Basin Report Objectives

This report is designed to provide a local perspective on the Statewide Water Supply Initiative 2010 (SWSI 2010) report. This basin report was prepared in consultation with the local Basin Roundtable established by House Bill 05-1177 and some sections of the report were directly produced by basin roundtable members. As such, the report not only summarizes basin-specific data from SWSI 2010, but also seeks to document progress, problems, and a path forward from the basin's perspective. The State of Colorado fully supports the basin roundtable process, yet the substantive conclusions of this report are those of the basin roundtable and are not necessarily endorsed by the State of Colorado.

This report is intended to provide reconnaissance-level data that employs consistency in data collection and forecast methodology across the state while maximizing available data. The methods utilized in this approach are for the purpose of general statewide and basinwide planning and are not intended to replace the efforts of local entities for project-specific purposes.

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Acronyms

AF	acre-feet
AFY	acre-feet per year
BCNP	Black Canyon National Park
BLM	Bureau of Land Management
BOR	U.S. Bureau of Reclamation
CBEF	Center for Business and Economic Forecasting
CDOW	Colorado Division of Wildlife
CDSS	Colorado Decision Support System
CRWAS	Colorado River Water Availability Study
CRWCD	Colorado River Water Conservation District
CU	consumptive use
CU&L	Consumptive Uses and Losses
CWCB	Colorado Water Conservation Board
DMRP	Drought Mitigation and Response Plan
DNR	Department of Natural Resources
DWR	Division of Water Resources
EIS	Environmental Impact Statement
GCM	global climate models
GIS	geographic information system
gpcd	gallons per capita per day
HB	House Bill
HUC	Hydrologic Unit Code
IBCC	Interbasin Compact Committee
IPPs	identified projects and processes
ISF	instream flow
IWR	Irrigation Water Requirement
LCWUA	Leroux Creek Water Users Association
M&I	municipal and industrial
NCNA	Nonconsumptive Needs Assessment
NFRIA	North Fork River Improvement Association
NHD	National Hydrography Dataset
NPS	National Park Service
Overland	Overland Ditch and Reservoir Company
RICD	recreational in-channel diversion
ROD	Record of Decision
SB	Senate Bill
SDO	State Demographer's Office
SEO	State Engineer's Office
SMP	Selenium Management Program
SRGAP	Southwest Regional Gap Analysis Project
SSI	self-supplied industrial
SWSI	Statewide Water Supply Initiative
UCRRIP	Upper Colorado River Recovery Implementation Program
UGRWCD	Upper Gunnison River Water Conservancy District
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Society
UVWUA	Uncompahgre Valley Water Users Association
UWPP	Uncompahgre Watershed Planning Partnership
WSL CU	Water Supply Limited Consumptive Use
WSRA	Water Supply Reserve Account

Section 1
Introduction

1.1 Gunnison Basin Roundtable

The Gunnison Basin stretches over 8,000 square miles of western Colorado, extending from the Continental Divide to the confluence of the Gunnison and Colorado Rivers near Grand Junction. The largest cities in the basin are Montrose, Delta, and Gunnison. The Gunnison Basin faces several challenges into the future including:

- Growth in the headwaters will require additional water management strategies.
- Addressing agricultural water shortages in the basin is an important goal of the community.
- The area between Ouray and Montrose is rapidly growing. Agriculture is important but will continue to feel pressures from the growth in the Uncompahgre Valley.

The Gunnison Basin has identified the following priorities:

- Preserve open space;
- Continue dialogue/negotiations between the Gunnison and other basin roundtables;
- Address aging infrastructure with the basin;
- Develop and implement a selenium management plan;
- Maintain agricultural viability;
- Provide for in-basin augmentation;
- Address compact delivery impacts to existing and future in-basin water rights;
- Ensure Endangered Species Act compliance through Aspinall re-operations; and
- Ensure adequate water for future needs (Municipal and Industrial [M&I], Agricultural, Environmental, and Recreational uses).

The Gunnison Basin Roundtable has completed their basinwide water needs assessments for their consumptive and nonconsumptive water supply needs and analyzed the basin's water supply availability. The basin roundtable conducted a separate study to examine their consumptive needs. This study, completed and adopted by the basin roundtable in August 2009, examined four specific areas—demands and supplies for smaller municipalities, rural domestic demands and supply, identified water supply vulnerabilities, and snowmaking demands. The basin has completed their nonconsumptive needs assessment (NCNA) mapping and is currently underway on the statewide effort with Phase 2 of the NCNA, which will identify specific projects addressing nonconsumptive needs within the basin.

Based on these needs assessments, the overall needs of the Gunnison Basin fall into six overlapping categories with specific projects related to each:

1. **Agricultural Water Shortages:** Agriculture is the sustaining life of the basin; it is central economically, culturally, and for the creation of the background for all other activities. It therefore has the highest priority for water needs. The roundtable has long known that there are shortages of agricultural water, which limit production, land use, and crop type throughout the basin. The Statewide Water Supply Initiative (SWSI) 2010 Report acknowledges this and quantifies the shortage as 128,000 acre-feet per year on average. While the roundtable feels this number is less than the actual shortfall, and will continue to analyze the agricultural water shortage, even this amount requires projects and methods to fill this gap.

2. **Rehabilitation and Maintenance of Existing Infrastructure:** Many of the existing sources of supply are aging and in need of more than routine maintenance. Dams, ditches, diversion structures, and other infrastructure are in many cases past their design life and need to be upgraded. The cheapest water supply is that which we already have and we cannot afford to lose any of our existing supply. Although there is a great deal of overlap between this need and others (efficiency, agricultural shortages, and selenium reduction) it should be emphasized as a distinct category.

3. **Efficiency:** There is a need to upgrade and improve water delivery and use. We must also address the question of what happens to saved water. Unless water saved can be used for our benefit, there is little incentive to become more efficient. Both agricultural and municipal water conservation needs to be addressed. This topic needs more discussion and input.

4. **Compliance with Federal Requirements:** The Gunnison watershed is controlled by federal demands. The Black Canyon water right, Endangered Species Act, power generation, and Aspinall reoperations Programmatic Biological Opinion are all needs that must be met by the water supplies of the basin. These needs dictate flow regimes on the Gunnison and will require further projects to minimize selenium loading of the river.

5. **Municipal Shortages:** There are shortages for municipalities identified in the SWSI 2010 Report. The Task Order report details some known municipal shortfalls but there are other projects needed to keep up with growth in the area. Since the Gunnison system is over appropriated, there are augmentation needs in all the sub basins as well.

6. **Compact Compliance:** All the water uses in the Gunnison Basin are impacted by the threat of a Colorado River Compact Call. We have, therefore, a need to understand the risks associated with further development of water within this basin. To that end, we need a better knowledge of the amount of water physically and legally available in the Gunnison. In addition, we need to plan for the effects of a Compact Call. The roundtable supports the efforts of the River District and others to create a water bank, which might allow more certainty to present any future water development. Specifically, the roundtable is a participant in studying the potential use of Blue Mesa storage capacity as a part of a water banking mechanism.

