another strategy that is heavily utilized by the Drought Committee to encourage greater participation in voluntary programs and to educate the community about efforts currently underway. This personal communication includes committee members doing neighbor-to-neighbor outreach as well as Blackfoot Challenge staff (specifically the Water Steward or Coordinator) making phone calls or personal visits to water users.[71] For this method to be most effective there needs to be a point person from each constituent group involved in the Committee and that point person needs to be someone who is trusted within their constituent community.[72] Burnett says, "these trusted community members go home and have discussions with their neighbors and friends in the coffee shop or in the bar" about the drought and the response work that is being done."[73] Blackfoot Challenge sees this method as the key to encouraging more senior irrigators and large irrigators to participate in the plan.[74]

When a trigger is hit and individual plans need to be implemented the committee sends out a letter with a return envelope and a card that participants fill out to indicate if they are implementing their voluntary plan or not.‡‡‡ They found that a letter as opposed to an email is more effective in this capacity because it stands out from the general river condition updates and is better suited to communicating with irrigators and outfitters who are outdoors for work much of the day.[75] The Water Steward and committee members then follow up via phone or personal visit with plan participants to encourage participation from those who did not respond and to check in on implementation with those that did.[76]

The Drought Committee also hosts an annual end-of-the-year meeting to present on plan response and implementation and to discuss potential revisions to the plan. According to Shoonen, the year-end meeting is a report out on water conditions by discussing how the response went and providing a timeline that details plan implementation for the past drought. And it is an opportunity for the community to say how they thought implementation went and what changes they would make, if any.[77]

‡‡‡See Appendix H for an example of an outreach letter.

Challenges

Communication

A major challenge that continues to confront water conservation efforts in the Blackfoot Valley is effectively communicating who is participating in the plan. Because the plan is voluntary, it is not always clear to those outside of the Drought Committee who is actively participating and what form that participation takes. This is an easy avenue for mistrust to develop especially between different water user groups. To explain this challenge, Burnett used an example of an outfitter out on the river who sees an irrigator running several pivots: "when an outfitter floats by the pump and they see it running [he thinks] 'he's running his pivots again'" but the reality might be that the irrigator is conserving by shutting off "another pump you can't see."[78] This experience could lead individuals to feel as though they are the only ones sacrificing in the face of drought and reduce their motivation to participate.

The Challenge and Drought Committee are developing ideas to overcome this challenge and increase awareness both about who is participating and what their contribution means in terms of water conserved. One idea that both Burnett and Shoonen referenced was putting up signage on properties of participating irrigators, so that as you "float down the river and…see a pump" you would also see as sign that might read "'voluntary participant- senior user.'"[79]

Evaluation and Monitoring Individual Plans

Currently, under the Drought Response Plan there are no guidelines for monitoring the impact of individual plans on water conservation.[80] As it stands, it is unclear how much water is being conserved through the approximately 90-100 individual plans.[81] It is especially important to understand how much participating seniors versus participating juniors are conserving through their plans because where juniors have an incentive to participate to avoid a Murphy Right call, seniors have no incentive other than the motivation of "shared sacrifice." Comparison of numbers showing the impact of participating juniors and seniors on water levels would go a long way toward ensuring that no participant feels he or she is the only one making sacrifices and would help boost support for and commitment to drought response.

The Committee is working with landowners to establish a system for monitoring the plans. The Committee only has mechanisms for participants to say they are implementing their plans, but no way of knowing if that is actually the case and how much water is being conserved through that implementation. Establishing trust with landowners is key to opening the door to monitoring plan implementation. Burnett mentioned that for monitoring to really work they "have to figure [it] out together- what would irrigators be comfortable with?" To overcome this monitoring challenge, it is critical to have irrigators involved in developing the process and figuring out how water conservation will be measured.

Additionally, there is some uncertainty over how effective the original plans are. Before the first drought hit, Montana FWP was unable to vet the plans to ensure that they sufficiently mitigate for low flows.[82] Drought Committee is hoping to have Montana FWP review all the plans before the next drought hits to ensure that they are achieving an adequate amount of water conservation.[83] The Drought Committee expects that the individual plans will need to be reviewed by FWP and, if

flow mitigation is not enough, the Water Steward will assist irrigators in increasing or improving conservation.

Targeted Participation

The Drought Committee has also struggled with ensuring participation by the outfitter community, large irrigators, and flood irrigators. In the beginning of the process "the outfitting public wasn't very involved."[84] And while a few key large irrigators were present during the plan development the Committee is focused on increasing participation of "large irrigators particularly those with senior rights."[85] Finally, most of the individual plans have been developed relative to pivot irrigation and not many flood irrigators were participating.[86] The Committee and the Challenge are working to bring representatives of these groups into the conversation. There is some indication that their efforts are working as a good number of outfitters were present at the recent end of season annual meeting.[87]

Recommendations

Recommendation #1: *Designate dedicated staff to coordinate the plan and continuously build relationships with constituent groups.*

Recommendation #2: *Create a formalized group or structure through which members of all integral constituent groups can meaningfully participate in plan development and implementation processes*. Meetings of the group should occur on an ongoing basis. The Blackfoot Drought Committee meets monthly in the winter and early spring and weekly in the late spring and summer. Additionally, they have the end of year wrap up meeting focused on reporting out and gaining input from the community and critical constituent groups. Participation in the group or committee should be open to all and widely publicized and communicated; if there are significant gaps in participation from critical constituent groups, they should be filled.

Recommendation #3: *Neighbor-to-Neighbor communication is key in increasing the number of participants and ensuring current participants are implementing their plans.*

Recommendation #4: *Create individual plans that are customized to each water user.* This allows water users to be fully "bought-in" to the process because they create their plans and dictate what strategies they will employ. The plans also give them ownership and allow them to act proactively in the face of low flows.

Recommendation #5: *Broadly communicate and showcase what each person is doing to conserve.* When all critical constituent groups know that others are sacrificing and participating, trust is built amongst groups and creates a sense of "shared sacrifice."

Recommendation #6: *Plan development (both for general plans and individual plans) should be an iterative process.* It should be clear how those plans will be updated and when and where participants should be involved in determining how outcomes will be monitored and what plan revisions should include.

Recommendation #7: *Develop trust through other program initiatives or through "easy" decisions*. The Blackfoot Challenge's 80/20 rule is working on the 80% you have in common to develop trust and then tackle the harder 20%.

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DESCHUTES RIVER BASIN, OREGON

Prepared by Emma Maack

Introduction

The Deschutes River Conservancy (DRC), located in a high-desert basin in central Oregon, has been recognized nationwide for successfully increasing instream flows in the Deschutes River and its tributaries. The focus of this case study, therefore, is not a regional water conservation plan but rather a regional instream flow program. The context in which the DRC works bears several similarities to the Roaring Fork Watershed context, including the extent of public land, dominance of agricultural water use, prevalence of tourists and second homeowners, and popularity of outdoor recreation. The DRC's work has evolved since its inception in 1996; the instream flow programs examined here have been the organization's focus since approximately 2004. In addition to describing the development and implementation of the DRC's programs, this case study will describe and analyze the organization's multi-stakeholder, consensus-based board structure. The case study is intended to help inform the instream flow recovery efforts that RFC plans to pursue once the regional water efficiency plan is in place, as well as provide insights on a regional-scale collaborative effort.

Context

Geographic and Ecological

The Deschutes River Basin covers approximately 10,700 square miles in central Oregon on the eastern side of the Cascade Range. Elevations range from 11,000 feet in the Cascades to below 100 feet at the Deschutes' confluence with the Columbia River. Much of the interior of the basin is a high desert ecosystem with annual precipitation of 10 inches in some lower locations. The headwaters of the Deschutes River and several major tributaries, in contrast, receive up to 100 inches of precipitation annually, mostly as snow. Fifty-one percent of land in the basin is publically owned, accounted for mostly by the presence of three national forests, one Bureau of Land Management district, and one national grassland. Most of the public land is in the upper watershed, while the lower and interior portions of the basin are in private (42%) or tribal (7%) ownership.[1]

Flows on the Deschutes River are unusually constant under natural conditions due to regular groundwater discharge from the area's porous volcanic soils, which have a high storage capacity. Near its confluence with the Columbia, mean monthly flows on the Deschutes range from 4,388 cfs to 7,511 cfs. Average annual discharge for the Deschutes River Basin is 1.2 million acre-feet.[2]

Demographic and Economic

The population of the Deschutes River Basin, centered in the towns of Bend, Redmond, Madras and Prineville, has grown significantly in recent decades and growth is expected to continue. Deschutes County, the most populous county in the watershed, grew from 75,000 residents in 1990 to 157,700 in 2010. [3,4] Outdoor recreation is one of the main draws of the area; popular activities include skiing, river rafting, fishing, hiking, and golf. Jobs in retail services, social services and construction are on the upswing. Though still important to the local economy, jobs in

manufacturing (especially the wood products industry) have declined. Historically, agriculture has had an important presence in the area, and it is still a source of employment; in 2006 it represented around 10% of county income in two of the five counties that make up most of the watershed.[5] However, farm and ranch land is increasingly being sold for development or converted from commercial to "lifestyle" or "hobby" farms. [6] Regardless, agriculture still accounts for the vast majority of water use in the basin.[7]

Figure 1: Map of the basin and its major rivers (credit: deschutesriverconservancy.org).

Oregon Water Law

Water rights in Oregon are based on the principle of prior appropriation.[8] Several aspects of Oregon water law are particularly relevant to the Deschutes River Basin and the DRC's work. Most important is Oregon's Instream Leasing Program, which allows most water rights holders to choose to lease their water for instream flows, provided leasing does not harm other rights holders.[9] The state owns all instream water rights. Another program related to instream flow and conservation, the Allocation of Conserved Water Program, requires that 25% of any water conserved through a conservation project be converted to an instream flow right, and allows the right holder to use the remaining conserved water for another beneficial use, or to lease or sell it.[10]

Deschutes River Conservancy

The Deschutes River Conservancy (DRC) is a non-profit organization founded in 1996 that focuses on restoring stream flow and improving water quality in the Deschutes River Basin. The DRC has a staff of nine and a 30-member board of directors. The board operates by unanimous consensus and is composed of representatives from a wide range of industries and interest groups, including ranching, agriculture, timber, hydro-power, recreation, tribal groups, municipalities, fish and wildlife, and environmental groups. The DRC focuses on voluntary actions and takes a market-

based approach to achieving its mission; this approach is described in subsequent sections. It runs four main programs designed to improve instream flows in the Deschutes River and its tributaries: Water Conservation, Water Rights Transfers, Water Rights Leasing, and Water Management Planning and Monitoring.[11]

Organization Development Process

The original participants in the creation of what became the Deschutes River Conservancy were the Confederated Tribes of Warm Springs, the Environmental Defense Fund (EDF), and the Central Oregon Irrigation District (COID). The origins of the organization began in the late 1980's when the Confederated Tribes successfully secured a substantial senior water right. Located in the lower watershed, the tribes were concerned about the quality of the water reaching them and the health of the local fishery. They were also aware of the impact of their consumptive use on the river and saw an opportunity to better protect the watershed.[12] Possessing senior water rights protected the tribe's water security, which allowed them to take a non-adversarial approach to the broader issue of water use in the basin. They began working with EDF and COID with an interest in collaboration and the desire to avoid having basin water resources managed through the courts. The region had recently been in turmoil over spotted owl regulation in the national forests and there was a strong sentiment that litigation was not a good way to manage natural resources. This initial group of three, called the Deschutes Basin Working Group, decided to explore a concept that was quite new at the time: employing voluntary, non-regulatory, incentive-based strategies to promote river restoration. One result of the group's efforts was successful passage of federal legislation originally introduced as the Oregon Resource Conservation Act of 1996 and eventually passed as part of the Omnibus Parks and Public Lands Management Act of 1996. This bill enabled the Deschutes Basin Working Group to receive both technical support from federal agencies and federal appropriations for projects, provided that their board of directors included representatives of all major natural resource stakeholder groups and operated by consensus.[13]

The funding opportunity provided by this legislation in combination with a widespread aversion to litigating natural resource issues thus shaped the way that the group, which now became the Deschutes Resource Conservancy and eventually the Deschutes River Conservancy, was and continues to be structured. The main interests represented on the DRC board have not changed since its founding. Per the organization's bylaws, board members represent interests, not their employer or organization.[14] According to current DRC Executive Director Tod Heisler, although board members inevitably bring the perspective of their organization, this subtle distinction is important in allowing decisions to get made, as members are able to vote without consulting their superiors. Because board members represent interests, not organizations, there is no formal MOU agreement representing the relationship between the DRC and board members; when someone leaves the board the DRC asks the interest group to nominate a new representative.[15]

The early years of the organization were a "research and development" phase, according to Heisler, with a focus on figuring out the identity of the organization, what projects needed to be done, and perhaps most importantly what proposals could receive the necessary unanimous support. Initially the DRC's role was primarily as a re-grantor of federal funding; they held open solicitations for project proposals and funded a wide variety of watershed restoration activities.

Among the projects that were funded, one that showed immediate success and had broad support was a water leasing program started around 2000. Many landowners were reluctant to part with water rights permanently, but were comfortable leasing them temporarily. Because summer

dewatering was a serious problem, temporary leasing provided immediate benefit to the watershed. When Heisler arrived at the DRC in 2004, he observed the success of the leasing program and decided to focus the organization on water leasing and other instream flow-oriented efforts, dropping the other types of watershed restoration projects that the organization had been funding. He felt the DRC had spent time experimenting and it now made sense to focus on the area where it could have the most impact. This changed the organization from a more responsive, primarily grant-giving organization to a more strategic and proactive entity with a particular area of focus: increasing instream flows.

Although the DRC initially operated primarily on federal funding, today the organization's funding comes from a variety of sources, with federal funding comprising only 4% of revenue in 2012. The largest funding sources in 2012 were foundations and corporations (30%), the National Fish and Wildlife Foundation (24%), and the state of Oregon (23%).[16]

The Deschutes River Conservancy's Programs

Currently the DRC has four main programs through which it works to increase instream flows: Water Conservation, Water Rights Transfers, Water Rights Leasing, and Water Management Planning and Monitoring.

The Water Conservation program works with irrigation districts on piping and lining irrigation canals and on-farm efficiency projects. The Deschutes River Basin's porous, volcanic soils mean water loss can be up to 50% in unlined canals, making piping and lining a particularly high payoff approach to conservation in this area.[17] Steve Johnson, the current manager of COID, reports that COID participates in the program by identifying projects it wants to pursue and approaching the DRC about partnering, but notes that other irrigation districts may work differently. The districts oversee the engineering and construction side of their projects, while the DRC's main contribution is in the form of helping to secure project funding. Because all of the efficiency projects the DRC is involved with are paid for with public funding, all of the water they conserve becomes an instream right. The DRC's water conservation projects lead to permanent instream conservation, totaling over 109cfs as of 2012.[18]

Agricultural Focus

In spite of the decline in agriculture in recent decades, farming and ranching still represents by far the largest use of water in the Deschutes River Basin, hence the DRC's focus on agricultural use. Estimates in a 2006 report from the Deschutes Water Alliance attributed 89% of the consumptive use in the upper portion of the basin (which includes the four largest cities) to agriculture, with 11% attributed to municipal and industrial uses.[19] Heisler expects that it will be many generations before urban water use in the area is significant enough in quantity to be a priority for conservation measures. The disparity between the volumes of agricultural and urban use is well recognized and the users therefore do not tend to point fingers over who is responsible for putting water back in the river. That being said, urban use is an important concern for fast-growing municipalities, making it an important issue politically if not on the basis of volume.[20] The DRC engages with urban water use in two ways: through the state's Groundwater Mitigation Program that requires new groundwater withdrawals in the basin to be mitigated by increasing instream flows, and in working with the Deschutes Water Alliance.

The Water Rights Transfer program also leads to permanent instream protection, as water rights are permanently transferred to instream use. The transfer program mainly focuses on "urbanizing water," that is, agricultural water rights attached to land that is being developed. In the transfer process the irrigation district acquires the water right from the patron, declares it surplus, and then sells it to the DRC, which converts it into an instream flow right. As of 2012, 23cfs have been protected through this program.[21] The water being permanently transferred instream, therefore, is water that is no longer needed due to the reduced amount of agricultural land in the basin. This means that the availability of water for permanent transfer varies depending on the state of agriculture and the amount of development occurring.[22]

The Water Rights Leasing program, which also targets irrigation uses, protects instream flows temporarily; leases can be for a half-season, one year, or five years with an option to opt out each year.[23] Since all instream flow rights belong to the state, the DRC's work is in facilitating the leasing process. In the case of the COID, the largest irrigation district in the basin, in addition to some land in the district becoming developed, many irrigation district patrons are aging or are absentee owners who do not regularly use their water right. COID keeps track of which of their patrons are using their water rights in full, in part or not at all through aerial photography of properties. If a water right is not used for 2 years running, the district sends a letter to the patron letting them know that they are at risk of losing their right, and suggesting that they consider participating in the water leasing program in order to avoid forfeiture of the right. Most irrigation districts promote the leasing program in a similar fashion. If non-use continues for 5 years, the district can confiscate the water right. Under the state's instream leasing program, water right holders can avoid forfeiture by leasing their water for instream flow.[24]

Figure 2: DRC is seeking to restore 198cfs to the Crooked River (credit: deschutesriverconservancy.org).

When water is leased for instream flow, the DRC pays for most of the cost of the state paperwork involved; the patron pays a small fee, but may in turn be paid for the water they are leasing, depending on their irrigation district and the length of the lease. Steve Johnson reports that the leasing program adds only minimal work for his district. He says that the majority of COID patrons do use their water rights in full each year, but of those that receive a letter warning about non-use, 80-90% participate in the leasing program.[25] In 2012, 93cfs were protected through the efforts of the DRC's leasing program.[26]

The Water Management Planning and Monitoring program focuses on long-term planning of "next generation" projects and initiatives for water management in the basin, as well as monitoring the DRC's current projects.[27] Currently, the main focus of the program in terms of planning is participation in the Deschutes Water Planning Initiative. The initiative was launched in 2012 in partnership with the Deschutes Water Alliance, a group that brings together stakeholders from the environmental, municipal and agricultural communities, to work on identifying all instream and out of stream water supply needs in the basin and developing a unified strategy for meeting these

needs.[28] To date, the basin's water supply and management goals have been identified, and the group is in the process of developing and investigating various scenarios for meeting those goals. An upcoming step is developing a proposal for a Bureau of Reclamation basin study.[29]

The Deschutes Water Planning Initiative is an ambitious effort that should be of interest to anyone interested in watershed-wide water management. However, at this point the effort is still in the planning stages and the impact it will have on water use in the basin and instream flows in the river is unknown. Valuable information on the successes and challenges of the effort should emerge over time as the initiative progresses.

Program Implementation

The DRC is generally considered to be quite successful in its approach to increasing instream flows, and its reporting shows steady increases in the number of cfs retained instream each year over the past decade (see Figure 2). It is worth noting that unlike many organizations, the DRC has a relatively easy time measuring the success of its programs and calculating their effect, especially insofar as it has chosen increasing instream flow as its goal (as opposed to a measure such as improving aquatic habitat or protecting biodiversity.) The additional goal of improving water quality, though undoubtedly affected by the DRC's programs, has received less attention to date.

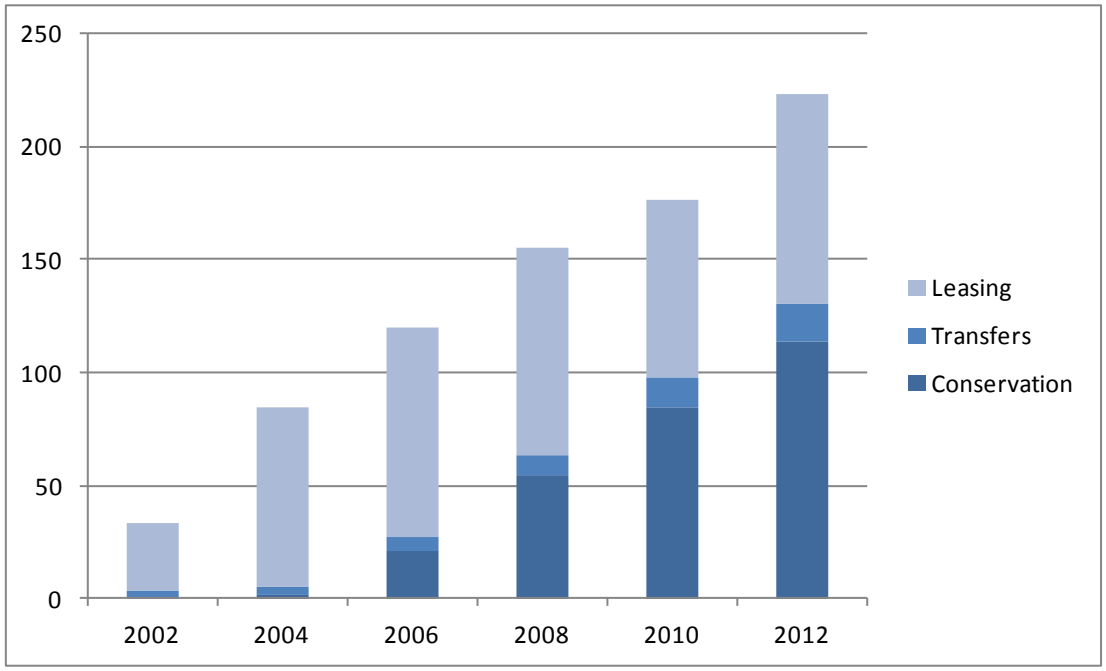

Figure 3: Increases in instream flows in the Deschutes River Basin displayed by amount leased, transferred, or conserved in cubic feet per second.

The strategic approach that the DRC has chosen is to develop projects focused on particular areas of the basin with specific instream flow targets, and employ a combination of its four programs to meet those instream flow goals. The DRC works with the partners implementing each project (e.g. irrigation districts or state departments) as a facilitator, organizer, and funder, as well as helping to secure additional funding from federal, state and foundation sources. In one sense, now that the main DRC programs have been designed and there is a process for implementing them, the primary

strategy lies in where those programs can be deployed for greatest effect. However, Heisler also notes that increasing flows in some parts of the basin, such as the upper Deschutes River, is a complex process that will require a combination of both current and new approaches.[30]

One change over time in how project implementation occurs is a move away from having the DRC board approve every project, large and small. Rather, the organization has several major initiatives which are strategically chosen by staff based on their potential contribution to overall flow objectives. For each initiative, the board approves the approach and sets a cap on the price that can be spent per acre-foot of restored stream flow. The staff is then responsible for the details of the projects and getting the most flow that they can for the price, and they report back regularly to the board on project progress. This change has streamlined the organization's work and focused the board on big-picture thinking rather than day-to-day details.[31]

Challenges

External Factors

Putting together projects that are win-win for a diverse set of stakeholders can inevitably be challenging, but over time the DRC has developed its ability to identify the projects that will win support. The key factors are a project's ability to both restore instream flows and provide benefits to irrigators, such as protecting water from forfeiture or reducing maintenance costs through switching from ditches to pipes. Heisler reports that currently the biggest challenge to the DRC in implementing its programs is external influences. Specifically, federal, state, and local policies and regulations (for example, a new Endangered Species Act listed species) that do not directly impede the project can still affect project participants' relationships, views, and willingness to undertake a project. DRC-led projects can in effect become "collateral damage" of policy and regulatory actions. Heisler also mentions a situation in which the DRC spent years putting together a project which then became incorporated into a piece of federal legislation. In theory this should have been a positive development, but in the policymaking process the legislation was put on hold for three years and the project had to be halted. Not all projects are stopped short in this way, but when the implications for participants are changed, projects can run into trouble.[32]

The DRC's ability to attempt to influence emerging legislation or regulations that might indirectly impact the viability of its projects is limited by its consensus structure. Because of the differing interests among board members, new policies are often a positive for some groups and a negative for others. The rare exception to engaging in advocacy is when something will directly affect the DRC's work. All of the DRC's projects are susceptible to this type of external policy interference, but Heisler notes that pursuing multiple projects in different locations does make it unlikely that all projects will be affected at the same time.[33]

Land Use Changes

The ongoing change in land use in the Deschutes River Basin from agriculture to urban uses presents both an opportunity and a challenge for improving instream flows. Because urbanized land uses significantly less water per acre than agriculture, overall demand for water is lessening; studies suggest that the basin does not really face water scarcity, but rather an allocation and distribution problem. However, the process of changing the distribution of water has challenges. These include the fragmentation of small water rights that are time-consuming for irrigation

districts to deal with and the uncertain future role and viability of the irrigation districts themselves as land uses continue to change under them.[34]

Collaborative Structure

Although the challenges that external policies and regulations can create for DRC projects are related to the cooperative nature of the DRC's work, the fact that external forces, rather than internal struggles to reach consensus or difficulty bringing project partners together, are seen as the main challenge is evidence of the strength of the organization's collaborative structure. In fact, this structure is clearly part of the key to its programmatic success. The desire to avoid litigation over natural resource issues, based on traumatic past experience, undoubtedly has helped the group stay collaborative. But the commitment to collaboration has also grown stronger over time. Heisler observes, "I suspect that in earlier days involvement with the DRC was more about protecting one's own interest, but now there is more of an understanding of mutual interests."[35] Jim Manion, the general manager of Warm Springs Power and Water Enterprises and one of the founding members of the DRC, observes that although there was a strong interest in working together, the stakeholders on the board originally came together with considerable apprehension. He estimates that it took 3-5 years to build trust and make people comfortable. Eventually participants came to see and believe that it was actually easier to work together on their respective interests, rather than work alone and compete with one another.[36] Persevering with the collaborative model in spite of some discomfort therefore appears to be an important contributor to the ultimate success of the organization and its programs.

"The board can be useful in influencing others to adopt new practices and to work with the staff to develop programs and projects."
- Tod Heisler

There are clear payoffs to having stuck with the collaborative structure. Manion believes that having a wide-reaching group of board members provides a net gain as it brings more knowledge to the board as a whole, although he does acknowledge that there is a delicate balance between the diversity of the group and the consensus-based process. However, he states that the main challenge with the large and diverse board is not reaching agreement but rather ensuring that everyone understands the policy implications and funding processes of proposals.[37] Heisler points out that the board's reach can enable it to influence others to adopt new practices, and the board brings a range of relevant expertise that can be helpful to staff as they are developing programs and projects.[38]

"Our basic rule is no surprises—no press releases that will get people excited before getting the information to the other stakeholders."
- Steve Johnson

Manion and Johnson both characterize the value and approach of the diverse board as a practical means of avoiding conflict between different interests. Manion describes the motivating attitude as, "If we can get together before there's a problem, we can avoid having problems in the future."[39] Johnson states, "Our basic rule is no surprises—no press releases that will get people excited before getting the information to the other stakeholders."[40] The DRC's success in the face of a variety of potentially conflicting interests in the basin has shown that this approach can yield impressive results.

Recommendations

Recommendation #1: *Find compelling ways to remind people why collaboration is better than the alternatives.* A clear sense of what the alternative to collaboration looks like can help keep people at the table when things get challenging.

Recommendation #2: *Take time to focus on and build support for the process and the idea of collaboration.* A strong commitment to the collaborative process itself, not just to the desired outcome, can be key to making the process work.

Recommendation #3: *Be patient.* It can take a long time (i.e. years) to build a foundation of trust in a collaborative group.

Recommendation #4: *Consider a multi-pronged programmatic approach.* Doing so can help sustain progress when inevitable external factors stall or derail individual projects.

Recommendation #5: *Focus on agricultural water use to increase instream flows.* The amount of water used by different sectors was a key factor in the DRC's decision to focus primarily on agricultural water use. Working with the agricultural community on water conservation is likely to pay off due to the relative amount of use, even if the going is slow.

Recommendation #6: *Consider dedicating resources towards pursuing policy changes.* The opportunities and incentives provided by Oregon water law for protecting agricultural water rights through instream flow leasing are a key part of the successful efforts in the Deschutes River Basin. Similar changes in Colorado water law may be necessary to see the same level of benefits in the Roaring Fork Valley.

Recommendation #7: *Consider contacting those involved in the Deschutes Water Planning Initiative to learn more about the approach, challenges and outcomes.* Following the progress of the DWPI may provide useful information about the successes and challenges of this type of region-wide, long-term water management planning.

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[3] Ibid.
[4] U.S. Census Bureau
[5] Growth, Urbanization and Land Use Change: Impacts on Agriculture and Irrigation Districts in Central Oregon, http://www.deschutesriver.org/Growth-Urbanization-and-Land-Use-Change.pdf
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[7] Heisler, Tod. Personal Interview. 11 Oct. 2013
[8] http://www.oregon.gov/owrd/pages/pubs/aquabook_laws.aspx
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[16] Deschutes River Conservancy 2012 Annual Report, http://www.deschutesriver.org/2013%20Summer%20Newsletter%20and%20Annual%20Report.pdf

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[27] http://www.deschutesriver.org/what-we-do/streamflow-restoration-programs/water-management-planning-and-monitoring/
[28] Deschutes Water Planning Initiative: Water Supply Goals and Objectives, http://www.deschutesriver.org/DWPI%20Prelim%20Report%20and%20Appendix%20A%20-%20Workshop%20Draft%20-%20FINAL.pdf
[29] http://www.deschutesriver.org/June%2025%20meeting%20summary_distributed%20draft.pdf
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[31] Heisler, Tod. Personal Interview. 22 Nov. 2013.
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[33] Ibid.
[34] Ibid.
[35] Heisler, Tod. Personal Interview. 5 Nov. 2013.
[36] Manion, Jim. Personal interview. 14 Feb. 2014.
[37] Manion, Jim. Personal interview. 27 Nov. 2013.
[38] Heisler, Tod. Personal Interview. 5 Nov. 2013.
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PART VI: WATER CONSERVATION EDUCATION & OUTREACH CAMPAIGNS

Prepared by Emma Maack

INTRODUCTION AND GOALS

The Roaring Fork Conservancy ("RFC") is planning to launch a major education/outreach campaign to promote water conservation once the regional water efficiency plan is in place. The ultimate goal is for increased water conservation to lead to increased instream flows in the Roaring Fork, Fryingpan and Crystal Rivers. The importance of education and outreach for achieving water conservation was emphasized in most of the interviews the project team conducted with staff from the valley's major water providers and from the SGM consulting firm.§§§

This section of the report provides information about water conservation education/outreach campaigns, along with recommendations for the RFC to consider in designing and conducting their campaign.

Relationship to the 2010 Master's Project [*Fostering Implementation of the Roaring Fork Watershed Plan*]

This section differs from the education/public awareness section of the 2010 Roaring Fork School of Natural Resources and Environment ("SNRE") Master's Project Report[1] in several ways. The 2010 project had a much wider focus in its education case studies: it looked at efforts with various emphases (water quantity, water quality, and riparian habitat), and looked at education campaigns that were trying to raise awareness as well as those trying to change behavior. Regardless, our current project and the 2010 report make some similar points, particularly regarding the value of social marketing-style campaigns to change behavior and the importance of evaluating education/outreach efforts to determine what works.

The 2010 project provides education/outreach case studies that were written with RFC in mind, and it may be useful for RFC to revisit those that are relevant to the current endeavor. The *Water Use It Wisely, Bert the Salmon, Clark Fork Coalition* and *Denver Water* case studies have a water conservation focus, while the *Bert the Salmon* and *Denver Water* case studies also have a behavior change/social marketing focus.

In contrast to the 2010 project, this report focuses on specific education/outreach *strategies* (as opposed to *case studies*) designed to achieve the goal of water conservation. This report also focuses exclusively on behavior change rather than on awareness-raising campaigns, for reasons discussed below.

§§§ For the full summary of these interviews, see Part III of this report.

Integration with the Regional Water Efficiency Plan

RFC will need to determine how best to combine its work on the education/outreach campaign with the activities of the water providers under the regional water efficiency plan. Some of the strategies described below may actually need to be implemented by the water providers rather than RFC. An important component of RFC's campaign will thus entail working with the water providers to implement the activities that fall under their purview. Given the existence of activities that might be considered part of both the regional plan and the education/outreach campaign, the project team recommends that RFC's education program staff work as closely as time and resources allow with the water providers during the development of the regional plan, in order to ensure the best understanding and design of both the plan and the campaign.[****]

METHODOLOGY

Research on perception change education/outreach campaigns was conducted by searching several relevant scholarly databases using search terms such as: water conservation, perception, attitude, attitude change, education, outreach, household, residential, and evaluation.

Research on behavior change education/outreach campaigns was conducted by searching several relevant databases that collect scholarly articles, studies and resources. Databases searched included: ProQuest Water Resources Abstracts (water resources), ERIC (education), and PsychINFO (psychology). Search terms used included: water conservation, barrier, behavior, behavior change, information, education, outreach, domestic, residential, measure, evaluation. The websites for the American Water Works Association and the Alliance for Water Efficiency were also reviewed for applicable information and examples.

Three resources that focus on how to create behavior change provided the strategies described in this section: Doug McKenzie-Mohr's Community-Based Social Marketing website[2], the Tools of Change website[3], and a 2012 SNRE Masters Project entitled "Watershed Outreach Professionals' Behavior Change Practices, Challenges, and Needs: Insights and Recommendations for the Chesapeake Bay Trust."[4]

PERCEPTION CHANGE CAMPAIGNS

Consumer attitudes and perceptions about water conservation are important to understand in education/outreach campaigns; someone who does not believe water conservation is important is less likely to conserve. However, there are few formal evaluations of the effects of perception-focused water conservation campaigns on domestic consumption, and those that do exist often pertain to the short-term effects of campaigns during droughts rather than the long-term effects of ongoing campaigns.[5] Of the studies that do exist, some have found attitudes towards water conservation have been predictive of consumption levels,[6] but other studies have found little or no correlation between general awareness of water conservation issues and household consumption.[7] In addition to being inconclusive, most of the research on this topic has been conducted in Mexico and Australia, and therefore may not necessarily be predictive of consumption patterns in the Roaring Fork Watershed.

[****] For a summary of existing education/outreach efforts by water providers in the Roaring Fork Watershed, see Appendix I.

Although the research is inconclusive, it suggests that educational campaigns seeking to change perceptions towards water conservation should take into account the influence of both personal norms (a person's inner convictions regardless of the behavior of others) and social norms (an understanding of the behavior of others).[8] Personal normative beliefs about water conservation have been seen in some studies to have a direct influence on pro-environmental behavior.[9] In some instances, social pressure can encourage conservation, even in the absence of personal norms. The influence of friends or family can also predict an individual's intention to conserve water.[10] However, the influence of social norms can also hinder conservation, and one study found that individuals who perceived that other people wasted water reported lower levels of motivation for conserving water, and consequently increased their own water consumption.[11] This trend is of particular concern in the Roaring Fork Watershed, where water users might worry that the water they save is simply going to be pumped across the divide to the Front Range. Any educational campaign in the Roaring Fork Watershed should address this concern, especially if it can be demonstrated that conserved water will remain in the watershed.

BEHAVIOR CHANGE CAMPAIGNS

Knowledge, awareness, and concern: maybe necessary but not sufficient

As discussed above, it is logical that water users would need to be aware of the reasons for conserving water and perhaps the environmental effects of water consumption in order to begin conserving, and research confirms the *correlation* between knowledge, awareness, and concern and "pro-environmental" behavior. However, multiple studies have also shown that knowledge, awareness and concern *alone* are not enough to generate action. In other words, many people have the relevant knowledge and are concerned about the environment, but are nonetheless not conserving water. This reality has been discussed in a number of widely-cited articles beginning in the 1980s, including two meta-analyses of research on behavior from the environmental education field, completed in 1987 and 2006.[12]

If knowledge, awareness and even concern about environmental issues are not enough to prompt changes in behavior, how can behavior be changed? Dr. Michaela Zint, who studies the evaluation of environmental education programs and was consulted on this project, emphasized the demonstrated importance of imparting "knowledge of actions" that can be taken to conserve water and of identifying the barriers that keep people from conserving water and finding ways to overcome them.[13] This type of approach is also employed by community-based social marketing ("CBSM") proponents such as Doug McKenzie-Mohr.[14] This emphasis on education and outreach strategies that equip people to act and overcome potential barriers to water conservation behavior will be the focus of the following section. In the case of the Roaring Fork Conservancy's planned water conservation education/outreach campaign, there is a clear behavioral goal and a clear environmental impact being sought: to reduce water use and keep more water in the river for ecological benefit.