A final and overriding need for the basin is the achievement of **funding** for the projects considered in our needs assessment. It is obvious that none of our needs can be satisfied if funding sources cannot be found. There will have to be creative partnerships formed among all project beneficiaries to provide the revenue needed. Among other sources, hydropower on existing or new projects is a promising avenue.

1.2 Overview of the Water for the 21st Century Act

In 2005, the Colorado General Assembly passed the Colorado Water for the 21st Century Act (House Bill [HB] 05-1177). This legislation set up a framework that provides a permanent forum for broad-based water discussions, and it created two new structures—1) the Interbasin Compact Committee (IBCC), a statewide committee that addresses issues between basins; and 2) the basin roundtables, which were established in each of the state's eight major river basins plus the Denver Metro area. The purpose of the basin roundtables is to facilitate discussions on water issues and encourage locally driven collaborative solutions. The broad-based, collaborative nature of this process is reflected in the basin roundtable membership.

To help the basin roundtables accomplish their major responsibility of developing basinwide needs assessments, they have relied on groundwork completed during the Statewide Water Supply Initiative (SWSI) Phase 1 study. To further develop their needs assessments, support water activities in each of the basins, and implement identified water projects and methods, it was clear that the basin roundtables needed staff support as well as technical and financial assistance. Using resources provided through HB 06-1400, the Colorado Water Conservation Board (CWCB) provides staff support and technical assistance to the basin roundtables and the IBCC for the ongoing implementation of the Colorado Water for the 21st Century Act. The basin roundtables were also provided financial resources through Senate Bill (SB) 06-179, which established the Water Supply Reserve Account (WSRA). The WSRA appropriates money to the CWCB to help implement the consumptive and nonconsumptive water supply projects and methods identified by the basin roundtables. These bills and other relevant legislation are summarized below. The purpose of this report is to summarize the results of the Gunnison Basin Roundtable's needs assessment that have been completed to date.

SB03-110 authorized SWSI 1, which implemented a collaborative approach to water resources issues by establishing SWSI roundtables. SWSI 1 focused on using a common technical basis for identifying and quantifying water needs and issues.

HB05-1177 or The Colorado Water for the 21st Century Act provides a permanent forum for broad-based water discussions. It creates two new structures: 1) the IBCC, and 2) the basin roundtables. There are nine basin roundtables based on Colorado's eight major river basins and the Denver Metro area.

SB06-179 created the WSRA. Throughout SWSI and Colorado Water for the 21st Century Act processes, there has been a clear recognition that financial assistance is needed to address the water challenges in our state. This legislation funds the WSRA, which directs the State Treasurer to annually transfer $10 million from the Operational Account of the Severance Tax Trust Fund to the WSRA. These monies are available to the basin roundtables to fund water activities.

HB06-1385 created the CWCB's Intrastate Water Management and Development Section, which implements SWSI, the WSRA, develops reconnaissance level water supply alternatives, and tracks and supports water supply projects and planning processes. This section is now called the Water Supply Planning Section.

HB06-1400 appropriated money to the CWCB to fund staffing of the Water for the 21st Century Act process and monies for a contractor to technical assistance the basin roundtables.

SB09-106 authorized the funding of the WSRA in perpetuity.

Basin roundtables are legislatively required to be made up of a diverse set of stakeholders, including representatives from counties, municipalities, water conservancy districts, the environmental and recreational communities, agriculture, and industry. The responsibilities of the basin roundtables can be grouped into three categories—procedural, substantive, and public involvement. Each basin roundtable adopted bylaws that include the basin roundtable's goals, objectives, and operating procedures. These

bylaws reflect the specific needs of the basin roundtable and reflect the uniqueness of each basin. Each basin roundtable developed procedures and selected two members of the IBCC.

The most extensive substantive responsibility assigned to each basin roundtable is to develop a basinwide water needs assessment. This is performed in cooperation with local governments, area water providers, and other stakeholders. The Colorado Water for the 21st Century Act states "Using data from the Statewide Water Supply Initiative and other appropriate sources and in cooperation with the ongoing Statewide Water Supply Initiative, develop:

- An assessment of consumptive water needs (municipal, industrial, and agricultural)
- An assessment of nonconsumptive water needs (environmental and recreational)
- An assessment of available water supplies (surface and groundwater) and an analysis of any unappropriated waters
- Proposed projects or methods to meet any identified water needs and achieve water supply sustainability over time"

Equally important to selecting members of the IBCC and developing a basinwide water needs assessment, the basin roundtables serve as a forum for public involvement. The basin roundtable activities are required by law to be open, public meetings. The basin roundtable process creates an expanded foundation for public involvement.

This SWSI 2010 Report was largely based on basin roundtables' water needs assessments. This report is a summary of the Gunnison Basin Roundtable's needs assessment results that were utilized in the SWSI 2010 Report and that were chosen by the basin roundtable to be included in this Gunnison Basin Roundtable Needs Assessment Report.

1.3 Overview of the SWSI 2010 Report

The last decade brought many changes to the State of Colorado's water supply outlook. Despite the recent economic recession, the state has experienced significant population growth, and Colorado's population is expected to nearly double within the next 40 years. Colorado needs to provide an adequate water supply for its citizens and the environment, yet Colorado is transitioning from an era of undeveloped resources to an era of managing a more developed resource. Meeting the state's municipal, industrial, agricultural, environmental, and recreational water needs will involve implementing a mix of local water projects and processes, conservation, reuse, agricultural transfers, and the development of new water supplies, all of which should be pursued concurrently. Ultimately, the future of Colorado—both its vibrancy and its beauty—is dependent on how our water resources are sustained, used, and developed.

To help understand and address these trends, the CWCB undertook a number of important initiatives. The CWCB is statutorily charged to conserve, protect, manage, and develop Colorado's water resources for current and future generations. In advancing this mission, the CWCB helps ensure that water is utilized to meet the needs of Colorado's citizens while protecting the environment.

In the last few years, state leaders and resource management agencies have increasingly focused on helping ensure that Colorado has an adequate water supply for its citizens, agriculture, and the environment. In 2003, the Colorado General Assembly recognized the critical need to understand and better prepare for our long-term water needs and authorized the CWCB to implement SWSI. SWSI 1, approved by the Board in 2004, was a comprehensive identification of Colorado's current and future water needs, and it examined a variety of approaches Colorado could take to meet those needs. SWSI 1 implemented a collaborative

approach to water resource issues by establishing "basin roundtables"—diverse groups of individuals representing water interests who provide input on water issues.

This was followed by SWSI 2, which established four technical roundtables—Conservation, Alternative Agricultural Water Transfers, Environmental and Recreational Needs, and Addressing the Water Supply Gap. The overall goal of SWSI 2 was to develop a range of potential solutions that would help water providers, policymakers, and stakeholders gain a deeper understanding of the relative role that water efficiency, agricultural transfers, and new water development can play in meeting future needs and the trade-offs associated with these solutions.