> "Research showed that in most cases, increases in knowledge and awareness did not lead to pro-environmental behavior." – Kollmus and Agyeman[15]

Research on water conservation behavior

Over the past several decades, water conservation education/outreach campaigns have been deployed at the state, region, municipality and utility level in many places both nationally and

internationally. Unfortunately, only a few of these campaigns have been rigorously evaluated to measure their effect on water use. This is somewhat understandable, given the resource investment required to isolate the effects of an education/outreach campaign from other factors that might influence changes in water use—weather, a changing population, changing preferences for landscaping which may or may not have resulted from the campaign, and especially other water conservation measures such as rate changes. Campaigns that lack proof of their impact were not necessarily unsuccessful; rather, their success is still unknown. It is important to remember that ultimate "success" by RFC's definition is more water conserved; the number of people reached with information, faucet aerators distributed, or water audits performed are valuable but intermediate measures of campaign success.

Based on the existing research, the remainder of this section provides:

- A discussion of barriers to changing water conservation behavior.
- A collection of strategies recommended for generating environmental behavior change, including those promoted by CBSM, with specific examples of their applications in water conservation contexts. Examples are drawn from campaigns that have shown some evidence of success.
- Two case study descriptions of water conservation education/outreach campaigns that have some evidence of success and provide a more detailed picture of the application of strategies that may be of interest to RFC.

It should be noted that while the geophysical and economic context of the Roaring Fork Watershed differs considerably from many other parts of the United States, at the level of residential water use, many of the specific conservation strategies available are similarly applicable across the country and even internationally. Additionally, no obvious pattern has emerged in the research reviewed here that indicates particular strategies are better for certain climates or community types. The project team therefore found it appropriate to cast a wide net for successful campaigns and strategies, especially given the overall lack of evaluation of these campaigns. The best way for RFC to ensure that its campaign is appropriate to the local context is to invest time in exploring local residents' barriers to water conservation behavior.

Given the time and resources available, the project team chose to focus on residential or domestic water conservation education/outreach campaigns. This is not to imply that other targets for water conservation (e.g. commercial or agricultural users) may not be worth pursuing, but simply reflects the fact that residential water use is expected to be a component of RFC's campaign, whereas other users may or may not also be included.

"We discovered if you gave away devices, most of them were "installed" in kitchen drawers, not on the bathroom or kitchen fixtures." –Steve Estes-Smargiassi, Massachusetts Water Resources Authority[16]

Barriers to Water Conservation in the Roaring Fork Watershed

Any education/outreach campaign in the Roaring Fork Watershed should attempt to lower the barriers that currently keep residents from conserving water. Other campaigns have conducted surveys or focus groups in order to better understand the barriers to the actions they seek. Different subsets of the Roaring Fork Watershed population are likely to experience different barriers to water conservation. For example, the Roaring Fork Watershed has many second homes,

and identifying and addressing the barriers to reducing water use by second homeowners or their representatives may require efforts that go beyond the most common strategies.

Audience segmenting or targeting in the application of water conservation strategies (e.g., addressing the specific barriers of second homeowners) is a common marketing concept and can be an important factor in the success of a campaign trying to change environmental behavior. It entails dividing the population whose behavior you want to change into distinct segments that are expected to respond differently to various strategies, or choosing to target only a subset of the population that is expected to be most receptive or to influence others.††††

Exploring local barriers to water conservation is RFC's opportunity to assess the degree to which perceptions and awareness pose barriers to water conservation behavior. If perceptions are one of the barriers, data from a survey or focus group may provide some ideas for how these perceptions can be changed.

Barriers to water conservation that have been reported in other studies and might be considered by RFC include:

- Perceptions about the need for conservation in the absence of a drought/water shortage[17]
- Perceptions about who has responsibility for conserving or ensuring a reliable water supply[18]
- Personal nature of water use and perception that being asked to modify water use is an intrusion into people's personal lives[19]
- Related to the installation of low-flow devices:
    - Concerns about breaking something[20]
    - Distaste for dealing with toilets[21]
    - Cost of installation[22]
    - Difficulty of installation[23]
- Related to switching to less water-intensive landscaping:
    - Cost of switching[24]
    - Lack of information about switching[25]
- Lack of information about installing a rain barrel[26]
- Lack of information about how much water is being used currently[27]
- Effort involved in conserving water[28]
- Time involved in conserving water[29]

BEHAVIOR CHANGE STRATEGIES

Through our research we identified three sources that provide concrete, practical guidance for those interested in generating change in environmental behavior. Doug McKenzie-Mohr is an environmental psychologist and one of the creators of the concept of community-based social marketing. He has done extensive training with practitioners and much of his work, including his book outlining the various CBSM strategies, case studies, and related articles, is available on his website. Tools of Changes is a similar website that describes strategies ("tools") for behavior change in environmental, health, and safety contexts, and provides numerous case study examples. The Tools of Change resources are based in part on McKenzie-Mohr's work; the website is created

†††† More detail on audience segmenting can be found in "Watershed Outreach Professionals' Behavior Change Practices, Challenges, and Needs," one of the sources described below.

and maintained by Cullbridge, a consulting firm that focuses on social marketing, and is funded by Natural Resources Canada and Health Canada. The third source is an SNRE master's project entitled "Watershed Outreach Professionals' Behavior Change Practices, Challenges, and Needs: Insights and Recommendations for the Chesapeake Bay Trust." This project involved compiling a descriptive list of behavior change strategies applicable to watershed organizations' outreach efforts, based on research from the conservation psychology field.

Below are the 13 strategies we have compiled from these three sources. Together they represent the basic strategies recommended by each of the sources, and we believe they are all potentially applicable to the RFC's water conservation education/outreach campaign. The following information is included on each strategy:

- **Source:** Which of the sources include this strategy (and what do they call it, if names vary). The three sources drawn from are:
    - "Watershed Outreach Professionals' Behavior Change Practices, Challenges, and Needs: Insights and Recommendations for the Chesapeake Bay Trust" (2012 SNRE Master's Project, copy available upon request) ("MP")
    - www.cbsm.com ("CBSM")
    - www.toolsofchange.com ("TOC")
- **Summary description:** Definition of the strategy from one of the sources.
- **Examples from water conservation education/outreach campaigns:** One or more examples of how this strategy has been applied in a real campaign with some evidence of success.

OR

- **Possible water conservation applications:** If the project team did not encounter any good examples of a given strategy being applied in a water conservation education/outreach campaign, a theoretical example is provided instead to illustrate the idea.

More detailed information on each of these strategies, including their benefits and challenges, the evidence supporting effectiveness, and tips on using the strategy are available in the original sources.

Strategy: Commitment

Source: MP, CBSM, TOC

Summary description (MP): Using verbal or written agreements, such as pledges, to encourage people to adopt a behavior**.**

Examples from water conservation education/outreach campaigns:

- Signing a pledge to water the lawn no more than one inch per week.[30]
- Signing a flyer committing to and encouraging others to conserve water while showering.[31]

Strategy: Extrinsic Rewards

Source: MP, CBSM (Incentives), TOC (Financial Incentives and Disincentives)

Summary description (MP): Using money or prizes to motivate behavior or assist with high cost**.**

Examples from water conservation education/outreach campaigns:

- Installing water-saving devices for free for interested residents. Procedures for doing this have included:
    - Distributing a paper flyer followed by door-to-door follow-up, then returning later to install devices.[32]
    - Sending people door-to-door to offer free installation of devices, and returning to install within 20 minutes for those interested.[33]

  The director who oversaw the campaign in which installation occurred within 20 minutes noted that in addition to ensuring devices were installed, another advantage of installing them for residents was being able to focus on the devices that were most effective. On their own, residents tended to install the devices that were easiest to install but which also happened to be those that generated the least water savings.[34]

- Providing rebates for low-flow appliances
    - In a variation on the rebate approach, Santa Monica has a Water Efficiency Revolving Loan Program that provides no-interest loans to pay for water efficiency activities such as irrigation system upgrades.[35]
    - In another variation on the program, the State of Arizona offers rebates to households that install rainwater harvesting or greywater systems.[36]

Strategy: Feedback

Source: MP, TOC

Summary description (MP): Providing information about the level of success or need for improvement in response to a particular behavior.

Examples from water conservation education/outreach campaigns:

- Water providers contact customers immediately when they see a change in water use that does not make sense.[37]
- Free indoor or outdoor water use audits or surveys.[38]
    - In addition to identifying where and how water is used, an audit might also include leak inspection, cost-benefit analysis of replacing appliances, or a customized watering schedule.
    - Audits are often tied to other programs such as distribution or installation of low-flow devices or information about low-flow appliance rebate programs.
- Shower meters and/or timers that provide information about how long a shower has lasted and volume of water used.[39]

Strategy: "How-to Skills"

Source: MP

Summary description (MP): Information and/or training on how to carry out environmentally responsible behaviors.

Examples from water conservation education/outreach campaigns:

- Providing how-to videos on converting to xeriscaped landscaping.[40]
- Providing workshops on water-efficient landscaping and gardening practices.[41]
- Providing on-site (i.e. at the resident's home) instructions on easy sprinkler maintenance.[42]
- Providing a customized watering schedule.[43]

Strategy: Intrinsic Rewards

Source: MP

Summary description (MP): Motivating individuals to perform an action because of the personal satisfaction it can offer or the experience it can provide; this may include how an activity can be enjoyable or interesting.

Possible water conservation applications:

- People who enjoy gardening may find it interesting to learn about xeriscaping and pick out native and water-tolerant plants for their yards.

Strategy: Positive Emotional States

Source: MP

Summary description (MP): Appealing to positive emotions, such as hope and enjoyment, as a way to change individuals' behaviors (see also Intrinsic Rewards).

Examples from water conservation education/outreach campaigns:

- The Water Use it Wisely campaign focuses on messages that are "empowering, applauding people as the solution without forcing the behavior change upon them" and has an "emphasis [on] stewardship, not hardship."[44]

Strategy: Prompts

Source: MP, CBSM, TOC

Summary description (MP): Short, simple reminders to perform a desired behavior.

Examples from water conservation education/outreach campaigns:

- Reminder tags on appropriate watering to hang on outdoor faucets.[45]

Strategy: Social Norms

Source: MP, CBSM, TOC (Norm Appeals)

Summary description (MP): Demonstrating the importance of a behavior to people, either by describing the behavior as socially acceptable or unacceptable or as a common behavior.

Examples from water conservation education/outreach campaigns:

- Subjects in a study at UC Santa Cruz who were showering in a gym were more likely to follow posted suggestions to turn off the water while soaping up when another person demonstrating the suggested behavior was in the shower. They were even more likely to do so when two other people performing the behavior were present.[46]

Strategy: Stories

Source: MP

Summary description (MP): Verbal or written tales with an imbedded environmental message, such as sharing what individuals or communities are doing to solve environmental problems.

Possible water conservation applications:

- A fisherman or rafter might talk about experiencing very low water in the river during a recent drought, realizing the connection between the river and the water he/she uses at home, and starting to conserve more.

Strategy: Building Motivation Over Time

Source: TOC

Summary description (TOC):

- Motivational techniques such as linking to activities that people are already doing, recognizing them for actions already taken, and providing ongoing opportunities to take further steps and become more involved.
- Steps for strengthening motivation over time.

Examples from water conservation education/outreach campaigns:

- Students making four to six visits to residents over the course of the summer to provide information on outdoor water use, discuss the best ways for that household to reduce use, and ask for commitments to conserve.[47]

Strategy: Vivid, Personalized Communication

Source: CBSM (Communication), TOC

Summary description (TOC):

- Communication full of the vigor and freshness of immediate experience, evoking lifelike images that are heard, seen, or felt as if they were real.
- Communication that has been custom-tailored for the person or people receiving the message.

Examples from water conservation education/outreach campaigns:

- A customized watering schedule is tailored to the climate and landscaping of the resident's house.[48]

Strategy: Social Diffusion

Source: CBSM

Summary description (based on CBSM): The spread of information via people who know and trust each other, such as friends, family members or colleagues.

Possible water conservation applications:

- Ask people who have a water use audit or low-flow device installation performed to tell their friends and neighbors about the opportunity. This strategy might also involve providing them with key information about the program to pass on (i.e. an email or postcard).

Strategy: Convenience

Source: CBSM

Summary description (based on CBSM): Making activities that are perceived as difficult, unpleasant or time-consuming easier to perform. Alternatively, making the status quo less convenient in order to make the behavior being promoted compare more favorably.

Examples from water conservation education/outreach campaigns:

- Providing those interested in switching to xeriscaping with six professionally-designed xeriscape plans that they can use.[49]
- Offering free installation of low-flow devices rather than just handing them out.[50]
- Providing a customized watering schedule makes efficient watering easier by eliminating the need for residents to figure out how much they should be watering or when.[51]

Behavior Change Case Studies

Durham Region, Ontario [52]

The Durham Region of Ontario, Canada, located east of Toronto, undertook an effort beginning in 1995 to reduce the amount of water used per capita. Their program included an education and outreach campaign designed using community-based social marketing strategies. One important component of the campaign was an outreach program to reduce lawn watering. The program hired university students over the summer to engage in person with residents and deploy a number of behavior-change strategies (noted in *italics* in the following description).

Over a series of summers, various strategies were tested in designated communities and measured against changes in water use, as well as cost per household reached. Changes in outdoor watering were measured initially by student observation and later by bulk metering. In the course of a summer, students had 4-6 in-person encounters (*building motivation over time*) with each household that provided the opportunity to discuss the household's particular water use situation and the most feasible strategies for reducing lawn watering (*personalized communication*). Students handed out information about appropriate watering, but also handed out rain gauges (*how-to skills*) and reminder tags for outdoor faucets (*prompts*) and asked for a written commitment to water no more than one inch per week (*commitments*). Durham Region saw outdoor watering decrease significantly‡‡‡‡ in comparison to control areas each year the program was implemented. One strategy that did not work well for this program was an attempt to recruit volunteers to spread the information more widely than the students could reach (*social diffusion*). It was difficult to recruit volunteers and more efficient to have students interact with residents themselves rather than spend time recruiting and training volunteers.

Another component of the outreach campaign, installation of low-flow toilets, provides a good example of focusing on how to actually change behavior. In the community of Uxbridge, rather than simply offer rebates and/or free installation and wait for residents to use the program, a survey was conducted to identify the specific local barriers to installing low-flow toilets. The results

‡‡‡‡ "Significant" is used in this section to mean "statistically significant," i.e., it is likely that differences or changes in numbers are real and not due to chance variation.

showed that residents believed that the toilets did not work well and that their retail price was too high. In response, the campaign began addressing the quality of the toilets in their communications and offered the toilets for free, with residents only paying for installation.

Sacramento County, California [53]

As of 2011, California's Sacramento County offered two free programs designed to encourage water conservation: Water Wise House and Business Calls ("WWHC") and the Data Logger Service. The WWHC program is a water use audit in which a trained professional checks for leaks and problems and provides information about conservation and water efficient landscaping, as well as providing training on using the irrigation controller if applicable (*how-to skills*), giving out toilet leak detection tablets (*convenience*) and providing a watering schedule (*how-to skills, convenience*). The Data Logger is a device that is installed at a home for one week and measures the water use of each fixture and the time period of use. About two days after the week of measuring is completed, the information collected is provided to the customer (*feedback*) along with recommendations for water conservation.

A study done with a quasi-experimental design using a control group of households that did not participate in either program showed that on average, both programs reduced water usage significantly, although some specific households within the programs increased usage. The study found that the households that increased use had lower average usage to start out, suggesting that everyone was converging on a status quo amount of use. Because of this effect, the authors speculate that this type of program may be most useful in reducing water use by high users.

It is worth noting that water use decreased on average even though the material provided by the county did not provide any specific guidelines on water use amounts, nor was there any follow-up monitoring or enforcement for these one-time programs. It should also be noted that households participated in these programs voluntarily; the effects of a program like the Data Logger might be different if people received the feedback without having requested it.

EDUCATION AND OUTREACH CAMPAIGN RECOMMENDATIONS

Recommendation #1: Undertake the education/outreach campaign with the recognition that knowledge about and concern for the environment are poor predictors of pro-environmental behavior such as water conservation.

Recommendation #2: Determine the barriers that keep Roaring Fork Watershed residents from engaging in water conservation behavior.

Recommendation #3: Apply strategies for behavior change that will address local residents' barriers to water conservation behavior.

Recommendation #4: Consider targeting specific categories of residents for the campaign, and/or apply different strategies to different segments of the population.

Recommendation #5: Have RFC education program staff work as closely as possible with the water providers during the development of the regional water efficiency plan, to ensure mutual understanding and complementarity of the plan and the campaign.

Recommendation #6: Evaluate the success of the campaign and adapt it based on findings.

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PART VII: LOWER CRYSTAL RIVER ECOLOGICAL AND HYDROLOGICAL DATA SUMMARY

Prepared by Kara Steeland

INTRODUCTION

The Lower Crystal River below Avalanche Creek to the junction with the Roaring Fork River near Carbondale, CO has been dewatered in recent drought years due to water diversions for agricultural and municipal use. The effects of flow alteration not only impact the ecology of the river but also impact recreational users and downstream water users.

Figure 1: Lower Crystal River near the Town of Carbondale.

In 2013, the Roaring Fork Conservancy ("RFC") and its partners held a series of meetings to begin work with major water rights holders in the Lower Crystal River on short- and long-term solutions to flow, water quality, and habitat issues. During the course of these meetings, it became evident that insufficient data existed to develop creative, scientifically sound water conservation solutions compliant with Colorado water law. Therefore, RFC obtained funding to complete the *Lower Crystal River Flow Assessment*. The ultimate goal of the *Lower Crystal River Flow Assessment* is to be able to continue discussions with local water users and water managers in order to inform and support voluntary, collaborative efforts to enhance stream flows in the Lower Crystal River.

The purpose of this report is to summarize the critical hydrologic and ecological information necessary to determine the impacts of water diversions on the biological integrity of the Lower Crystal River.

EVALUATION OF EXISTING DATA

Overview

This section of the report summarizes the available data relevant to the ecology of the Lower Crystal River. Fish, macroinvertebrate, stream and riparian habitat quality, and temperature data have been obtained from the appropriate organizations and agencies and are summarized here. For data with spatial information (i.e. geographic coordinates), sampling data points were converted into feature classes in Esri ArcGIS and are available in a GeoDatabase. Relevant attribute information is included with each feature class. A map of sampling points is located in Appendix J.

Fish Data

Fish data is available for the Lower Crystal River from Colorado Parks and Wildlife (CPW) sampling from 1970 through 2011. A map of fish sampling data points and sampling years is located in Appendix K. There has been little consistency in sampling location over this time period, although some sites have been sampled in multiple years. One site on the Crystal River near the junction with Edgerton Creek has been sampled in two different years. Beyond this site, no sites have been sampled consistently on the Crystal River and fish sampling sites are limited on the mainstem of the river.

There are many sampling sites on tributaries to the Lower Crystal River. Several sites along Middle Thompson Creek and North Thompson Creek have been sampled in multiple years. Sampling has been completed by CPW in 2011 at two sites on North Thompson Creek and near the CPW Fish Hatchery on the Lower Crystal River. The agency plans on consistently completing monitoring at the same sites every two years; however, due to flow conditions in the fall of 2013, fish sampling could not be completed. The fish biologist from CPW, Kendall Backich, indicated that agency plans to complete additional fish sampling when they are able.

Data has been collected utilizing several protocols, including catch per unit effort (CPUE), presence/absence, and two-pass removal. CPUE is utilized in lakes and reservoirs. Collected fish are identified to species, weighed in grams, and measured to the nearest millimeter. Sampling in the recent past has been completed with two-pass removal with electrofishing equipment. Species were analyzed with the following methods: CPUE, counts, or Seber-LeCren. The Seber-LeCren two-pass formula estimates population biomass from the collected data for a particular sampling site.[1]

Data from the 2011 sampling near the Crystal River Fish Hatchery indicates that mottled sculpin, rainbow trout, brown trout, and mountain whitefish were present (Table 1). Mottled sculpin were the most abundant species followed by brown trout and rainbow trout; few mountain whitefish were found during sampling. Additionally, population estimates were completed for brown trout and rainbow trout to determine the number of fish per acre and the pounds of each species per acre (Table 2). Trout biomass is low on the Lower Crystal River. Rainbow trout are stocked primarily as fingerlings with limited stocking of catchable trout in the Crystal; brown trout are not stocked. Brown trout biomass in the Crystal River is extremely low compared to other local rivers; however, rainbow trout biomass is comparable. The Lower Fryingpan River is a classified as a Gold Medal Fishery[§§§§] and has significantly greater pounds per acres than the Crystal River for brown trout. Ruedi Reservoir is upstream of the Lower Fryingpan River and positively influences the trout population.

Similarly, data was collected at two sites in 2004 on the Lower Crystal River, one site above the fish hatchery (indicated as CRRU – Crystal River Rearing Unit) and one site below the fish hatchery. Northwest Region Fisheries Management collected these data. The sites are not in the same location as the 2011 sampling site, although the sites are in relatively the same area. Species composition is similar between 2004 and 2011, although there were fewer rainbow trout found at the 2004 sampling sites (Table 3). Population estimates were calculated for rainbow and brown trout for each site, although weight data is not available for rainbow trout at either of the 2004 sampling sites (Table 4, Table 5).

[§§§§] Gold Medal Waters are designated as having a minimum of 60 pounds of trout per acre and 12 quality trout (greater than 14") per acre.

Table 1: Species counts from 2011 sampling by CPW near the fish hatchery the Lower Crystal River.

Species	Fish Hatchery
Mottled Sculpin	73
Rainbow Trout	12
Brown Trout	13
Mountain Whitefish	2

Table 2: Brown trout and rainbow trout population estimates from 2011 sampling by CPW on the Lower Crystal River.

Species	Mean Length (cm)	Number per Acre	Pounds per Acre	Number per Mile	Pounds per Mile
Brown	250.92	15.71	8.89	133.27	75.5
Rainbow	280.33	14.74	7.94	125.03	67.38

Table 3: Species counts from 2004 sampling by Northwest Region Fisheries Management at two sites on the Lower Crystal River.

Species	1 Mile Above CRRU	1 Mile Below CRRU
Mottled Sculpin	52	106
Rainbow Trout	2	4
Brown Trout	13	17
Mountain Whitefish	1	3

Table 4: Brown trout and rainbow trout population estimates from 2004 sampling by Northwest Region Fisheries Management at the site one mile above CRRU.

Species	Mean Length (cm)	Number per Acre	Pounds per Acre	Number per Mile	Pounds per Mile
Brown	309.23	15.57	12.74	139.62	114.31
Rainbow	200.00	2.35	N/A	21.12	N/A

Table 5: Brown trout and rainbow trout population estimates from 2004 sampling by Northwest Region Fisheries Management at the site one mile below CRRU.

Species	Mean Length (cm)	Number per Acre	Pounds per Acre	Number per Mile	Pounds per Mile
Brown	258.24	47.19	14.20	337.48	101.55
Rainbow	257.50	6.09	N/A	43.55	N/A

Macroinvertebrate Data

Macroinvertebrate data for four sites on the Lower Crystal River and its tributaries is available from 2011 sampling completed by the Roaring Fork Conservancy. Data was analyzed with selected metrics including the Multi-Metric Index (MMI), Hilsenhoff Biotic Index (HBI), and Shannon Diversity Index. Individual metrics were also used including taxa richness, Ephemeroptera Plecoptera Trichoptera (EPT) index for sensitive species, and clinger taxa metric. These data were presented in *A Review of Aquatic Life and Stream Health in the Roaring Fork Watershed*.[2]

Figure 2: CRMS bridge macroinvertebrate sampling site (credit: roaringforkconservancy.org).

From the 2011 sampling, based on the MMI scores, the two sites on the Lower Crystal River surpassed the scores for healthy aquatic conditions and were not considered impaired. The MMI scores are based off Colorado Department of Public Health and Environment Guidelines. Scores are a single index for each site based on five or six equally weighted metrics and creates a value that is adjusted to a scale from 1 to 100. Both sites from the Lower Crystal River and the site from Thompson Creek, a tributary to the Lower Crystal River, were classified as Biotype 1, transition zones. The highest MMI score for all sampled sites located in Biotype 1 (82.8) was obtained from data collected in Thompson Creek, a tributary of Crystal River. Two replicate samples were collected at the Crystal River Fish Hatchery site (site 12731A), and both MMI scores (65.4 and 58.2) were above the threshold for aquatic life use attainment, indicating that healthy aquatic conditions were present at this site. Two samples were collected (one by the RFC and one by the WQCD) during the fall of 2011 at the Thompson Creek Road (CRMS) Bridge (site 12731). Approximately 75% of Carbondale's development is located upstream of the CRMS Bridge site. Both MMI scores (74.8 and 63.0) produced at this site were above the threshold for attainment and appeared to reflect healthy macroinvertebrate communities. EPT values also indicated that there was no apparent stress for taxa with known sensitivities to disturbance. Similarly, HBI values indicated that the impacts from nutrients were essentially undetectable. These scores indicate that the sites on the Lower Crystal River had healthy aquatic conditions and healthy macroinvertebrate communities.

White River National Forest and RFC conducted sampling at one site on the Lower Crystal in 2012. This site represented the farthest downstream sampling location on the Crystal River. It was located in Biotype 1 and had potential impacts to the aquatic environment from nearby residential developments, roads, and all other possible disturbances that exist upstream. The Crystal River at CRMS Bridge site produced an MMI (74.6) well above the threshold for aquatic life use attainment.[3] Additional metrics applied to the data also suggested that this site maintained one of the healthiest aquatic communities in the study in 2012. Metrics designed to measure community balance (Taxa Richness and Diversity), sensitive taxa (EPT and Insect Taxa), and specialized taxa (Clinger Taxa) produced values detecting almost no evidence of disturbance. The HBI value produced at this site did not detect a negative influence from nutrient enrichment during this sampling event. In the fall of 2012, the Crystal River at CRMS Bridge produced macroinvertebrate results demonstrating healthy aquatic conditions, well-balanced aquatic communities, and recovery from impacts that were detected upstream. These MMI, HBI and Diversity metrics for this site were very similar to 2011 data.

Riparian and Instream Habitat Data

Data is available at five sampling reaches for the Lower Crystal River from 2003-2005 sampling efforts by the Roaring Fork Stream Health Initiative, published in the *Catalog of Stream and Riparian Habitat Quality for the Roaring Fork River and Tributaries, Central Colorado*[4]. The purpose of the project was to create a comprehensive inventory of instream and riparian habitat. Sampling for each stream reach was completed with established protocols that took into account a range of qualitative variables resulting in scores for instream habitat, left bank riparian habitat, and right bank riparian habitat for each reach.

All five sampling reaches on the Lower Crystal River were found to be moderately modified, heavily degraded, or severely degraded for both instream and riparian habitat. According to the report, water diversions and channel alteration have altered the natural flow regime. Historic and current development has had major impacts on channel and riparian condition. In riparian areas, plant species composition, habitat structure, and age class distribution have been altered. Additionally, the Lower Crystal River has been channelized; there are clear impacts from Highway 133 that affect channel structure along the entire segment, resulting in loss of sinuosity with a consequent decrease in stream habitat heterogeneity, increased gradient, and increased energy in the downstream direction. Activities that may be leading to downcutting of the channel include: 1) agricultural development and grazing on stream banks; 2) residential and golf development that results in the removal and degradation of riparian vegetation; and 3) commercial development that has resulted in the removal of riparian vegetation. The report provides a range of recommendations to mitigate existing impacts and to better manage and prevent future impacts. These recommendations range from restoring a natural hydrologic cycle to creating sustainable riparian setbacks to mitigating impacts from Highway 133.[5]

Temperature Data

Temperature data is available for 2007, 2008, 2012, 2013, and citizen monitoring temperature data has been recorded from 2012-2014 (6/18/12-8/14/14). Continuous temperature data is available from 2007 and 2008 from the CPW Crystal River Fish Hatchery (7/13/07-11/4/07 & 7/16/08-11/14/08). SK Mason LLC collected temperature and flow data in September and October of 2012 (9/4/12, 9/22/12, 10/20/12) at 14 sites in the Lower Crystal River. SK Mason also collected data at six sites on the Lower Crystal River in 2013 (7/24/13-8/16/13 & 8/22/13-10/1/13); data is not available for all sites for all sampling days.

CPW has determined that the upper temperature limit for brown trout (*Salvelinus trutta*) to thrive is 66°F and the state standard for temperature in the Lower Crystal River is 68°F. Citizen temperature monitoring data show that the temperature at several sites was equal to or exceeded 68°F during July or August of 2012, including the CRMS Bridge (72.5°F), the BRB Crystal River Resort (68°F), and the Crystal River Fish Hatchery (68°F). The snapshot temperature data collected by SK Mason LLC from September and October 2012 indicate that the temperature ranged from 40-64°F at Lower Crystal River sampling sites. The elevated temperatures during the summer of 2012 may be problematic for aquatic life, although, without consistent sampling, it is difficult to discern whether these high temperatures were representative of the normal thermal conditions in that time period. Temperature sampling data by SK Mason LLC from July-September of 2013 indicates that the maximum average temperature reached 68°F at several sites on the Lower Crystal River, thereby exceeding the thriving temperature for brown trout (Table 6).

Table 6: Temperature data collected by SK Mason LLC from July-September 2013.

Site	7-Day Average Mean Temp. (°F)	7-Day Average Max. Temp. (°F)
Near East Mesa Ditch	62	57
Near Lowline Ditch	61	67
Thompson Creek Open Space	62	68
County Line	61	68
RVR South Line	59	65
Stairway Park	61	68

Ecological Data Summary and Limitations

Macroinvertebrate data indicates that the Lower Crystal River is in good-to-excellent aquatic condition. Fish data from 2004 and 2011 show that the fish community is comprised of mottled sculpin, rainbow trout, brown trout, and mountain whitefish; these populations have not changed greatly between 2004 and 2011 sampling. Instream and riparian habitat data clearly show that the Lower Crystal River has been degraded moderately to severely, and many areas are in need of restoration efforts or mitigation practices. Similarly, temperature data may indicate that high temperatures could affect aquatic communities, as the temperature in sections of the Lower Crystal River may exceed the upper limits for trout to thrive during the summer months.

Data collection has been intermittent, although monitoring in the recent past has been more consistent for macroinvertebrates, fish, and temperature. A lack of consistent monitoring data at particular sites for fish and macroinvertebrate data makes temporal comparisons challenging. Fish data is available for the longest time period (1970-present), although the lack of consistency in sampling sites will make temporal comparisons of the same geographic location difficult. Additionally, the elevated temperatures from isolated sampling data may indicate problematic conditions for aquatic life, so more consistent, continuous temperature sampling should be considered a priority. Changes in individual populations, community structure, and overall ecosystem function may be hard to quantify without adequate sampling data. Efforts should be made to ensure that sampling of fishes, macroinvertebrates, temperature, and instream habitat is completed consistently at the same sites on a regular basis.

HYDROLOGIC MODEL FLOW PATHS

Overview

Lotic Hydrological LLC, a consulting firm, completed a hydrologic model of the Lower Crystal River utilizing StateMod to simulate baseline streamflow conditions and modified streamflows from surface water rights allocations in the watershed. Groundwater flow paths were a necessary input for the MODSIM-DSS model in order to determine subsurface return flows from irrigated parcels. These flow paths were generated utilizing ArcGIS and were provided to Lotic Hydrological as an input for the model.

Methods

A least-cost path analysis was utilized in Esri ArcGIS to create flow paths from each irrigated parcel in the Lower Crystal River Watershed. The Division 5 Irrigated Lands 2005[*****] layer was obtained from the Colorado Division of Water Resources. The irrigated parcel layer was clipped to the Lower Crystal River watershed boundary. Centroids were calculated for each of the irrigated parcels. A 10m DEM from USGS was filled utilizing the Fill tool in the Hydrology toolset in the Spatial Analyst toolbox. Fill was used in order to eliminate any sinks in the DEM that would affect the ability of ArcGIS to create flow paths. This filled DEM was analyzed with the Flow Direction tool to create a flow direction grid. The Cost Path tool in the Spatial Analyst toolbox was used to create a least-cost path. The DEM was used as the input cost distance raster, the flow direction grid was used as the input cost backlink raster, and the parcel centroids were used as the input. This model calculated the path of least resistance down the DEM from each parcel centroid. These lines, deemed flow paths, were converted to vector format and edited to end at perennial rivers from the Division 5 NHD layer. The length in meters was calculated for each flow path and was spatially joined to be associated with the corresponding parcel. See Appendix L for a map of the parcel centroids and flow path estimates.

ANALYSIS OF HYDROLOGIC MODEL SIMULATION DATA USING THE INDICATORS OF HYDROLOGIC ALTERATION (IHA)

The purpose of this analysis is to determine the changes in instream flow in the Lower Crystal River under different conservation scenarios utilizing the Indicators of Hydrologic Alteration (IHA) software. The Nature Conservancy developed the IHA software to allow the estimation of the magnitude, duration, and frequency of impacts due to hydrologic alteration in an ecosystem.[6] Analysis with IHA provides 32 statistically relevant parameters to characterize hydrologic variation each year; these parameters provide information on ecologically significant hydrologic features that influence river ecosystems.[7]

Hydrologic Model Background

Lotic Hydrological LLC completed the MODSIM-DSS hydrologic model of the Lower Crystal River that takes into account surface water conditions based on State of Colorado's Division of Water Resources (CDWR) and United States Geological Survey (USGS) data. See "Technical Report: Water Rights Allocation and Accounting Model Development for the Lower Crystal River" for further details about the creation of the MODSIM-DSS model.[8] The model created simulations for the mainstem of the Lower Crystal River under different management scenarios: 1) baseline conditions, 2) active water rights allocation according to the Prior Appropriations Doctrine, and 3) active water rights allocation under three potential water management scenarios by the Town of Carbondale. Water conservation scenarios were run under low savings, medium savings, and high savings; for this analysis the high water conservation scenario is utilized, which includes a 19% reduction in indoor water use and a 16% reduction in outdoor water use.

[*****] The 2005 layer was used because the 2010 layer was found to have errors in the size of irrigated parcels.

IHA Analysis

For the IHA analysis, two nodes were selected: upstream of the CPW Fish Hatchery and downstream of the Weaver and Leonhardy Ditch. Comparisons were made at each node between the baseline condition scenario where no consumptive or non-consumptive uses affect streamflow and the active water rights allocation scenario, which represents the current conditions on the Crystal River. To assess the positive benefits that water conservation efforts by the Town of Carbondale might have on stream flow, comparisons were made at each node between the active water rights allocation scenario and the high water conservation savings scenario. In the original model, all scenarios were run over the same time period, 2006-2013. For the IHA analysis, the data was broken into two time periods (2000-2006 & 2007-2013) to be able to assess the effects of water diversions or water conservation scenarios on the relevant parameters; however, all data is derived from the 2006-2013 simulation runs in the hydrologic model. See Appendix M for complete IHA parameter summaries for each comparison and node.

Upstream of the CPW Fish Hatchery

The comparison of baseline scenario and the active water rights allocation scenario show the 1-day minimum flows decreased under the water allocation rights scenario (Figure 3) and the number of low flood pulses has increased under the water rights allocation scenario (Figure 4). Minimum flows had a median of 70cfs under baseline conditions and are lowered to a median below 5cfs with the water diversions. Low flood pulses are defined as the mean water conditions drops below the 25th percentile of flow[9]; these low flows are more common under the active water rights allocation scenario. Minimum streamflow is of particular concern in the Lower Crystal River due to the historic dewatering and the subsequent negative impacts on biology from dewatering. As expected, the results of the IHA show that the water rights allocation scenario has altered the flow regime of the Lower Crystal River.

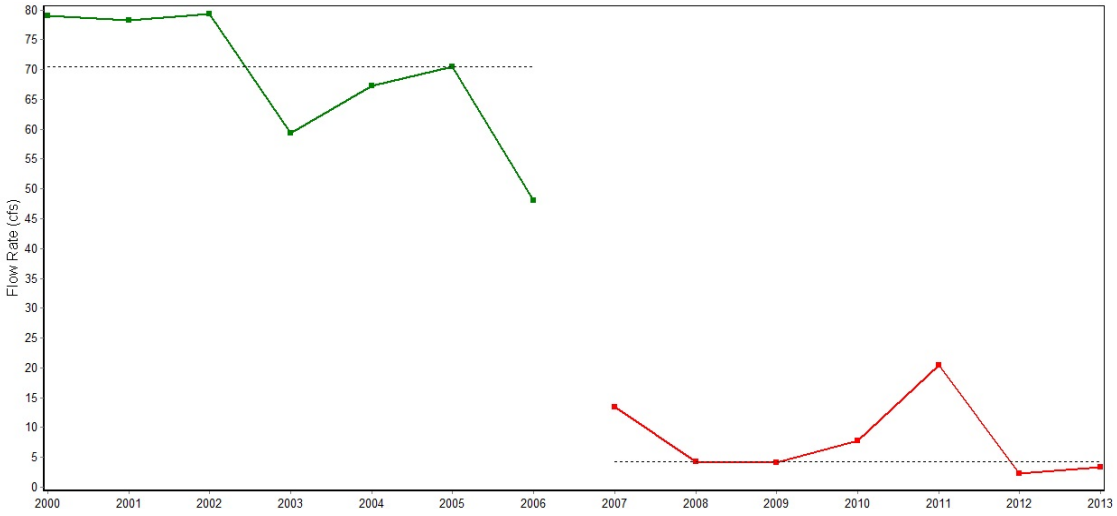

Figure 3: Comparison of minimum 1-day flows (cfs) upstream of the CPW Fish Hatchery for baseline conditions (represented in green, 2000-2006) and the water rights allocation scenario (represented in red, 2007-2013). The dashed line represents the median.