In 2005, the legislature reaffirmed the need to prepare for a future in which water resources are increasingly limited by passing the Colorado Water for the 21st Century Act. This legislation institutionalized nine basin roundtables and created a voluntary, collaborative process to help the state address its water challenges. This process is based on the premise that Coloradoans can work together to address the water needs within the state.

Figure 1-1 illustrates the nine basin roundtables, which were organized to represent Colorado's eight major river basins and a separate basin roundtable for the Denver Metro area. The Yampa-White, Colorado, Gunnison, and Southwest Basin Roundtables are all based on tributaries to the Colorado River. The North Platte, Metro, and South Platte Basin Roundtables represent watersheds tributary to the Platte River. The Arkansas and Rio Grande Basin Roundtables are the headwaters of these river systems.

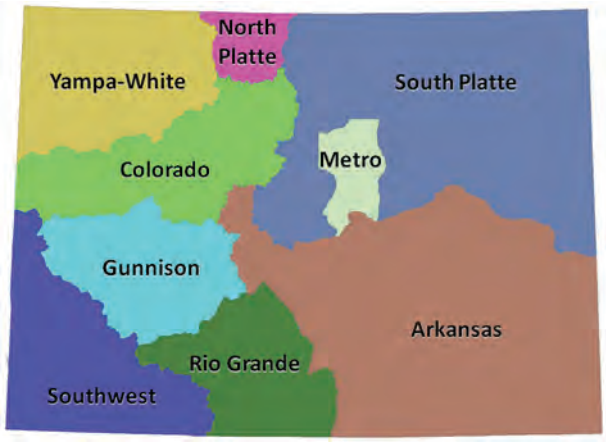

Figure 1-1 Colorado's nine basin roundtables provide a voluntary and collaborative process to help the state address its water challenges

In addition to the nine basin roundtables, the Colorado Water for the 21st Century Act established the 27-member IBCC to facilitate conversations between basins and to address statewide issues. The IBCC established its charter in 2006, which was soon ratified by Colorado's General Assembly. The charter outlines the roles of the IBCC—to provide a "framework that creates incentives for successful deliberations, agreements, and their implementation." To help advance this role, the IBCC embarked on a visioning process, through which the IBCC, CWCB, and basin roundtables agreed to evaluate water demand and supply strategies that could help address Colorado's water supply future.

1.4 SWSI 2010 Report Recommendations

With the completion of SWSI 2010, CWCB has updated its analysis of the state's water supply needs and recommends Colorado's water community enter an implementation phase to determine and pursue solutions to meeting the state's consumptive and nonconsumptive water supply needs. This will be accomplished through the following recommendations.

These recommendations do not necessarily represent a statewide consensus. The CWCB has deliberated on the information contained in SWSI 2010 and has put forth its view of how to move forward.

1. Actively encourage projects to address multiple purposes, including municipal, industrial, environmental, recreational, agricultural, risk management, and compact compliance needs.

2. Identify and utilize existing and new funding opportunities to assist in implementing projects and methods to meet Colorado's consumptive and nonconsumptive water supply needs.

3. Continue to lead the dialogue and foster cooperation among water interests in every basin and between basins for the purpose of implementing solutions to Colorado's water supply challenges.

4. Support water project proponents and opponents in resolving conflict and addressing concerns associated with implementing identified projects and processes (IPPs) that will reduce the M&I water supply gap. Identify IPPs that could be implemented by 2020.

5. Support meeting Colorado's nonconsumptive water needs by working with Colorado's water stakeholders to help:

    - Promote recovery and sustainability of endangered, threatened, and imperiled species in a manner that allows the state to fully use its compact and decreed entitlements.
    - Protect or enhance environmental and recreational values that benefit local and statewide economies.
    - Encourage multi-purpose projects that benefit both water users and native species.
    - Pursue projects and other strategies, including CWCB's Instream Flow Program, that benefit consumptive water users, the riparian and aquatic environments, and stream recreation.
    - Recognize the importance of environmental and recreational benefits derived from agricultural water use, storage reservoirs, and other consumptive water uses and water management.

6. Help meet Colorado's agricultural water supply needs by incorporating agricultural water needs into the development of water supply portfolios and supporting the implementation of multi-purpose agricultural water supply projects.

7. In order to determine the appropriate combination of strategies (IPPs, conservation, reuse, agricultural transfers, and the development of new water supplies) and portfolios to meet the water supply needs, CWCB will identify what it considers is achievable for each portfolio element and how those portfolio elements could be implemented.

8. Evaluate multi-purpose projects or packages of projects to develop new water supplies for use on the West Slope and the Front Range.

9. Develop and support risk management strategies so that Colorado can fully use its compact and decree entitlements to best balance Colorado's diverse water needs.

10. Support, encourage, and incentivize water providers in planning for and implementing M&I active conservation best management practices and other demand management strategies.

11. Work with water providers to identify opportunities where additional water could be made available by increased regional cooperation, storage, exchanges, and other creative opportunities.

12. Continue the evaluation of Colorado's water supply availability in all basins to help provide water users with viable analysis tools.

13. Help safeguard Colorado's water supply during times of drought by incorporating drought mitigation and response in statewide and local water supply planning.

14. Support local water supply planning.

15. The CWCB, in consultation with other state agencies, shall develop and implement a plan to educate and promote stewardship of water resources that recognizes water's critical role in supporting the quality of life and economic prosperity of all Coloradoans.

16. Establish a 6-year planning cycle for assessing Colorado's long-term consumptive and nonconsumptive water needs and support the implementation of projects and methods to meet those needs.

1.5 Gunnison Basin Roundtable Needs Assessment Report Overview

This report presents the information utilized in the SWSI 2010 Report and needs assessment information developed by the basin roundtable that is specific to the Gunnison Basin. Following is a description of the contents of this Basin Needs Assessment Report:

- **Section 2** is a summary of the **Gunnison Basin Nonconsumptive Needs Assessment** that have been completed to date. The roundtable has completed an extensive inventory of its environmental and recreational attributes and has summarized this information in focus area mapping.

- **Section 3** provides an overview of **Gunnison Basin Nonconsumptive Projects and Methods** that have been gathered and described by the Gunnison Basin Roundtable as well as a summary of projects and methods collected by the CWCB and a summary of this information as requested by the basin roundtable.

- **Section 4** summarizes the basin's M&I and agricultural water demands into a basinwide look at the **Gunnison Basin's Consumptive Needs Assessment**. The consumptive demands utilize a planning horizon of 2050.

- In **Section 5**, projects and methods to meet consumptive needs are considered. This includes a summary of projects and methods to address M&I and agricultural needs in the basin as summarized by the basin roundtable. As part of the summary, the **Projects and Methods to Meet Gunnison Basin M&I Needs** are described at a county level.

- The CWCB recently developed the draft Colorado River Water Availability Study (CRWAS). In **Section 6, Water Availability** is considered statewide including a summary of the analyses considered in CRWAS as well as water availability information developed by the Basin Roundtables as part of their basinwide needs assessments and during SWSI 1.

- **Section 7** is a summary of the **Gunnison Basin Roundtable's Strategies to Address Consumptive and Nonconsumptive Needs** as well as the basin roundtable's recommended next steps.

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Section 2
Gunnison Basin Nonconsumptive Needs Assessment

2.1 Overview of Nonconsumptive Needs Assessments

As discussed in Section 1, the basin roundtables are required to complete Nonconsumptive Needs Assessments (NCNAs). This effort has included an extensive inventory, analysis, and synthesized mapping effort that built upon the Statewide Water Supply Initiative (SWSI) 2 environmental and recreational attribute mapping as a common technical platform for the basin roundtables. **Figure 2-1** shows the process that was utilized by the Colorado Water Conservation Board (CWCB) and basin roundtables in completing their NCNAs. The basin roundtables have utilized environmental and recreational mapping to identify where the nonconsumptive focus areas are in their basins. The basin roundtables' nonconsumptive focus areas and further study efforts are intended to facilitate the identification of projects and methods to address environmental and recreational water needs. The Gunnison Basin nonconsumptive identified projects and methods are summarized in Section 3 of this report.

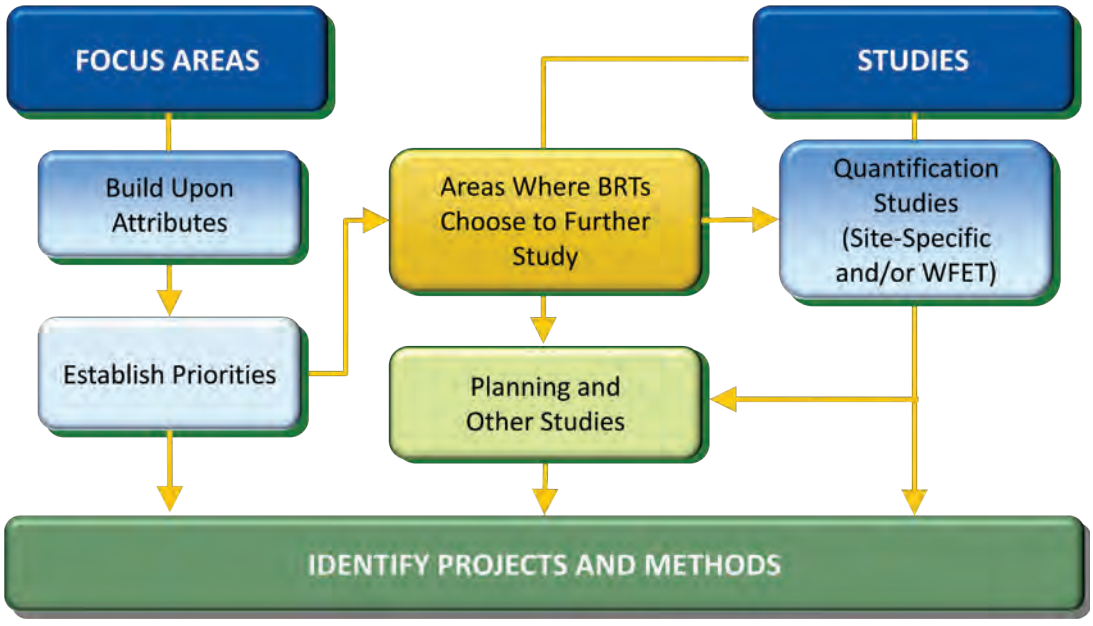

Figure 2-1 Nonconsumptive Needs Assessment Methodology

The focus area maps developed by each basin roundtable are based on a common set of environmental and recreational attributes and represent where Colorado's important water-based environmental and recreational attributes are located. The maps are reflective of stakeholder input for the focus areas and also reflect stream reaches and subwatersheds with higher concentrations of environmental and recreational qualities. These maps were generated to provide information to the basin roundtables on important environmental and recreational areas in their basins but were not intended to dictate future actions. It should be noted, and as will be shown in this section, that this effort has not identified all streams as important. The NCNAs are not intended to create a water right for the environment and will not diminish, impair, or cause injury to existing absolute or conditional water rights. The CWCB and basin roundtables developed the environmental and recreational focus area mapping for the following purposes:

- The maps are intended to serve as a useful guide for water supply planning so that future conflicts over environmental and recreational needs can be avoided.
- The maps can assist in identifying environmental and recreational water needs status, such as where needs are being met, where additional future study may need to take place, or where implementation projects in the basin are needed.
- The maps can help basins plan for the water needs of species of special concern so that they do not become federally-listed as endangered or threatened in the future.
- The maps can provide opportunity for collaborative efforts for future multi-objective projects.

2.2 Focus Area Mapping Methodology

Underlying the work done by the basin roundtables is a common technical platform, which builds off SWSI 2, as described above. This common technical platform approach recognizes the need for each basin roundtable to utilize the technical work in the most effective manner for the stakeholders and concerns within the basin. For example, some basins that were focused on wetlands or bird habitat issues used a watershed approach, while others focused on instream habitat.

Overall, the basin roundtables used three methods to identify their focus areas as shown in **Figure 2-2**. After the basin roundtables gathered additional data layers beyond existing SWSI 2 geographic information system (GIS) data layers, they each developed a summary map that highlighted environmental and recreational focus areas for their basin. The Gunnison Basin Roundtable used Method 3, which reviewed all available data layers for their basin, and based on stakeholder knowledge and outreach, selected stream reaches that represented the majority of environmental and recreational activity in their basins.

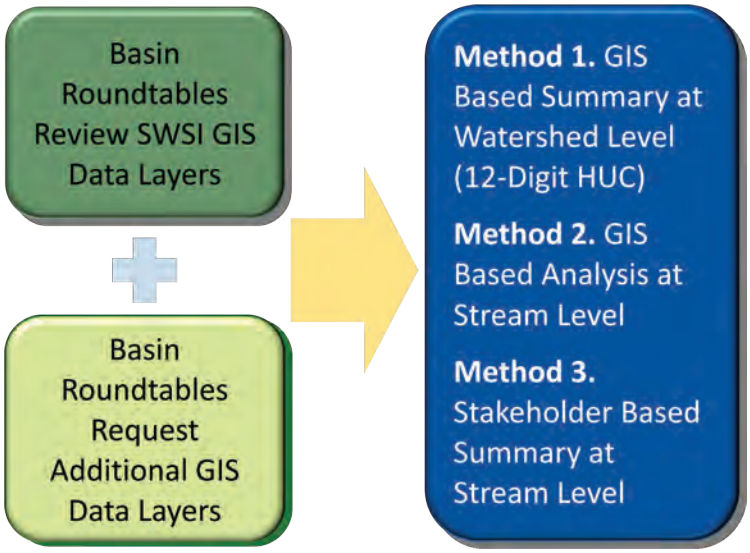

Figure 2-2 Basin Roundtable Focus Area Mapping Methodology

GIS software was used to organize the data layers for environmental and recreational attributes associated with nonconsumptive water needs for each basin. The term "data layer" refers to geographic data that represents a specific type of feature or attribute (e.g., wetlands or species habitat) and can also be referred to as a shapefile. Multiple data layers, organized collectively, are referred to as a dataset. The environmental and recreational data layers for each basin were selected using the SWSI 2 GIS data layers as a starting point. The basin roundtables reviewed the available data layers compiled during SWSI 2 and then suggested and contributed additional data layers as deemed appropriate for each basin. The SWSI 2010 Report's Appendix C contains the *Nonconsumptive Needs Assessment Focus Mapping Final Report* that provides the detailed methodology utilized by each basin roundtable in developing their focus area map.