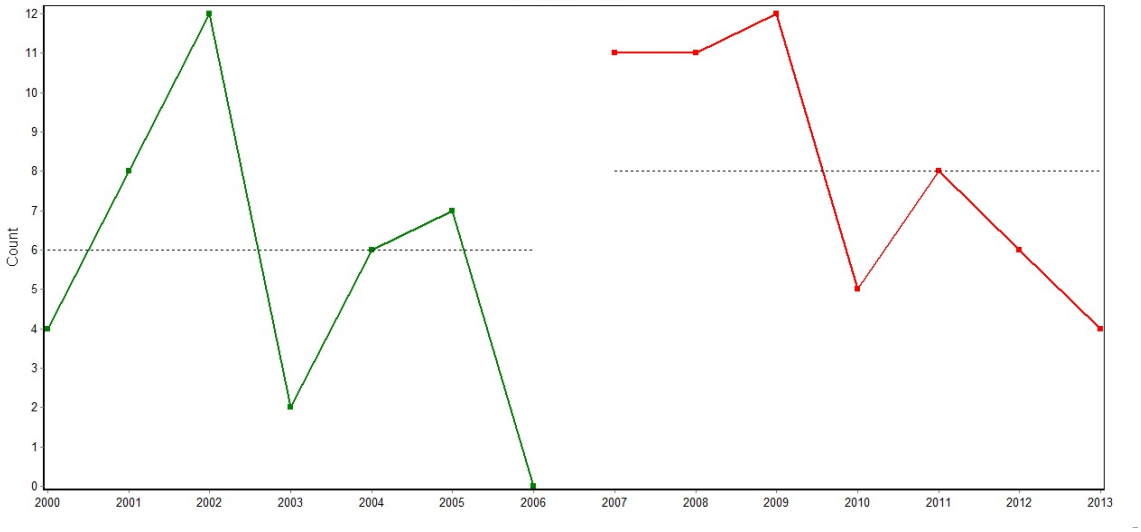

Figure 4: Comparison of the annual number of low flood pulses upstream of the CPW Fish Hatchery for baseline conditions (represented in green, 2000-2006) and the water rights allocation scenario (represented in red, 2007-2013). The dashed line represents the median.

The comparison of the active water rights allocation scenario to the high water conservation scenario show that there are negligible differences in the median of most parameters under the high water conservation scenario. For example, the median for 1-day minimum flows increases by 2cfs under the high conservation scenario. Differences in median flows for the summer months when low flows are of concern show that there are slight increases for June and July under the high water conservation scenario (Table 7). However, the size of detectable changes is small and is likely not biologically relevant.

Table 7: Median streamflow comparison for the water rights allocation and high water conservation scenarios for upstream of the CPW Fish Hatchery for summer months.

Month	Water Rights Allocation Median Flows (cfs)	High Water Conservation Median Flows (cfs)
June	1703	1707
July	424	427.4
August	101.9	105
September	51.11	51.08

Downstream of the Weaver and Leonhardy Ditch

The parameters for downstream of the Weaver and Leonhardy Ditch were similar to the results of the node upstream of the CPW Fish Hatchery. The comparison of the baseline scenario and the active water rights allocation scenario show the 1-day minimum flows decreased and the number of low flood pulses has increased under the water rights allocation scenario. Graphs are not provided, as the trends are similar to those displayed in Figure 3 and Figure 4. Minimum flows had a median of 75cfs under baseline conditions and are lowered to a median below 15cfs with the water diversions.

As with the CPW Fish Hatchery node, the comparison of the active water rights allocation scenario to the high water conservation scenario shows that there are negligible differences in the median of most parameters under the high water conservation scenario for downstream of the Weaver and Leonhardy Ditch. For example, the 1-day minimum flow increased by less than 2cfs under the high conservation scenario. Differences in median flows for the summer months when low flows are of concern show that there are slight increases for June, July, and August under the high water conservation scenario (Table 8). Further parameter comparisons can be referenced in Appendix M.

Table 8: Median streamflow comparison for the water rights allocation and high water conservation scenarios for downstream of the Weaver and Leonhardy Ditch for summer months.

Month	Water Rights Allocation Median Flows (cfs)	High Water Conservation Median Flows (cfs)
June	1720	1726
July	438.1	442.8
August	120.7	124.6
September	59.82	55.74

IHA Conclusions

While water management by the Town of Carbondale is likely an important component of surface water availability in the watershed, this analysis indicates that, even under high water conservation scenarios, instream flows in the Lower Crystal River cannot be greatly increased through municipal conservation efforts. Small increases in flow can be seen through the modeled conservation scenarios; however, based on the IHA analysis, these increases and changes in streamflow are likely too small to be biologically or ecologically relevant. Efforts to increase instream flows to benefit ecological condition should focus on additional opportunities to decrease water diversions and should possibly target other stakeholder groups in the Lower Crystal River watershed.

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[2] Roaring Fork Conservancy. 2011. *A Review of Aquatic Life and Stream Health in the Roaring Fork Watershed*.
[3] Roaring Fork Conservancy and White River National Forest. 2014 (Draft). *2012 Crystal River and Coal Basin Aquatic Life Use Assessment.*
[4] Malone, DG and JC Emerick. 2007. *Catalog of Stream and Riparian Habitat Quality for the Roaring Fork River and Tributaries, Central Colorado*. Roaring Fork Stream Health Initiative.
[5] Malone, DG and JC Emerick. 2007. *Catalog of Stream and Riparian Habitat Quality for the Roaring Fork River and Tributaries, Central Colorado*. Roaring Fork Stream Health Initiative.
[6] Richter, BD, JV Baumgartner, J Powell, and DP Braun. 1996. *A Method for Assessing Hydrologic Alteration within Ecosystems. Conservation Biology*. 10: 4.
[7] Ibid.
[8] Lotic Hydrologic, LCC. 2014. *Technical Report: Water Rights Allocation and Accounting Model Development for the Lower Crystal River*.
[9] Richter, BD, JV Baumgartner, J Powell, and DP Braun. 1996. *A Method for Assessing Hydrologic Alteration within Ecosystems*. Conservation Biology. 10: 4.

PART VIII: FINAL COMMENTS

Over the past year and a half, the project team has examined regional water conservation planning efforts across the American West. Although recommendations are included throughout each section of the report, what follows are general, concluding observations of note for future regional planning efforts.

Regional water conservation planning is a promising approach for promoting both water conservation and the health of a watershed's riparian and aquatic ecosystems. Unlike plans that cover only one water provider, regional plans are better able to address large-scale challenges by covering multiple entities and communities located throughout the watershed. All the communities with a watershed are inextricably linked by their common hydrologic system, and both positive and negative changes to that system reverberate throughout the watershed. Further, the ecological health of a watershed is interconnected with the natural flows of its surface and groundwater. Therefore, regional plans that take place on a watershed level provide a real opportunity to address issues and challenges within this interconnected system. Regional plans can have greater cumulative effects by uniting the conservation efforts of multiple actors within the covered region.

The success of regional planning efforts depends not just on the plan, but also on the process. Developing a planning process that engages critical stakeholders and accommodates divergent interests is key to adopting an innovative water conservation plan. Additionally, inclusive processes help augment buy-in and increase the likelihood of successful implementation. However, even beyond the creation and implementation of a plan, a planning process of this nature is beneficial because it can build strong collaborative relationships, provide a space for individuals and groups to discuss and tackle difficult challenges, and raise awareness about the efforts different sectors are taking to address community-wide problems. While each community is different, looking to the form and function of other planning processes can help planning participants glean advice on how to establish a successful planning process that will reconcile competing interests in the watershed and achieve desired results.

The process should be iterative and adaptive. An ongoing process and an adaptive plan can further encourage the involvement of various interests by ensuring that there is always place to bring forth new views and a method to incorporate and actualize new ideas. Revisiting the plan over time also provides the opportunity to measure and monitor impacts and, where needed, to adapt the plan to include new stakeholder groups, to avoid or reduce unintended consequences, to revisit original plan goals, to create new plan goals, and to adopt new conservation methods and programs. Finally, monitoring and adapting through an iterative process can add to the baseline of knowledge about what works and what does not, thereby aiding future regional planning efforts.

Often, the development of water conservation plans is motivated by a state requirement. These state mandates typically outline minimum requirements that must be met in order for a plan to be approved. The Colorado Water Conservation Board (CWCB) process that governs the approval of the Roaring Fork Water Conservation plan is no different; the CWCB oversees the municipal planning mandate and ensures that baseline requirements are fulfilled prior to plan approval. The upside to CWCB and other similar state mandated planning processes is that they are often flexible and allow planning participants to go beyond the scope of the minimum requirements. For example, although the CWCB guidelines are for municipal providers, creating a regional plan provides a key opportunity to include other large water users such as irrigators. Planning processes that use state

mandates as a springboard to achieve additional goals often see a greater impact both in the scope of the strategies implemented and in the number and diversity of groups and/or individuals involved.

The ability of a municipality or an irrigator to put conserved water towards instream flows is determined by the legal structures established within each state. Therefore, the ability of a region or watershed to increase instream flows through water conservation plans is not a legal certainty. There are two points, however, that make regional conservation plans an integral part of efforts to boost stream flows. First, these plans place a priority on conservation and serve as a key tool to increase awareness within the broader community of the importance of conservation. Second, even those conservation plans that only address municipal water conservation can be used to motivate other sectors to conserve as well. When it becomes clear that a municipal provider is taking concrete action to conserve water, it is more challenging for other large water users to avoid reducing water use as well.

While this report was written with the goal of helping to inform the water conservation planning process underway in the Roaring Fork Valley, it is the hope of the project team that the report's conclusions and recommendations are of use in other regional water conservation efforts. These concluding thoughts are by no means exhaustive, but provide some idea of the key opportunities and benefits that individuals, organizations, and communities can realize through regional water conservation planning.

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APPENDIX A: CWCB STATUTE REQUIREMENTS

Minimum Required Water Conservation Plan Elements†††††

As of July 1, 2005, the minimum water conservation plan elements defined in §37-60-126(4) C.R.S. are:

• Water-efficient fixtures & appliances, including toilets, urinals, showerheads, and faucets

• Low water use landscapes, drought resistant vegetation, removal of phreatophytes, and efficient irrigation

• Water-efficient industrial & commercial water-using processes

• Water reuse systems

• Distribution system leak identification & repair

• Dissemination of information regarding water use efficiency measures, including by public education, customer water use audits, and water-saving demonstrations

• Water rate structures & billing systems designed to encourage water use efficiency in a fiscally responsible manner

• Regulatory measures designed to encourage water conservation

• Incentives to implement water conservation techniques, including rebates to customers to encourage the installation of water conservation measures

• Statement of the covered entity's best judgment of the role of water conservation plans in the covered entity's water supply planning

• Steps to the covered entity used to develop, and will use to implement, monitor, review, and revise, its water conservation plan

• Time period, not to exceed seven years, after which the covered entity will review & update its adopted plan

• Either as a percentage or in acre-foot increments, an estimate of the amount of water that has been saved through a previously implemented conservation plan and an estimate of the amount of water that will be saved through conservation when the plan is implemented

• A public review and comment process must take place. If the covered entity does not have rules, codes, or ordinances to make a draft plan available for a public planning process, then the covered entity shall publish a draft plan, give public notice of the plan, make such plan publicly available,

††††† http://cwcb.state.co.us/water-management/waterEfficiency/Documents/MinReqWaterConservePlanElements.pdf

and solicit comments from the public for a period of not less than 60 days after the date on which the draft plan is made publicly available.

APPENDIX B: ROARING FORK WATERSHED INTERVIEW PROTOCOL

The following is the interview protocol that the project team used during July 2013 interviews of irrigators, ranchers, and water providers in the Roaring Fork Watershed:

ROARING FORK INTERVIEWS:

- Introduce ourselves
- What is their role?

OPENING QUESTIONS

- [for ag] What are your views on water conservation in the area both municipal and within the agriculture community?
- How familiar are you with the regional water conservation planning process?

OVERARCHING QUESTIONS

1) Their objectives for the water conservation planning process and role in the process

- What is your level of interest in being involved in a regional water conservation planning process?
    - Who would make the final decision to participate in the regional water conservation plan?
    - Who in your municipality is most likely to advocate for adopting the plan?
- And how have you been involved in the process to-date?
    - Have you or has your organization been involved in any processes or efforts similar to this one before?
- What would you say are the primary objectives for the water conservation planning process?
- How do you see maintaining instream flows as factoring into a regional water conservation plan? To your mind, should this be a primary objective of the plan?

2) Water conservation strategies

- What do you think are successful water conservation strategies? Have you implemented any of these strategies or considered implementing any of these strategies?
    - In your mind, what would be the three most important elements or components that should be included in a successful conservation plan?
- One part of our project is to develop case summaries of other water conservation planning processes in watersheds facing similar issues in the West. What aspects of these plans or planning processes would you most like to see examples of?

3) Who they think should be involved in the process

- Who do you think should be involved in a regional water conservation plan?
- How would you characterize the relationships among the groups that are involved in the process and anyone else you think should be involved?
    - What do you think are major challenges to collaboration between the groups involved? Do you have any suggestions for solving these challenges?
    - How often and in what capacity do you work with the other entities that will be participating in the process? What about others in your organization? How long has your organization worked with the other organizations?

4) Their perceptions of the major issues to be addressed in the process and likely challenges to it

- What are the major issues that need to be addressed in the process?
- What are the likely challenges to the process?

- And what concerns do you have about the planning process and about water conservation in the area in general? What are your concerns with the implementation of the plan itself?
- Do you think residents of the Roaring Fork Watershed are aware of and/or interested in water conservation efforts? Do you think educational resources about water conservation are readily sufficiently available in the area?

WRAPPING UP QUESTIONS

- Is there anything else you would like to add about the regional water conservation planning process and/or content of the future plan?
- Are there any additional points you would like to discuss that have not yet been covered?
- Is there anyone else that you feel would be valuable to interview?
- How much water do you sell for irrigation, municipal use, or other uses?

INTERVIEW QUESTIONS FOR ROARING FORK AGRICULTURE COMMUNITY

RANCH OPERATION

- How big is your operation?
- What do you put most of your water use towards?

OPENING QUESTIONS

- What are your views on water conservation in the area both in terms of municipal water conservation and within the agriculture community?
    - Do you think residents of the Roaring Fork Watershed are aware of and/or interested in water conservation efforts? Do you think educational resources about water conservation are sufficiently available in the area?
- How have you been involved in water conservation in the area? Have you been approached by agencies or organizations about water conservation practices?
- What are your views on a regional water conservation plan? Do you think both the agriculture community and municipal providers should work on a plan together?
- How do you see maintaining instream flows as factoring into a regional water conservation plan? To your mind, should this be a primary objective of the plan?

WATER CONSERVATION STRATEGIES

- Have you implemented any water conservation strategies?
    - If not what stopped you from adopting any?
- Are there any water conservation strategies that you think the agriculture community would be receptive to?
- What incentives would help make water conservation more appealing to the agriculture community?
- What do you think of the legislative efforts to remove the usage incentive from water law?
    - Rotational land fallowing
    - water leasing program by CWCB

CHALLENGES AND CONCERNS

- What are the major challenges to water conservation?

- What are your concerns with water conservation generally and water conservation planning?
    - Disputes with neighbors?
    - What are the relationships around water and water rights with neighbors now?

WRAPPING UP QUESTIONS

- Is there anything else you would like to add about the regional water conservation planning process and/or content of the future plan?
- Are there any additional points you would like to discuss that have not yet been covered?

APPENDIX C: CASE STUDY INTERVIEW PROTOCOL

The following is the interview protocol that the project team used when interviewing people for the water conservation case studies:

PLANNING PROCESS: ["How" questions--how was the plan developed?]

- What was the motivating factor for developing a water conservation plan? (e.g. water scarcity, government requirement, etc.)
- What was the process for developing the plan?
    - Who initiated the effort?
    - How was it decided which organizations should participate in the planning process? Was there an official partnership? If so, how was the partnership between plan participants formed?
    - How were decisions made about what form the planning process should take and what elements should be included in the plan?
- Were conservation initiatives already in place at the single water provider level? If so, how were these incorporated into the collaborative water conservation initiative?
- What would you say are the major factors that facilitated the planning process?
    - E.g. the relationships among those involved? Level of enthusiasm for the effort? Other factors?
    - (If they exist) Were municipal water providers with preexisting water conservation initiatives more readily willing to participate in a collaborative conservation effort?
- What were the major challenges encountered in the planning process, and how were they addressed? [any factors that hindered the planning process?]

PLAN CONTENT:

- What are the primary water conservation strategies in the plan? (e.g. education initiatives, rate structure changes)?
- What are the primary objectives of the plan?
    - Is addressing ecological concerns an objective of the plan? If so, how has it been incorporated into the plan?
    - Is reducing energy consumption an objective of the plan? If so, how effective has the plan been at achieving this?
- Did any participants have interests that were not addressed directly in the plan? If so, what were those?
    - E.g. Were there things that planning participants wanted to get out of the plan that were more informal and not expressed explicitly within the plan itself (building relationships with other planning members, increasing instream flows, increasing organizational involvement in water conservation, etc.)
- In what ways was plan development impacted by the water rights system in your state?
    - Were plan participants or other actors concerned about losing their water rights as a result of the plan? If so, how did you address that issue?

PLAN IMPLEMENTATION

- Is plan implementation occurring as intended or as expected?
    - What factors appear to be enabling and/or facilitating plan implementation?
    - What have been major challenges in the implementation of the plan?
    - If there is an enforcement aspect to the plan, has enforcement been occurring successfully?
    - In what ways has cooperation between participating organizations been successful and/or unsuccessful?
    - What measures do you use to judge the success of plan implementation?

WRAP-UP/MISCELLANEOUS

- In hindsight, is there anything you wish you had done differently during a) the planning and b) the implementation process?
- Our project is focused on regional water conservation planning processes and water conservation strategies, especially those that seek to improve instream flow; are there any additional points you would like to discuss that you believe would be helpful to cover given the scope and objective of our project?
- Is there anyone else that has been involved in the project that you feel would be valuable to interview?