2.2.1 SWSI 2 GIS Data Layers

The Environmental and Recreational Technical Roundtable that was formed under SWSI 2 developed a list of select environmental and recreational GIS data layers that could potentially be used by decisionmakers to determine areas of focus for environmental and recreational water needs. The complete list of SWSI 2 GIS data layers is shown in **Table 2-1**.

Table 2-1 SWSI 2 Environmental and Recreational Data Layers

Arkansas Darter	Gold Medal Trout Streams
Audubon Important Bird Areas	Greenback Cutthroat Trout
Bluehead Sucker	Greenback Cutthroat Trout
Bonytail Chub	Humpback Chub
Boreal Toad Critical Habitat	Rafting and Kayak Reaches
Colorado Department of Public Health and Environment Water Quality Control Division 303(D) Listed Segments	Rare Riparian Wetland Vascular Plants
Colorado Pikeminnow	Razorback Sucker
Colorado River Cutthroat Trout	Recreational In-Channel Diversions
CWCB Instream Flow Rights	Rio Grande Cutthroat Trout
CWCB Natural Lake Levels	Rio Grande Sucker
CWCB Water Rights Where Water Availability had a Role in Appropriation	Roundtail Chub
Flannelmouth Sucker	Significant Riparian/Wetland Communities
Gold Medal Trout Lakes	

In addition to the SWSI 2 environmental and recreational GIS data layers, the basin roundtables requested the attainment and development of other important environmental and recreational GIS data layers. Some of the additional GIS data were received directly from state and federal agencies, nongovernmental organizations and municipalities, or downloaded from their official websites. Other additional GIS data were digitized from available information, lists, or maps provided by basin roundtables, specialists (biologists, recreation guides), and other stakeholders. **Table 2-2** contains a list of additional environmental and recreational data layers that were collected based on basin input.

Table 2-2 Additional Statewide Environmental and Recreational Data Layers Based on Basin Roundtable Input

Additional Fishing	National Wetlands Inventory
Additional Greenback Cutthroat Trout Waters	Northern Leopard Frog Locations
Additional Paddling/Rafting/Kayaking/Flatwater Boating	Northern Redbelly Dace
Additional Rio Grande Sucker and Chub Streams	Osprey Nestsites and Foraging Areas
Bald Eagle Winter Concentration	Piping Plover
Bald Eagle Active Nestsites	Plains Minnow
Bald Eagle Summer Forage	Plains Orangethroat Darter
Bald Eagle Winter Forage	Preble's Meadow Jumping Mouse
Brassy Minnow	River Otter Confirmed Sightings
Colorado Birding Trails	River Otter Overall Range
Colorado Outstanding Waters	Rocky Mountain Biological Laboratory (scientific and educational reaches)
Common Garter Snake	Sandhill Crane Staging Areas
Common Shiner	Southwestern Willow Flycatcher
Ducks Unlimited Project Areas	Stonecat
Educational Segments	Waterfowl Hunting Areas
Eligible/Suitable Wild and Scenic	Wild and Scenic Study Rivers
Grand Mesa, Uncompahgre, and Gunnison Wilderness Waters/Areas	Wildlife Viewing
High Recreation Areas	Yellow Mud Turtle
Least Tern	

2.2.2 Categorization of Data Layers

The Gunnison Basin Roundtable examined their collected environmental and recreational data layers and utilized a stakeholder process to establish what the environmental and recreational focus areas should be for their respective basins. The basin roundtables summarized their environmental and recreational attributes on a map and created a table summarizing why the segment was included as a focus area and important attributes for each segment. This information has been summarized at the National Hydrography Dataset (NHD) stream reach level. Detailed information about this approach is summarized in Appendix C of the SWSI 2010 Report.

2.3 Nonconsumptive Focus Area Mapping Results

Using the methodologies and techniques outlined above, the Gunnison Basin developed a unique map showing focus areas with nonconsumptive environmental and recreational water needs. The basin map was created as a Geospatial PDF file, or GeoPDF, to allow the user the ability to "click" areas of the map and view characteristics of that portion of the map such as what attribute subcategories are present for a given Hydrologic Unit Code or stream segment. In addition, the presence of specific attributes (e.g., bluehead sucker, trout, kayaking, etc.) is also summarized as well as information designated by the basin roundtable through creation of tables associated with their map. To utilize the maps interactively, select the tools dropdown list, then select the analysis tools arrow and then click on the "object data tool." Using this tool, triple click a reach for additional information that will appear on the left side. **Figure 2-3** at the end of this section shows the environmental and recreational focus mapping for the Gunnison Basin. The Gunnison Basin created a map showing major stream and lake segments with environmental, recreational, and both environmental and recreational nonconsumptive water attributes. The Gunnison Basin also included scientific and education segments in their focus map. As described above, the basin created a table with the supporting data for the selected segments. These tables and other details for these basin roundtables mapping efforts are located in Appendix C of the SWSI 2010 Report. GIS analysis was performed to join these tables to their spatial location within the basin. A GeoPDF was then developed for the basin allowing the viewer the ability to select a stream segment and see the specific attributes for that NHD reach plus details from the associated tables that were created by the basin roundtables.