APPENDIX D: DESCRIPTION OF FINAL 14 CASE STUDIES

Following are the 14 case studies that the project team considered in depth before selecting the six case studies in Part V of this report:

Arizona- Upper Verde River Watershed Protection Coalition Regional Water Conservation Program Development and Recommended Implementation Plan: The Upper Verde River Watershed Protection Coalition attempts to balance reasonable water needs of residents in the watershed with protection of the base flow of the Upper Verde River to the maximum extent possible. The coalition comprises the City of Prescott, Town of Chino Valley, Town of Prescott Valley, Yavapai County, and Yavapai-Prescott Indian Tribe. In 2007, the Coalition identified the development of a regional water conservation plan to improve water use efficiency as a high priority. This plan identifies existing conservation efforts, develops water use metrics to identify the effectiveness of these efforts, and analyzes regional water conservation programs to establish recommendations. Chapter 9 of the document includes recommendations for conservation program implementation. However, it should be noted that the progress and/or implementation of the actual water conservation plan remains unclear at this point. The Verde River is a major tributary of the Colorado River, and the Upper Verde River largely flows through the Prescott National Forest. This is a semiarid area with low annual precipitation, but the river is also groundwater fed. Increased development and more wells threaten the groundwater, surface water, and existing reservoirs. Agriculture utilizes a major percentage of water in the area.

California- Salmon Creek Water Conservation Plan (SCWP): This multi-year, multi-stakeholder effort is focused on developing alternative water solutions that focus on supporting human needs and protecting and restoring instream flow for wildlife and fish. The plan was developed in response to low instream flows impacting aquatic habitat during the summer season in addition to water scarcity issues for residents of the communities in the area. The plan is a collaborative effort between project partners including the Salmon Creek Watershed Council, Water Institute, NOAA, and Golf Ridge Resource Conservation District. Salmon Creek is located in Sonoma County, and the area is comprised of four communities: Freestone, Bodega, Salmon Creek, and Bodega Bay. This is a rural, coastal watershed where insufficient summer flows have created disconnected habitat and poor water quality conditions. Agriculture is a significant user of water in the region. Seasonal water scarcity is ongoing and water must often be trucked in during the summer months. Initially, the plan focused on a demand analysis to understand how residents throughout the watershed utilize the water resources. From this analysis, the plan suggests specific conservation strategies and the potential effectiveness of each of these strategies. This plan includes suggestions for water conservation and is not legally binding. California does not follow a strict prior appropriation doctrine like Colorado's.

California- Santa Clarita Valley Water Conservation Strategic Plan: The Santa Clarita Water Conservation Plan is a collaborative effort between four water suppliers in the Santa Clarita Valley to address urban water conservation. A major goal of the plan is to achieve a long-term reduction in water demand of at least 10% over the next 20 years. This is a planning tool to guide the actions of the suppliers and does not commit a supplier to a particular water use efficiency identified by the plan. The plan focuses on conservation strategies ranging from education to legislation with a continuum from information to incentives to requirements. To develop the strategies, the planners utilized stakeholder workshops to create collaboratively recommended programs. Santa Clarita Valley is located in Northwest Los Angeles County and is the valley of the Santa Clara River. There are water scarcity concerns due to increasing development and growth. There is a strong seasonal

use pattern with increased irrigation needs during the hot, dry summers. The Angeles National Forest is located to the south and the Los Padres National Forest is located to the north. This area is much more urbanized in comparison to the Roaring Fork Watershed.

Colorado- Steamboat Springs: Steamboat Springs water conservation plan is one of the two regional water conservation plans that have been approved by the Colorado Water Conservation Board. The plan is based in Colorado and therefore subject to the same legal and regulatory approval process as the Roaring Fork Plan will be and must operate under the same water rights structure. The plan is not regional. It covers only the municipal water providers servicing the town of Colorado Springs. Additionally, Steamboat falls within the Upper Yampa Watershed which shares many characteristics with the Roaring Fork Watershed: there are large amounts of public land within the watershed, its local economy hosts a strong tourism industry especially during winter ski season, cattle ranching is the primary form of agricultural production and it is a major economic activity within the watershed. Steamboat is also located in close geographic proximity to the Roaring Fork and also suffers from water scarcity issues. The plan is focused on municipal water use and does not directly focus on instream flows.

Colorado- Grand Valley: Grand Valley, containing the town of Grand Junction, is the second water conservation plan that the Colorado Water Conservation Board has approved to date. Although Grand Valley does not share as much in common with the Roaring Fork Watershed as Steamboat Springs, the plan can still shed light on the CWCB process and plan requirements. Grand Valley, like the Roaring Fork Watershed, is located on the western slope in Colorado and is also impacted by water scarcity. Additionally, the Grand Valley plan operates under the same legal water rights structure as Roaring Fork and the plan is regional. The valley does boast an agriculture industry; specifically it is touted for its fruit production. However, tourism, while still present, is less of a factor here than in the Roaring Fork.

Montana- Blackfoot River Basin: The Blackfoot Challenge developed a drought response plan as a temporary measure in a low-flow year; however, the increased frequency of drought years has lead to the call for a long-term water conservation and efficiency plan. Past work has focused on in-stream flow leases, stream restoration, irrigation system conversions, and irrigation water conveyance improvement projects. The Big Blackfoot Chapter of Trout Unlimited is particularly active in water conservation and it has prioritized work to address low in-stream flows and to establish permanent water rights dedications rather than short-term leases. The Blackfoot River Basin is 44% public land and has a large agriculture presence. Water scarcity is also an issue in the Basin and Montana follows the prior appropriation doctrine. While there is no full fledged water conservation within the Blackfoot Basin, the collaborative work to date is specifically concerned with using water conservation as a means to improve in-stream flows and ecosystem health.

Nevada- Washoe County: Washoe County includes parts of the Sierra Nevada Mountains and Incline Village at Lake Tahoe, making tourism water use a factor in the area. Washoe County is also the second most populous area of Nevada and its largest city is Reno. The regional water management plan covers the whole county and is multi-jurisdictional, but it is also broader than just water conservation. The plan was developed in order to address the needs of the area with respect to water supply, water quality, wastewater and sewage treatment, flood control, storm water drainage, and water conservation. Water scarcity is a big issue in Washoe County and the plan details ongoing water conservation measures as well as future water conservation initiatives and sets requirements for the region's water suppliers. The plan is aimed at assisting the County, Cities, residents, and businesses in "using only the water that is needed to achieve a desirable and sustainable quality of life." The plan does not directly address instream flows. Additionally, there is

minimal public land that falls within the county (i.e. the plan coverage area) and agriculture does not have a large presence.

New Mexico- One of the 16 regional water plans: The objective of New Mexico's regional water plans is to identify water supply and project demand and, where water supply is determined to be inadequate to meet projected demand, to develop strategic alternatives to meet their water shortage challenges. Conservation is an important aspect of regional water plans, however these plans are advisory, not binding or enforceable. Water conservation can be required through another avenue, the state permitting process. Seasonality of water use and the presence of agriculture, tourism and public lands vary among the different plan areas but each are present in some areas. Water scarcity is an issue in New Mexico. New Mexico's water law is based on prior appropriation, with some incorporation of historic pueblo and Indian rights. These plans were chosen based on their regional scale, involvement of multiple stakeholders, water scarcity context and potential similarities to the characteristics of the Roaring Fork area.

New Mexico- Sante Fe County Water Conservation Plan: The objective of this plan is to meet Bureau of Reclamation and state permit requirements. The plan is generally regional (county-wide) in scale, although how many and what entities were involved in creating it remains to be clarified. Creation of the plan was required (by BOR?) but it is unclear whether implementation by the water providing entities is also required or enforceable. Water use in the region likely varies seasonally, and there is an agricultural presence as well as public land (state park and national forest) in the region covered by the plan. Tourism is an important industry and source of water use in the region, and water scarcity is an issue. New Mexico's water law is based on prior appropriation, with some incorporation of historic pueblo and Indian rights. This plan was chosen based on its regional scale, the water scarcity context and similarities to the characteristics of the Roaring Fork area.

Oregon- Joint Water Commission Water Management Plan: The objective of this plan is to fulfill state water conservation requirements associated with receiving a water diversion permit, and the members of the plan are legally bound to implement its contents. The plan is regional in scale, including 5 water providers in Washington County. Agriculture is not a major presence in the immediate area (i.e. the communities served by the water providers), nor are there significant tracts of public lands within the plan coverage area. Tourism is not a major industry in the immediate area and water scarcity is not a major problem. Oregon's water law is based on prior appropriation. Increased instream flow is not a goal of the plan. This plan was chosen based on its regional scale, involvement of significant cooperation among different water providers, and robust, enforceable water conservation requirements. Its similarity to the Roaring Fork context in terms of the scale and nature of the plan participants is one of its strongest points.
Note: Members of this plan also belong to the Regional Water Providers Consortium (see below).

Oregon- Regional Water Providers Consortium's Regional Water Supply Plan: The objective of this plan is to "provide a comprehensive, integrated framework of technical information, resource strategies and implementing actions to meet the water supply needs of the Portland metropolitan area to the year 2050." Participation in the consortium and plan is voluntary. The plan is regional in scale with over 20 members in 3 counties in the Portland metro area. There may be some agriculture in the area, but it is primarily a metropolitan area. There is public land (state and federal) to the east and west of the plan coverage area. There is some tourism in Portland and the surrounding area, but it is unlikely that it has a direct, significant impact on water use, and the area covered by the plan is not primarily a tourist economy. Water scarcity is not a major problem. Oregon's water law is based on prior appropriation. Increased instream flow is not a goal of the plan. This plan was chosen based on its regional nature and the fact that individual providers

voluntarily sign on. It is relevant in terms of its elements of collaboration, multiple stakeholder involvement, and coordination among many entities.

Oregon- Deschutes River Conservancy, Deschutes Water Alliance: The non-profit Deschutes River Conservancy (DRC) does not have a water conservation plan; the Deschutes Water Alliance (DWA) is a related entity that might be a better case study match, but it is not clear what is their current status/level of activity. The DRC's mission is to restore instream flow and improve water quality; the DWA's mission is to balance instream flow and water quality with agricultural and urban uses. Participation by any entities in the DRC's programs is voluntary. The DRC's efforts are regional (basin-wide) in scale. Agriculture is a major presence in the basin and leads to significant increases in water diversions during the irrigation season. The DRC's main target for water conservation is agricultural users. There is national forest land within the area where the DRC is active, and tourism is an important industry (fishing, hiking, rafting, skiing). Water scarcity is a problem insofar as there is insufficient water to have both current levels of agricultural use and a healthy river ecosystem. Oregon's water law is based on prior appropriation. This case was chosen as an example of a successful agriculture-oriented conservation program, and based on the collaborative example of the involvement of irrigation districts in founding the DRC. Both a recent American Rivers paper on water conservation as well as Andrew Fahlund recognized this example as an area of interest for water conservation.

Texas- One of the 16: In 1997, the Texas Legislature established a new water planning process that divided the state into 16 regions and directed each region to create a water conservation plan. Each region has a planning group made up of 20 members from diverse interest groups, including agriculture, industry, environment, the public, municipalities, business, water districts, river authorities, water utilities, counties, groundwater management areas, and power generation. The regional planning groups are tasked with a variety of objectives, but one primary one is evaluating water management strategies and preparing plans to meet the water needs of the region. In 2011, 16 new regional water plans were approved. We propose adding one of these 16 plans to our list of case studies. Regions A, K, O, and M have significant agricultural water use similar to Colorado; combined, these four regions represent 80-90% of the water used in the state for agriculture irrigation. The plans are targeted towards the municipal water providers, but they are advisory and not legally binding. Texas has split groundwater and surface water regimes, but follows a strict prior appropriation doctrine for surface water. Texas, like Colorado, is suffering from extreme water scarcity and recently the Texas Governor signed several water conservation bills into law highlighting the elevated status that water conservation is receiving in the state.

Washington- Quad Cities Regional Water Forecast and Conservation Plan: The Quad Cities Conservation Plan aims to inform customers of effective water wise activities, to encourage customers to reduce water waste, to ensure all municipal programs are water wise, and to measure the net consumptive use from the Columbia River. The plan is a collaborative effort between four cities: Kennewick, Pasco, Richland, and West Richland. These four cities have a collective water right (the Quad Cities Water Right) and each city also has individual water rights. In addition to focusing on municipal water suppliers, the plan addresses a joint plan with irrigation districts to address urban irrigation needs. As the area is semiarid (with less than 10 inches of precipitation annually), water scarcity is an inherent problem with increased seasonal use in the summer. This area is located in the southeastern region of the state and includes basin-like and valley bottomland with surrounding mountain areas. Agriculture is a major industry in the area. There is not significant public land in the surrounding area, but Saddle Mountain National Wildlife Refuge is located to the northwest.

WATER CONSERVATION

OPINION SURVEY 2007-2008

DEADLINE TO SUBMIT
OCTOBER 30, 2007

Water Smart

PRESCOTT VALLEY

CENTRAL YAVAPAI COUNTY PARTNERSHIP

FUNDED IN PART BY A GRANT FROM:
U.S. BUREAU OF RECLAMATION

PROJECT CONTACT
928-777-1130
water.smart@cityofprescott.net

COMPLETE SURVEY ONLINE:
www.co.yavapai.az.us

Water Conservation Opinion Survey

The Towns of Prescott Valley and Chino Valley, City of Prescott, and Yavapai County are working to promote regional water conservation. By completing the survey you will assist with our effort. Information gained will be used to develop educational programs, a long-range work plan, and a regional water conservation workbook.

Deadline to submit survey, October 30, 2007 Please take a few minutes to complete this survey, fold, tape the end, and return it to: Water Conservation Survey, P.O. Box 2059 Prescott, Arizona, 86302, or complete it online at:
www.co.yavapai.az.us - follow the link to the water conservation opinion survey

1) How many people are in your household? _____ **YOUR ZIP CODE** _____
2) How is water delivered to your home? ___ City or Town system ___ Private company ___ Well ___ Hauled
3) Do you receive a monthly municipal or private company water bill? ___Yes ___No
4) If you pay a monthly water bill, do you look at the details of your monthly water use? ___Yes ___No
5) Do you live in an area with a homeowners' association that maintains common landscapes? ___Yes ___No
6) How old is your home? ____ less than 5 years ____5 to 10 years ____10 to 30 years ____ over 30 years
7) How large is your home? ___ less than 1,800 sq. ft. ____ 1800 to 3000 sq. ft. ___Greater than 3,000 sq. ft.
8) How big is your lot? ___standard lot about 10,000 sq. ft. ___up to 1 acre ___1 to 2 acres ___Over 2 acres
9) How much grass do you mow and water? ____None ____ under 1000 sq. ft. ___Over 1000 sq. ft.
10) Do you have planted trees and shrubs in your yard that you water regularly? ___Yes ___No
11) Do you hire a lawn service or gardener to care for your yard? ___Yes ___No
12) During the growing season, usually April through October how often do you water your landscape areas?
_____Daily ___ I water ____days per week for ____minutes ____Weekly ____Monthly ___Never
13) If you have an automatic irrigation system with a timer, how often do you reset your timer?
_____Never ____Monthly ___Seasonally ____No set schedule ____I'm not sure how to set my timer
14) What time in the day do you usually water outdoors? ____ Morning _____Afternoon ____Evening
15) Do you have low water use fixtures and/or appliances? __Yes __No What kinds? _____

THE FOLLOWING INFORMATION IS OPTIONAL AND VOLUNTARY.

In your own words, what do you want to know about water and conservation. (attach additional page if needed)

_____

_____

Please print this information to enter a weekly drawing for a useful water conservation product.

Name	***Address***
Phone	***E-Mail***

Personal information gathered through this survey will only be used by the Central Yavapai County Partnership to improve communication with local water users. Personal information will not be shared with or distributed to any outside organization.

17) Please circle your top three (3) choices for questions a) through e) below.							
a) I prefer to receive water conservation program information by:							
Direct Mail	*Utility Bill Insert*	*Website*	*E-mail*	*Newspaper*	*Television*	*Radio*	*Public Event*
b) I'm in favor of lawn areas on the grounds of: *(1000 sq. ft. of lawn needs about 30,000 gallons/water per year)*							
Parks	*Private Homes*	*Business*	*Ball Parks*	*Schools*	*Roadways*	*Public Building*	*Other*
c) I prefer to learn about outdoor landscape design and irrigation practices from:							
Gardening Class	*Retail Nursery*	*Homeowner Association*	*My Neighbor*	*Professional Gardener*	*News Articles*	*Website*	*Books*
d) I am most concerned about our region's:							
Water Supply	*Cost of Water*	*Conservation Practices*	*Water Quality*	*Watersheds*	*Groundwater*	*Private Wells*	*Rapid Growth*
e) I consider these planning principles when landscaping my home:							
Color	*Maintenance*	*Play Area*	*Water Use*	*Patio Space*	*Fire Safety*	*Shade*	*Cost*

18) In and around my home: *(answer only if the question applies)*	Yes	No
a) We listen for, check regularly, and quickly repair any indoor or outdoor water leak.		
b) We select and install water saving fixtures, showerheads, and indoor appliances.		
c) We planned our yard to be a low-water use landscape, with no grass area.		
d) We know how much water to budget annually for indoor and outdoor use.		
e) We water our native vegetation monthly *(e.g., Ponderosa Pine, Alligator Juniper, Oak).*		
f) We know how to and understand the principles to conserve water in the landscape.		
g) We conserve to preserve our region's water supply and protect the eco-system.		
h) We understand the seven steps to a Xeriscape and the efficiency of a drip system.		
i) We would like to learn more ways to conserve water in the outdoor landscape.		
J) Our children learn and bring home water conservation information.		

19) Please mark the box that best fits your agreement. *Rank the statement using the following scale:* (1) *I Agree* (3) *I am Neutral* (5) *I Disagree*		1 Agree	2	3 Neutral	4	5 Disagree
a)	Water rates should be higher for customers who don't conserve.					
b)	Government should spend tax dollars on water conservation.					
c)	Government should adopt laws limiting the size of private property lawns.					
d)	Government should adopt laws limiting the size of public building lawns.					
e)	Imported water is necessary to meet the needs of growing communities.					
f)	I understand the purpose of the Prescott Active Management Area (AMA).					
g)	I'm more likely to buy water saving fixtures/appliances if there is an incentive.					
h)	I will remove a portion of my lawn **only** if I receive a cash rebate or credit.					
i)	Installing automatic in-ground sprinklers and timers will save water.					
J)	Water conservation is about efficient water use and water supply management.					
k)	I live in an arid (dry), highland area, and **not** in a desert.					
l)	If I harvest rainwater for outdoor watering, I can plant what I want.					
m)	Outdoor water use accounts for over 50% of household's water consumption.					
n)	It is too expensive for me to replace high water use toilets and appliances.					
o)	Water conservation supports the region's economy and natural eco-system.					
p)	If I conserve water it will **only** benefit new growth and development.					
q)	I conserve water because I am worried about my well going dry.					
r)	I will conserve water **only** if the water saved is allocated to meet safe yield.					
s)	I will conserve water **only** to save money on my monthly water bill.					
s)	If people can afford water, they should be allowed to use as much as they want.					
u)	Limiting growth rather than conservation is how to preserve our water supply.					
v)	I conserve water; it is important for the wildlife and natural environment.					
w)	I conserve water to preserve this resource for future generations.					
x)	Watering outdoor gardens using a handheld hose is wasteful.					
y)	Harvested rainwater should be the **only** water allowed for outdoor landscapes.					
z)	Conserving electricity and water conservation are directly related.					
aa)	Water use is a personal choice requiring **no** government regulation.					

APPENDIX F: UPPER VERDE RIVER RACK CARD EXAMPLES

Water Smart™

Landscape Principles

A proven seven step low maintenance landscaping method results in attractive outdoor living spaces using water smart plants, trees and shrubs.

Research plants and the site in relation to sun, soils, water and maintenance demands. Consider site geography, wildlife, views and privacy.

THE 7 PRINCIPLES

1 **Design a Plan** – Sketch area including existing and proposed walkways, outdoor spaces, structures and planted areas. Group plants, trees and shrubs with similar light and water needs on the same irrigation zone. Consider how outdoor spaces will be used, and their function to indoor spaces.

2 **Amend the Soil** – Most plant and turf areas require some organic compost; native plants are the exception. Improve soil during site preparation, especially turf areas for long term water saving and turf health.

www.uvrwpc.org

3 **Select Low Water Use Plants** – A variety of native plants, available through local nurseries, are suitable for water smart landscaping. They are divided into three categories: very low, low, and moderate water use. Consider the long term water demand, fire resistance, mature size and maintenance needed.

4 **Create a Practical Lawn Area** – Lawns have a place in water smart landscapes. Options include seasonal native grasses, turf, ground covers and native wildflowers. Consider at lease 6" of top soil during site prep, estimate long term water demand, maintenance and cost.

5 **Install an Irrigation System** – Design an efficient watering system during the planning phase. Permit and install the required backflow prevention device. Hydrozone trees, shrubs and turf areas. Adjust watering systems to account for plant maturity, topography and seasonal precipitation.

6 **Mulch Top Dress** – Install 2 to 3" of mulch or rock over a woven fabric weed barrier. Shredded wood chips and garden compost help conserves soil moisture. Decomposed granite and select rock types work best in unplanted areas. Consider pre-and post-emergent to reduce weed growth.

7 **Maintain the Landscape** – Seasonal maintenance and an efficient irrigation system will ensure outdoor living areas remain healthy and water smart.

For more information and helpful community links, visit the Coalition website at

www.uvrwpc.org

Upper Verde River Watershed Protection Coalition

Printed on post consumer recycled paper

APPENDIX G: BLACKFOOT DROUGHT RESPONSE PLAN

Flow & Temperature Triggers

As flows near the 700 cubic feet per second (cfs) trigger, the Committee will:

- Contact the roster of consumptive water users. Participants are asked to confirm their participation or non-participation in the Blackfoot Drought Response via "response cards".
- Contact the roster of non-consumptive water users and alert them to the potential need for angling restrictions.
- Implement outreach activities necessary to inform water users and the general public of drought conditions and the need for participation in the Drought Response.

When flows in the Blackfoot River fall to 700 cfs, the Committee will:

- Notify consumptive water users (primarily irrigators) that the Blackfoot Drought Response is active and request implementation of their voluntary drought management plans.
- Confirm participation by junior water users through response cards, personal communication, and field checks;
- Convene and make recommendations on a "call for water" from non-participating junior water users under the Murphy Right;
- MT FWP, in consultation with the Committee, will issue a "call for water" from non-participating junior water users. Junior water users who receive a "call for water" are ordered to cease water withdrawals;

If flows in the Blackfoot River are below 700 cfs and/or maximum daily water temperatures reach or exceed 73oF for three consecutive days at Bonner:

- MT FWP will issue mandatory afternoon (2:00 pm – 5:00 am) fishing restrictions.

As flows near the 600 cfs trigger, the Committee will:

- Contact the roster of non-consumptive water users to alert them of the potential need for angling restrictions if not already in place or the need for additional angling restrictions.
- Implement outreach activities necessary to inform water users and the general public of drought conditions and the need for participation in the Drought Response.

When flows in the Blackfoot River fall below 600 cfs, the Committee and MT FWP will:

- Issue an Angler Alert
- Convene to confirm irrigator in the Drought Response.
- Request additional "calls for water" are made by MT FWP under the Murphy Right.

If flows in the Blackfoot River are below 600 cfs and maximum daily water temperatures reach or exceed 71oF for three consecutive days at Bonner:

- MT FWP will issue mandatory afternoon (2:00 pm – 5:00 am) fishing restrictions;

If flows in the Blackfoot River are below 600 cfs and/or maximum daily water temperatures in the North Fork Blackfoot River and Monture Creek reach or exceed 60oF for three consecutive days:

- MT FWP will issue mandatory afternoon (2:00 pm – 5:00 am) fishing restrictions on all critical bull trout streams. These include Gold Creek, Belmont Creek, Cottonwood Creek, Monture Creek, North Fork Blackfoot River, Copper Creek, Landers Fork, and Morrell Creek.

If flows in the Blackfoot River are below 600 cfs and/or maximum daily water temperatures in the North Fork Blackfoot River and Monture Creek reach or exceed 65oF for three consecutive days:

- MT FWP will issue mandatory all day fishing restrictions in all critical bull trout streams.

As flows in the Blackfoot River near 500 cfs, the Committee will:

- Convene to confirm irrigator in the Drought Response.
- Request additional "calls for water" are made by MT FWP under the Murphy Right.
- Implement outreach activities necessary to inform water users and the general public of drought conditions and the need for participation in the Drought Response.

If flows in the Blackfoot River are below 500 cfs:

- All water users junior to the Murphy Right, including those participating in the Drought Response, must cease junior water right withdrawals to satisfy MT FWP's in-stream flow right. The Committee will also work with senior water right holders and seek further water conservation measures;
- MT FWP will issue mandatory all day fishing restrictions on the mainstem Blackfoot River as well as all critical bull trout streams if measures are not already in place.

APPENDIX H: BLACKFOOT EXAMPLE OF OUTREACH LETTER TO PLAN PARTICIPANTS

Blackfoot Drought Committee
PO Box 103
Ovando, MT 59854

August 12th, 2013

Blackfoot Water Users,
Flows in the Blackfoot River (as measured at the USGS gage station near Bonner) fell below 678 cfs on August 12, 2013. High temperatures and well below average precipitation this summer have combined to create critical stream flows. Blackfoot River flows are currently below the long-term average.

The Drought and Water Conservation Committee is now asking Drought Plan participants to implement their individual drought management plans if they have not already done so. If you have not confirmed your participation in this year's Blackfoot Drought Response, please do so by either sending in your Drought Response Card (which was included in the July letter) or by contacting the Drought Committee, Deb Dillree at deb@blackfootchallenge.org or 406-793-3900. If you do not have a drought management plan, please contact the Drought Committee and we will assist you with developing one. Due to the severity of conditions this year, water users who are junior to the Murphy Right will receive a call for water if not participating in the Blackfoot Drought Response.
Your continued support of and participation in the Blackfoot Drought Response is very much appreciated. Anglers; monitor water temperatures, be aware of low flows and take appropriate actions to reduce stress to fish. Posters have been prepared to alert the general public of conditions in the Blackfoot as well. Please feel free to contact the Drought Committee with questions or assistance with your drought plan. The Blackfoot Challenge website, www.blackfootchallenge.org, also provides information to help you prepare for low flows.

Sincerely,

Harry Poett
Blackfoot Drought Committee Chair
406-793-5107
poetts@blackfoot.net

Gary Burnett Blackfoot Challenge
Executive Director
406-793-3900
gary@blackfootchallenge.org

APPENDIX I: CURRENT WATER PROVIDER EDUCATION/OUTREACH EFFORTS

Currently, the largest water providers in the Roaring Fork Valley vary in the nature and extent of their education/outreach efforts. Below is a summary of current education/outreach efforts at each of the large water providers.

CITY OF ASPEN
Aspen has an extensive efficiency outreach effort and employs Jeff Rice to shepherd this initiative. The program has a presence at every other farmer's market, and distributes efficient fixtures to customers in the Valley. In addition, the city has an active overall conservation program, the "Canary Initiative;" however, this is generally focused on limiting greenhouse gas emissions rather than water conservation.

SNOWMASS WATER AND SANITATION DISTRICT
Snowmass Water and Sanitation District's new draft water efficiency plan has a number of education/outreach components. These include promotion of xeriscaping, free audits to the highest water users, conservation tips in bills, newsletters and the website, and water conservation workshops for citizens. Snowmass has high occupancy in the winter, when draws on its water sources are a much higher percentage of in-stream flows, but there are few documented water restrictions or conservation measures in place specific to winter conservation.

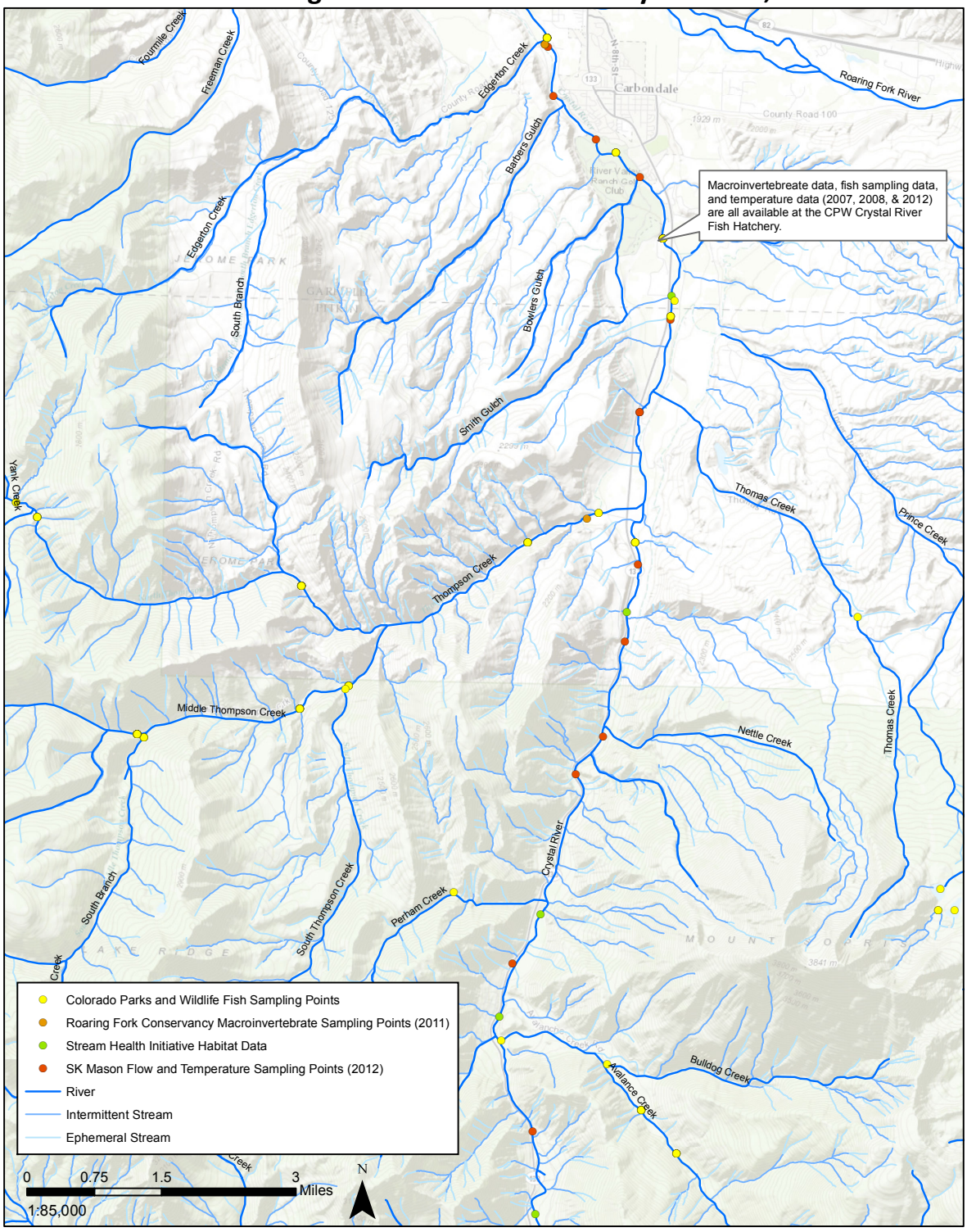
TOWN OF BASALT
Education/outreach efforts include: public notices in the local paper; yellow/red placards in the window of town hall; notices on the website; written announcements at major road intersections (only during "Stage 2" water shortage). The water manager is considering investing in rain sensors to limit unnecessary watering during periods of wet weather.

CITY OF GLENWOOD SPRINGS
Glenwood Springs uses bill stuffers and door hangers to communicate water conservation notices. In addition, they provide field trips to their treatment facilities to schools and other groups that include discussions of water conservation behaviors.

TOWN OF CARBONDALE:
The Town of Carbondale currently has no water conservation education/outreach efforts, although other groups do some education work in Carbondale. Utilities Director Mark O'Meara believes a region-wide education effort will be an important part of regional water conservation planning.