Figure 2-3 shows the Gunnison Basin Major Environmental and Recreational Stream Segments as determined by the basin roundtable. The Gunnison Basin chose to include waters within the Rocky Mountain Biological Laboratory property as scientific and educational waters. These are highlighted on the map in aqua. Waterbodies shown in purple are those that are known as boating and fishing reaches. Segments highlighted in orange have environmental nonconsumptive water attributes. Many of these streams are located within wilderness areas including the Roubideau Special Management Area and the Dominguez Canyons Wilderness Area. Segments highlighted in red have both environmental and recreational nonconsumptive water attributes. This overlap occurs on a large portion of the Gunnison River. The Gunnison Basin GeoPDF provides the viewer the ability to select stream segments and display their attribute categories and specific attributes (e.g., kayaking, wildlife viewing, waterfowl hunting, etc.). In addition, other details from the Gunnison table, such as the rationale for consideration, are also detailed in the GeoPDF. The attribute categories for the Gunnison Basin that are shown within the GeoPDF include:

- Federally listed fish species
- Aquatic-dependent state endangered, threatened, and species of concern
- Rare aquatic-dependent plants and significant riparian wetland plant communities
- Special value waters
- Whitewater and flat water boating
- Riparian/wetland wildlife viewing and waterfowl hunting
- Significant cold- and warm-water fishing
- High recreation areas

Legend

Major Environmental, Recreational and Scientific/Educational Segments

- Environmental and Recreational Segments
- Recreational Segments
- Scientific and Educational Segments
- Environmental Segments
- Roads
- Rivers and Streams
- Lakes and Reservoirs
- Cities and Towns
- County Boundary
- Wilderness Areas

Land Management

- BLM
- BOR
- CDOW
- CITY
- COUNTY
- FWS
- LAND TRUST
- NPS
- PRIVATE
- SCHOOL DISTRICT
- SLB
- STATE
- STPARKS
- USFS

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0 4 8 16 24

Miles

1 inch = 4 miles

Figure 2-3

Gunnison Basin Nonconsumptive Needs Assessment Major Stream and Lake Segments

COLORADO WATER CONSERVATION BOARD STATE OF COLORADO 1876 1937

CDM

Section 3
Gunnison Basin Nonconsumptive Projects and Methods

The mapping effort described in Section 2 and Figure 2-3 of that section and Sections 3.1 to 3.3 below are the ratified work of the Gunnison Basin Roundtable and its Nonconsumptive Needs Committee. Concurrent to the roundtable process, the Colorado Water Conservation Board (CWCB) completed an outreach effort in the Gunnison Basin to the environmental and recreational communities to identify existing or planned nonconsumptive projects or methods. These are summarized in Sections 3.4 to 3.7 below. The CWCB analysis also includes the nonconsumptive fisheries management needs as described by the Colorado Division of Wildlife (CDOW).

3.1 Gunnison Basin Nonconsumptive Projects and Methods Overview

As described in Section 1, the Colorado Legislature adopted House Bill (HB)05-1177, the Colorado Water for the 21st Century Act. Section 37-75-104 authorized the formation of basin roundtables. "37-75-104(1)(a) to facilitate continued discussions within and between basins on water management issues, and to encourage locally driven collaborative solutions to water supply challenges…" (2)(c) directs each roundtable to develop a basinwide consumptive and nonconsumptive water supply needs assessment … and propose projects or methods, both structural and nonstructural, for meeting these needs…

With guidance and assistance from the CWCB and its contractors, each basin identified and mapped the nonconsumptive (environmental and recreational) attributes and needs in our basins. This was Phase 1 of the assessment and is summarized in Section 2 of this report. In the Gunnison Basin, we prioritized 21 segments where there was an aggregation of attributes and needs. These segments covered both warm and cold water eco-zones as well as flat water and stream boating and fishing activities. We also included segments with impaired water quality that interferes with attaining the identified beneficial uses of water. A purpose of Phase 1 was to identify segments that require strategies to help maintain properly functioning riparian and aquatic ecosystems; segments where recovery of fish or riparian function restoration is needed; and to identify segments where water quality remediation needs and efforts are underway or being organized.

In the Gunnison Basin, Phase 2 involves a description of management strategies that address these nonconsumptive needs. Some of these strategies were developed through hard-fought legal battles while others were developed through collaborative, proactive stakeholder efforts. Since natural hydrologic cycles involve dynamic and variable conditions, most if not all of these efforts are ongoing and involve adaptive management.

Many of these strategies include a quantification of flow needs or targets while others involve restoration goals that can be described as either short-term or long-term. A description of these management strategies was ratified by the roundtable in August 2010 and is summarized in the next section.

3.2 Gunnison Basin Nonconsumptive Strategies

Following is a summary of the Gunnison Basin Roundtable's strategies to address its nonconsumptive focus areas described in Section 2. The geographic extent of these strategies is shown in **Figure 3-1**.

Segment 1 –Blue Mesa, Morrow Point, Crystal Reservoirs (Aspinall Unit of the Colorado River Storage Project) and Gunnison River in Curecanti National Recreation Area

Water rights are held by the United States and managed by the U.S. Bureau of Reclamation (BOR) to meet multiple federally authorized purposes. The unit is operated to allow the Black Canyon Water Right decree to be met and, in the future, to benefit endangered fish in the lower Gunnison River. The predominately flat-water recreational facilities and opportunities are managed by National Park Service (NPS), by contract with BOR, in cooperation with CDOW. The boating access facilities have been designed to function within the normal variation of lake levels. The NPS and CDOW operate an aggressive invasive species control program to prevent infestation of quagga and zebra mussels. CDOW is also aggressively managing the lake trout populations to maintain a balance of fishery populations of brown and rainbow trout and kokanee salmon. Illegal introduction of yellow perch has resulted in a reproducing population that is currently being monitored.

Inflows to Blue Mesa Reservoir are partially affected by the 1975 Taylor Park Exchange Agreement. Reservoir storage levels are described in the Aspinall Draft Environmental Impact Statement (EIS) prepared in 2009. Storage levels predicted ensure that public safety and welfare are protected, recreational opportunities are provided, and the federally authorized purposes of the Aspinall Unit can be met.

Segment 2 – Gunnison River in Black Canyon of the Gunnison National Park

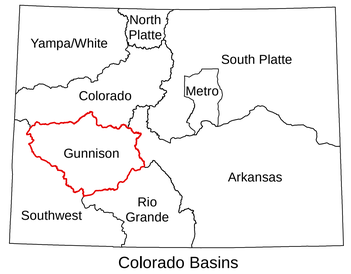
The Black Canyon water right was decreed to preserve the ecological and aesthetic values for which the Black Canyon National Park (BCNP) was originally reserved in 1933. These rights are primarily used to mimic the natural hydrograph. Reclamation operates the Aspinall Unit in order to allow the water right to be met. In addition, following a Record of Decision (ROD) on the Aspinall EIS, these releases, combined with natural side inflows, will help meet the recommended flows to help recover the endangered fishes of the lower Gunnison River Basin. The park, rim-to-rim, is designated wilderness and is managed as such. The Gunnison River downstream from Crystal Reservoir is designated as a Gold Medal fishery by CDOW and as such is managed under special regulations. It is arguably one of the best sport trout fisheries in the State of Colorado, if not in the western United States. Minimum flow protections in the BCNP and ramping rate guidelines in the Aspinall Unit EIS also preserve and protect the trout fishery. The use of Crystal Reservoir to re-regulate large flow fluctuations from upstream peak power production is important to preserve the good natural reproduction that supports this wild trout fishery.

Segment 3 – Gunnison River in Gunnison Gorge National Conservation Area downstream to Confluence with North Fork of the Gunnison River

This segment is also designated wilderness, rim-to-rim, and benefits from the controlled releases from the Crystal Dam and the Black Canyon water right. Bureau of Land Management (BLM) manages boating and fishing access and use of the Gorge to protect the wilderness values. CDOW manages this segment for fish and wildlife resources in the same manner as the upstream segment and benefits from the previously mentioned Black Canyon water rights and Aspinall Unit operations.

Legend

- NCNA Projects
- Focus Segments
- River and Stream
- Lake and Reservoir
- City and Town
- Road
- County Boundary
- Basin
- Wilderness Areas



Colorado Basins

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Figure 3-1
Gunnison Basin Roundtable Non-Consumptive Projects and Methods

\\denjisvr1\cdmGIS\SW\NONCONSUMPTIVE\GUNNISON\MXD\Gunnison_Roundtable_Nonconsumptive.mxd

Segment 4 – Gunnison River - Hartland Diversion to Confluence Colorado River

This segment contains occupied and designated critical habitat for two federally-listed endangered fish species. As such, quantity and some quality (selenium) issues for this reach come under the influence of the Upper Colorado River Recovery Implementation Program (UCRRIP) for these endangered fishes. The flows in this segment are predominantly influenced by releases from the Aspinall Unit. The BOR, as a member of the UCRRIP, is implementing changes in operations of the unit to aid in the recovery by attempting to meet the U.S. Fish and Wildlife Service (USFWS) flow recommendations (or reasonable alternative thereto). Additionally, this is a popular boating segment that benefits from improved flow regimes.

Water quality in this segment is impaired by high concentrations of selenium that will soon be managed by a Selenium Management Program (SMP) that is being developed. A Programmatic Biological Opinion was signed by the USFWS on December 4, 2009 for the Gunnison Basin that requires the development of the SMP. It is anticipated that the U.S. Department of Interior will sign a ROD that will formalize the operations of the Aspinall Unit for the benefit of endangered fish. The SMP plan is scheduled for completion in late 2011 and should result in improved water quality conditions.

Segment 5 –Gunnison River - Confluence with North Fork Gunnison River to Hartland Diversion

Boating in this reach is related to both fishing and daily recreational trips. The reoperation of the Aspinall Unit, as previously discussed, should benefit both the native and sport fisheries in this reach. However, there may be some adverse impacts to the sport fishery if summer base flows are lowered significantly and/or temperature increases measurably. This segment is listed by the State of Colorado as impaired by selenium and will benefit from implementation of the SMP. There is also a plan to replace the Hartland Diversion with a new structure that would improve fish passage that will extend their habitat, make the structure safer to navigate, and ensure diversion efficiency and stability.

Segment 6 – North Fork of the Gunnison River - Paonia Dam to Confluence with the Gunnison River

This segment has three distinct characteristics with respect to aquatic resource and recreational values. Above Fire Mountain Diversion, the river produces an excellent fishery. Between Somerset and Paonia there is limited public access with a decent fishery. Below the Farmers Ditch above Paonia to the confluence with the Gunnison, this segment can be severely depleted during the irrigation season with no fishery management attempted by CDOW. The middle and lower segments could benefit from additional flows but no source of additional water is available at this time. The Paonia Reservoir has a significant buildup of sediment that is beginning to restrict its active capacity. A study of the sediment issue and potential management approaches, funded by the roundtable, is to be released soon. This study might suggest a modification of operations or possible structural improvements that would prevent or remove the accumulation of sediment. The Town of Somerset and Oxbow Mine currently divert water from the river via pumps to meet their water needs. A new project to replace the pumping with gravity feed would also improve river access, fish habitat, and boating. The North Fork River Improvement Association (NFRIA) is actively working with land and water right owners to improve diversion structures to improve efficiency and to improve habitat. NFRIA is also involved in monitoring water quality in the North Fork. It should be noted that NFRIA and the Western Slope Environmental Resource Council are currently merging their organizations.

Water quality in this segment is generally good as most of the selenium issues in the basin are from Mancos shale landscapes downstream from Paonia. Currently, the impairment due to selenium begins approximately 2 river miles upstream from Paonia at the "Black Bridge."

Segment 7 – Stream Segments on Headwaters Wilderness Areas

These segments are designated as Outstanding Resource Waters and are protected from degradation of water quality by the State of Colorado. This precludes any future activities that could impair water quality.

Most, if not all, of these segments have instream flow (ISF) water rights held by the CWCB that are intended to protect base flows in these streams. Historic water diversions do exist in some of these areas. CDOW has indicated that native Cutthroat Trout habitat could be improved with enhanced land use management, fencing enclosures, and more non-native fish (exclusion) barriers.

Segment 8 – Coal Creek, Slate River and Tributaries

These segments are impaired by high concentrations of cadmium and zinc from acid mine drainage. The Coal Creek Watershed Coalition is a diverse stakeholder group dedicated to restoration of the ecological integrity of this watershed. Water quality monitoring is a key component of its program. There are ISF filings in these segments to protect base flows.

Segment 9 – East River - Gothic to Almont

This segment has some significant irrigation diversions that control the river and stabilize flows. The historical irrigation methods provide for almost immediate return flows that help provide for a healthy fishery. The ecological attributes are also protected by limited public access and base flow ISF filings. Upstream snowmaking depletions are limited by a bypass flow requirement. Low flows in this reach are difficult to measure and can lead to difficulty in river administration.

Segment 10 – Henson Creek and Tributaries

This watershed is impaired by high concentrations of metals from acid mine drainage. The Lake Fork Valley Conservancy is a group of local stakeholders dedicated to remediation of the legacy mining. Water quality monitoring is a component of their work. The CWCB owns ISF rights to protect base flows.

Segment 11 – Uncompahgre River and Tributaries - Headwaters to Ouray

This segment has impaired water quality from historical mining and natural mineralization that would benefit from additional remediation. Local stakeholders are in the process of forming the Uncompahgre Watershed Planning Partnership (UWPP) to empower local stakeholders to begin a process to develop remediation plans for this segment. In addition to a part time paid coordinator, the UWPP employs Volunteers in Service to America interns and uses volunteers to collect data and to gather and disseminate information. The group intends to produce a watershed-planning document that will identify priority actions and to guide future riverine activities in the Uncompahgre River Basin. There are some ISF filings to protect some base flows.

Segment 12 – Uncompahgre River - Ouray to South Canal Outfall and West Canal Flume

At present this segment is considered as a single unit but in the future it should probably be divided in two with the upper segment terminus being Ridgway Reservoir and the lower being from Ridgway to the South Canal. The upper segment is impaired by metals contamination where additional remediation could improve environmental and recreational opportunities. The UWPP intends to focus its work to address these issues on this segment. There is an ISF for this segment and the operating criteria for Ridgway Reservoir require minimum releases below the reservoir to protect the fishery. Much of the metals in the upper segment are sequestered in the reservoir improving water quality below the reservoir. Discussions between the CDOW and the Tri-County Water Conservancy District are ongoing related to desired improvements to the winter minimum flows and to address nitrogen super-saturation that limit the trout fishery below the dam.