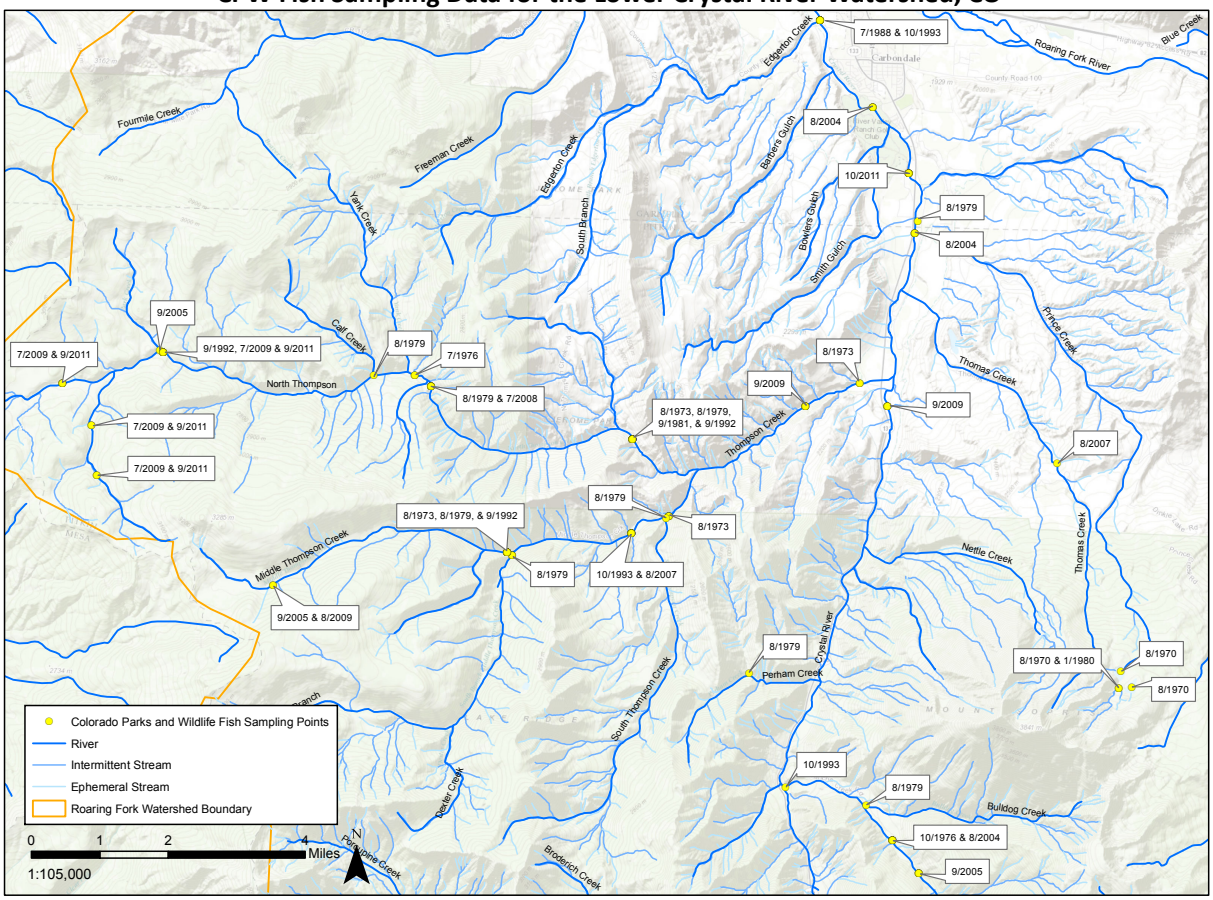
APPENDIX J: AVAILABLE ECOLOGICAL DATA FOR THE LOWER CRYSTAL RIVER

Available Ecological Data for the Lower Crystal River, CO

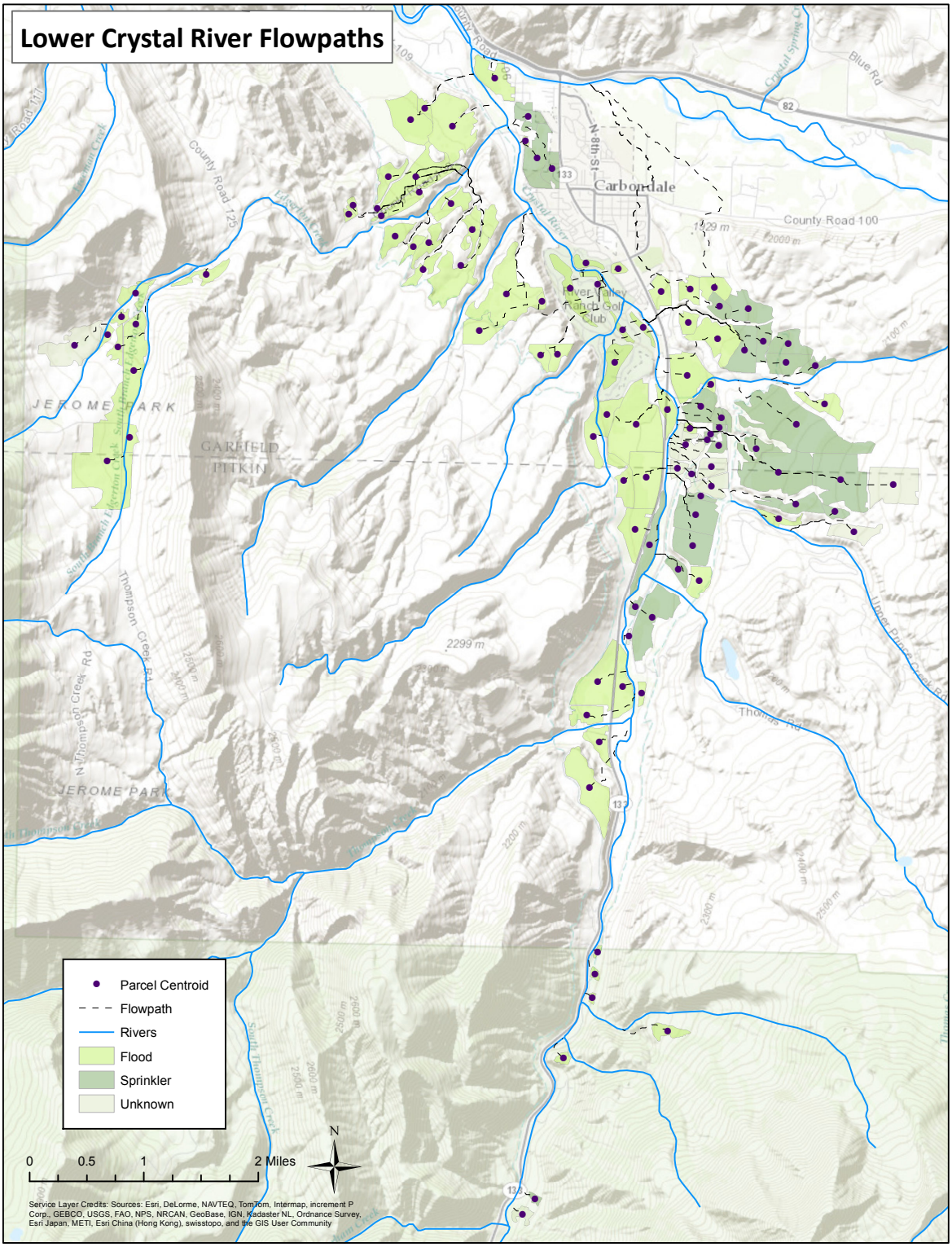


APPENDIX K: CPW FISH SAMPLING DATA FOR THE LOWER CRYSTAL RIVER

CPW Fish Sampling Data for the Lower Crystal River Watershed, CO



APPENDIX L: FLOW PATHS FROM IRRIGATED PARCEL CENTROIDS TO THE LOWER CRYSTAL RIVER



APPENDIX M: RESULTS OF THE INDICATORS OF HYDROLOGIC ALTERATION (IHA) ANALYSIS

Upstream CPW Fish Hatchery: Baseline Conditions to Water Rights Allocation Comparison

Pre-impact period: 2000-2006 (7 years)		Post-impact period: 2007-2013 (7 years)
NormalizationFactor	1	1
Mean annual flow	469.6	399.2
Non-Normalized Mean Flow	469.6	399.2
Annual C. V.	1.55	1.72
Flow predictability	0.72	0.62
Constancy/predictability	0.47	0.34
% of floods in 60d period	0.5	0.5
Flood-free season	201	245

	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
November	117.6	127.4	0.2038	0.1722	0.08331	0.1554	0.3914	0.8539
December	98.03	102	0.2571	0.2424	0.0406	0.05694	0.5606	0.9449
January	91.18	94.31	0.2146	0.2	0.03433	0.06826	0.5796	0.9259
February	84.24	86.71	0.2812	0.2613	0.02926	0.07088	0.7227	0.965
March	115.3	116.9	0.5574	0.5377	0.01362	0.03524	0.961	0.9449
April	317.1	317.7	0.4143	0.404	0.001955	0.02485	0.991	0.982
May	914.4	799.7	0.5069	0.5842	0.1254	0.1527	0.1912	0.8959
June	1908	1703	0.6941	0.7502	0.1079	0.08083	0.6737	0.8959
July	612.4	424	1.769	2.56	0.3077	0.4473	0.6436	0.3984
August	239.8	101.9	0.7885	1.787	0.5751	1.267	0.08008	0.1532
September	187.5	50.94	0.3567	0.9625	0.7284	1.698	0.1522	0.02703
October	138.9	51.11	0.6165	1.818	0.6319	1.949	0.07608	0.05405
Parameter Group #2								
1-day minimum	70.51	4.27	0.2778	2.363	0.9394	7.505	0.2633	0.05405
3-day minimum	76.12	6.687	0.239	2.608	0.9122	9.912	0.2472	0.01502
7-day minimum	78.68	9.67	0.2452	2.247	0.8771	8.164	0.2472	0.01502
30-day minimum	82.58	26.66	0.2827	1.31	0.6772	3.632	0.1231	0.02703
90-day minimum	92.55	65.77	0.2291	0.8545	0.2893	2.73	0.1802	0.01201
1-day maximum	3032	2922	0.7467	0.7657	0.03619	0.02543	0.8498	0.9219
3-day maximum	2824	2720	0.7813	0.8001	0.03677	0.02403	0.965	0.97
7-day maximum	2794	2687	0.6984	0.7091	0.03829	0.0154	0.971	0.952
30-day maximum	2232	2093	0.4973	0.5173	0.062	0.04023	0.8208	0.996
90-day maximum	1378	1250	0.6666	0.735	0.09249	0.1026	0.7347	0.8759
Number of zero days	0	0	0	0				
Base flow index	0.1618	0.03135	0.3952	0.8081	0.8062	1.045	0.2553	0.2883
Parameter Group #3								
Date of minimum	33	257	0.1503	0.04645	0.776	0.6909	0.3704	0.1441
Date of maximum	160	160	0.07377	0.07377	0	0	0.961	0.9409
Parameter Group #4								
Low pulse count	6	8	1	0.75	0.3333	0.25	0.3974	0.6897
Low pulse duration	2.75	3	6.182	1.333	0.09091	0.7843	0.8318	0.3964
High pulse count	2	1	1.5	1	0.5	0.3333	0.2613	0.6396
High pulse duration	30	51	3.317	1.275	0.7	0.6157	0.5095	0.4715
Low Pulse Threshold	98.59							
High Pulse Threshold	430.7							
Parameter Group #5								
Rise rate	8.82	8.53	0.4677	0.4326	0.03288	0.07504	0.7738	0.8859
Fall rate	-6.67	-7.43	-0.3726	-0.3701	0.1139	0.006556	0.5065	1
Number of reversals	132	140	0.1136	0.2071	0.06061	0.8229	0.09309	0.04805

Upstream CPW Fish Hatchery: Water Rights Allocation to High Conservation Scenario Comparison

Pre-impact period: 2000-2006 (7 years)		Post-impact period: 2007-2013 (7 years)
NormalizationFactor	1	1
Mean annual flow	399.2	400.4
Non-Normalized Mean Flow	399.2	400.4
Annual C. V.	1.72	1.72
Flow predictability	0.62	0.62
Constancy/predictability	0.34	0.34
% of floods in 60d period	0.89	0.89
Flood-free season	232	231

	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
November	127.4	127.5	0.1722	0.1718	0.0007455	0.001884	0.956	1
December	101.5	102.1	0.2437	0.2431	0.005912	0.002259	0.8779	0.993
January	94.33	94.31	0.1999	0.2	0.0002121	0.0002121	0.98	1
February	86.75	86.77	0.2612	0.2612	0.0002306	0.000009928	0.952	1
March	116.9	116.9	0.5447	0.5382	0.0001711	0.0118	0.967	1
April	317.7	317.9	0.4089	0.4036	0.0005508	0.01297	0.969	0.995
May	805.1	802.1	0.592	0.5841	0.003677	0.01347	0.952	1
June	1703	1707	0.7589	0.7497	0.002678	0.01217	0.968	0.963
July	424	427.4	2.56	2.54	0.007972	0.007643	0.959	0.988
August	101.9	105	1.625	1.751	0.03072	0.07738	0.8679	0.8769
September	47.06	53.41	1.191	0.9432	0.1351	0.2083	0.7928	0.6887
October	51.11	51.08	1.885	1.817	0.0005869	0.03588	0.974	0.981
Parameter Group #2								
1-day minimum	4.27	5.47	2.363	2.375	0.281	0.004983	0.7027	0.997
3-day minimum	6.687	8.63	2.608	2.149	0.2906	0.1759	0.7077	0.7978
7-day minimum	9.67	11.33	2.247	2.034	0.1717	0.09471	0.7708	0.8609
30-day minimum	26.66	28.47	1.31	1.282	0.06801	0.02093	0.8619	0.966
90-day minimum	65.77	67.88	0.8545	0.8109	0.03207	0.05104	0.8909	0.9149
1-day maximum	2922	2926	0.7657	0.7655	0.001321	0.0003374	0.968	1
3-day maximum	2720	2724	0.8001	0.7995	0.00147	0.0007541	0.968	1
7-day maximum	2687	2691	0.7091	0.7087	0.001461	0.0005918	0.968	1
30-day maximum	2093	2097	0.5173	0.5168	0.001882	0.0009587	0.968	1
90-day maximum	1250	1253	0.735	0.734	0.001953	0.001401	0.959	0.978
Number of zero days	0	0	0	0				
Base flow index	0.03135	0.03712	0.8111	0.6616	0.1841	0.1843	0.6026	0.7708
Parameter Group #3								
Date of minimum	256	257	0.04372	0.06011	0.005464	0.375	0.8318	0.4064
Date of maximum	160	160	0.07377	0.07377	0	0	0.962	0.9419
Parameter Group #4								
Low pulse count	6	7	1	0.8571	0.1667	0.1429	0.7447	0.7548
Low pulse duration	4	5	4.875	3.8	0.25	0.2205	0.2943	0.7668
High pulse count	3	3	0.6667	0.6667	0	0	0.3764	0.9059
High pulse duration	5.5	5	9	10	0.09091	0.1111	0.5385	0.7708
Low Pulse Threshold	80.52							
High Pulse Threshold	344.6							
Parameter Group #5								
Rise rate	8.53	8.535	0.456	0.4312	0.0005867	0.05454	0.8218	0.964
Fall rate	-7.43	-6.87	-0.3701	-0.3974	0.07537	0.07365	0.5325	0.961
Number of reversals	140	138	0.2071	0.2101	0.01429	0.01449	0.7267	0.984

Downstream Weaver-Leonhardy: Baseline Conditions to Water Rights Allocation Comparison

Pre-impact period: 2000-2006 (7 years)		Post-impact period: 2007-2013 (7 years)
NormalizationFactor	1	1
Mean annual flow	480.8	409.3
Non-Normalized Mean Flow	480.8	409.3
Annual C. V.	1.52	1.68
Flow predictability	0.72	0.62
Constancy/predictability	0.47	0.37
% of floods in 60d period	0.58	0.58
Flood-free season	208	245

	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
November	126.7	138.1	0.1992	0.1654	0.09013	0.1695	0.2603	0.8669
December	104.2	110.3	0.2418	0.2233	0.05834	0.07649	0.5536	0.8919
January	99.49	103.8	0.1967	0.1812	0.04322	0.07866	0.6396	0.953
February	91.85	95.38	0.2579	0.2367	0.03838	0.08229	0.7067	0.9019
March	123.5	126.3	0.5212	0.4961	0.02227	0.04807	0.8949	0.965
April	325.4	327.1	0.398	0.3837	0.005085	0.03579	0.988	0.985
May	920.6	807.1	0.5019	0.5754	0.1232	0.1465	0.2593	0.8939
June	1929	1720	0.6843	0.746	0.1083	0.0903	0.6547	0.8899
July	633.6	438.1	1.72	2.491	0.3085	0.4485	0.6046	0.4294
August	256.1	120.7	0.7974	1.597	0.5286	1.003	0.1221	0.2352
September	204.7	52.38	0.3267	0.9593	0.7442	1.936	0.1161	0.03203
October	155.3	70.23	0.4828	1.254	0.5478	1.598	0.03403	0.08609
Parameter Group #2								
1-day minimum	76.04	18.03	0.2576	0.5186	0.7629	1.013	0.2382	0.4344
3-day minimum	81.65	18.54	0.2173	0.497	0.7729	1.288	0.2382	0.3403
7-day minimum	86.29	21.64	0.2229	0.4945	0.7492	1.219	0.2342	0.3123
30-day minimum	90.23	41.35	0.2613	0.5011	0.5418	0.9179	0.05706	0.2012
90-day minimum	100.5	79.86	0.2106	0.5838	0.2055	1.771	0.3824	0.04404
1-day maximum	3044	2930	0.7484	0.7687	0.03739	0.02712	0.9229	0.9499
3-day maximum	2836	2729	0.7829	0.8028	0.03763	0.02542	0.9079	0.953
7-day maximum	2806	2696	0.7003	0.7124	0.03939	0.01717	0.9439	0.986
30-day maximum	2246	2104	0.498	0.5193	0.06335	0.0428	0.8779	0.9269
90-day maximum	1394	1262	0.6646	0.7326	0.09423	0.1023	0.7007	0.8428
Number of zero days	0	0	0	0				
Base flow index	0.1719	0.05898	0.3699	0.299	0.6569	0.1919	0.2422	0.8939
Parameter Group #3								
Date of minimum	33	259	0.1503	0.06011	0.765	0.6	0.01902	0.0951
Date of maximum	160	160	0.07377	0.07377	0	0	0.98	0.9479
Parameter Group #4								
Low pulse count	7	6	0.8571	1.167	0.1429	0.3611	0.6046	0.4525
Low pulse duration	2.5	3	7.05	1.5	0.2	0.7872	0.7307	0.7608
High pulse count	2	1	1.5	2	0.5	0.3333	0.4765	0.5035
High pulse duration	30	51	3.333	1.608	0.7	0.5176	0.5205	0.6897
Low Pulse Threshold	106.2							
High Pulse Threshold	442.3							
Parameter Group #5								
Rise rate	8.785	8.68	0.5304	0.409	0.01195	0.229	0.7948	0.5265
Fall rate	-6.67	-7.555	-0.3771	-0.364	0.1327	0.03464	0.3263	0.987
Number of reversals	132	140	0.1288	0.09286	0.06061	0.279	0.03403	0.6256

Downstream Weaver-Leonhardy: Water Rights Allocation to High Conservation Scenario Comparison

Pre-impact period: 2000-2006 (7 years)		Post-impact period: 2007-2013 (7 years)
NormalizationFactor	1	1
Mean annual flow	409.3	410.8
Non-Normalized Mean Flow	409.3	410.8
Annual C. V.	1.68	1.68
Flow predictability	0.62	0.62
Constancy/predictability	0.37	0.38
% of floods in 60d period	0.81	0.81
Flood-free season	225	225

	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
November	138.1	138.2	0.1654	0.1651	0.0007241	0.001817	0.967	1
December	110.3	110.3	0.2233	0.2241	0	0.003654	0.992	0.993
January	103.8	103.8	0.1812	0.1812	0	0	0.984	1
February	95.42	95.44	0.2366	0.2366	0.0002096	0.00001209	0.975	1
March	126.3	126.3	0.5027	0.4966	0.0001584	0.01213	0.973	0.994
April	327.1	327.3	0.3885	0.3833	0.0005503	0.01325	0.973	1
May	812.6	810.4	0.5827	0.5692	0.002781	0.02317	0.975	0.989
June	1720	1726	0.7489	0.7456	0.002999	0.004445	0.973	1
July	438.1	442.8	2.491	2.466	0.01061	0.01002	0.957	1
August	120.7	124.6	1.46	1.566	0.03215	0.07263	0.973	0.9129
September	59.82	55.74	0.84	0.9176	0.06829	0.0923	0.8979	0.9439
October	70.23	70.2	1.272	1.246	0.0004273	0.02029	0.962	0.9229
Parameter Group #2								
1-day minimum	18.03	19.17	0.5186	0.5728	0.06323	0.1045	0.7898	0.9089
3-day minimum	18.54	19.61	0.497	0.5229	0.05752	0.05197	0.6937	0.972
7-day minimum	21.64	24.03	0.4945	0.5182	0.1104	0.04801	0.8659	0.9449
30-day minimum	41.35	44.19	0.5011	0.4857	0.06881	0.03071	0.8529	0.985
90-day minimum	79.86	83.19	0.5838	0.5603	0.04175	0.04019	0.9229	0.983
1-day maximum	2930	2935	0.7687	0.7682	0.001594	0.0006071	0.973	1
3-day maximum	2729	2734	0.8028	0.8021	0.001693	0.0009807	0.973	1
7-day maximum	2696	2700	0.7124	0.7117	0.001724	0.0008598	0.973	0.995
30-day maximum	2104	2109	0.5193	0.5186	0.00222	0.001352	0.973	1
90-day maximum	1262	1266	0.7326	0.7314	0.002516	0.001638	0.957	1
Number of zero days	0	0	0	0				
Base flow index	0.05898	0.0654	0.3025	0.2806	0.109	0.0726	0.4925	0.8118
Parameter Group #3								
Date of minimum	259	259	0.06011	0.06011	0	0	0.957	0.975
Date of maximum	160	160	0.07377	0.07377	0	0	0.9499	0.981
Parameter Group #4								
Low pulse count	8	7	0.75	0.8571	0.125	0.1429	0.5626	0.8438
Low pulse duration	3	3	0.1667	1	0	5	0.7067	0.3954
High pulse count	3	3	0.6667	0.6667	0	0	0.8198	0.975
High pulse duration	5	3	10	16.67	0.4	0.6667	0.4354	0.6296
Low Pulse Threshold	88.81							
High Pulse Threshold	354.2							
Parameter Group #5								
Rise rate	8.68	8.735	0.4096	0.4408	0.006337	0.07616	0.9259	0.8979
Fall rate	-7.555	-7.42	-0.364	-0.3383	0.01788	0.07066	0.9269	0.9339
Number of reversals	140	138	0.09286	0.1232	0.01429	0.3266	0.6857	0.5726