Segment 13 – Grand Mesa Reservoirs on National Forest

The Grand Mesa Water Conservancy District and the associated Grand Mesa Water Users Association manages approximately 110 structures that impound up to 22,000 acre-feet (AF) of water within the Surface Creek drainage. These entities, in coordination with CDOW, maintain self-sustaining and/or stocked-fish populations in these facilities and in some of the more accessible reservoirs. Water is moved

from the higher and more remote impoundments downstream as the irrigation season progresses. They typically try to retain at least 6,000 AF of carryover water storage in total, which helps assure winter fish habitat and maintain good fishery management. From year to year, there is flexibility with where the winter storage occurs.

Segment 14 – Tributaries to Taylor Park Reservoir

Although there are some private tracts of land in this watershed, it is predominantly composed of U.S. Forest Service (USFS) National Forest property. The related Forest Management Plan, the Travel Management Plan, and Special Use Permit prescriptions guide management strategies. The CWCB has extensive ISF filings in the basin to protect base flows.

Segment 15 – Taylor Park Reservoir

The United States owns the water right for the first fill of the reservoir, which is operated by the Uncompahgre Valley Water Users Association (UVWUA). The second fill right is also owned by the United States for the benefit of the Upper Gunnison River Water Conservancy District (UGRWCD). The CDOW manages the fishery. The reservoir levels, releases, and the resulting stream flows in the Segments 16 and 17 immediately downstream are heavily influenced by the 1975 Taylor Park Reservoir Operation and Storage Exchange Agreement (1975 Agreement). This is a four-party agreement between the BOR, the UVWUA, UGRWCD, and the Colorado River Water Conservation District (CRWCD) and administered by the Colorado Division of Water Resources (DWR). The UGRWCD convenes a diverse stakeholder group that meets regularly to evaluate current hydrologic conditions and makes recommendations to the four parties on an optimal water release schedule to enhance piscatorial and wildlife habitat, flat water, and river recreational opportunities while providing sufficient flows for supplemental irrigation in the Upper Basin and irrigation supply to the Uncompahgre Valley. This flexible management opportunity is provided in the 1975 Agreement that allows for a downstream exchange of the storage rights of the UVWUA into Blue Mesa Reservoir.

Segment 16 – Taylor River - Taylor Park Reservoir to Almont

See above description for Segment 15. There are ISF filings in this segment.

Segment 17 – Gunnison River - Almont to Blue Mesa Reservoir

In addition to the management strategies described in Segment 15, this segment benefits from flow management related to the UGRWCD-owned recreational in-channel diversion rights for a whitewater park located just west of the City of Gunnison. These variable flow rights protect a reliable flow of water to several in-channel structures with submerged features to enable kayaking activities and other riverine recreational activities. It was constructed by Gunnison County. The UGRWCD and High Country Citizen's Alliance have funded a riparian assessment of this segment that might suggest new projects/ strategies. A planned project will add a third kayak drop structure in the Gunnison Whitewater Park, which is also designed to reduce the amount of annual maintenance needed for the diversion structure of the most senior water right in the basin.

Segment 18 – Lake San Cristobal

An Intergovernmental Agreement was created to coordinate the construction of a new outlet to control Colorado's second largest natural lake's level and related downstream releases to support flows in the Lake Fork of the Gunnison River. This new outlet will help stabilize lake levels and to create an active storage pool by controlling the top 3 feet of water in the lake. This new water storage volume will provide augmentation for junior water rights and uses in the basin including numerous trout ponds, ISFs, and municipal and domestic uses. One hundred acre-feet, until required for augmentation, can be used, at the discretion of the CWCB, to protect the environment to a reasonable degree in the Lake Fork below Lake San Cristobal.

Segment 19 – Lake Fork of the Gunnison River - Lake San Cristobal to Blue Mesa Reservoir

See above description of Segment 18

Segment 20 – Ridgway Reservoir

Tri-County Water Conservancy District manages this facility under contract with the BOR. Reservoir levels and releases are made for the multiple purposes of irrigation (11,200 AF) recreation, environmental flows, and municipal supplies including releases by exchange via the Gunnison Tunnel. Inflows to the reservoir are largely uncontrolled and managed as described in Segment 12.

Segment 21 – Upper East River and Tributaries - Headwaters to Gothic

There are ISF filings in these segments. The USFS manages the public lands with some special protection for long-term research areas. The Rocky Mountain Biological Lab, the primary research facility, is working to develop an augmentation plan to improve the reliability of its water supply. There are relatively few privately held lands in this sub basin.

3.3 Gunnison Basin Roundtable Nonconsumptive Conclusions and Recommendations

A key element to maintaining the effectiveness of these strategies is not only to work at assuring their continued funding but to also protect and enhance the integrity of these strategies by resolving that future water development projects will avoid or reduce and mitigate their impacts to the attributes we have identified. To accomplish this, we need to integrate non-consumptive needs into planning efforts of future water supply projects.

New water development projects to meet consumptive needs can have impacts or benefits to environmental function (both riparian and aquatic) and to recreational opportunities of our waterways. A significant contribution to our economic wellbeing relies on maintaining healthy stream flows. To avoid new conflicts, new projects can be designed with multifaceted aspects that can not only provide new supplies but also protect these functions. It is the advice of this roundtable that proponents of new water projects be respectful of the environmental and recreational attributes that we have identified and that we deem worthy of continued protection, restoration, and enhancement.

The roundtable recognizes that it has no authority to require adherence to these principles but all project proponents will be asked to consider how their project might improve, or at least not damage, nearby identified nonconsumptive uses. Respect for the common-ground values identified and ratified by consensus will facilitate a smoother path to approval and implementation of new water supply projects. To back this up, the roundtable can and does offer incentives. We have a grant program for use within our basin to fund studies, to fund design and engineering to prepare projects as well as to assist with actual construction. We also offer support for worthy projects that compete for a larger pool of statewide funds that are available. This support can also be used to encourage other funding opportunities available from a diversity of sources, both governmental and non-governmental.

This report should not be taken as a final word on identifying all of the attributes or challenges to protecting these resources or restoring them. The Gunnison Basin Roundtable recognizes that more can be done to protect, conserve, and restore our treasured resources. Wise land use planning and land conservation efforts are important tools that can be utilized to maintain properly functioning riparian and aquatic habitat that contribute to ecosystem.

We request and hope that the entities represented on this roundtable and elsewhere will utilize their authorities to follow a path that reduces conflict and achieves the goal of meeting our future needs by

acknowledging that our activities create impacts that can and should be avoided or minimized and mitigated.

3.4 CWCB Nonconsumptive Projects and Methods Overview

As described above, the Water for the 21st Century Act requires the basin roundtables to identify projects and methods to meet their consumptive and nonconsumptive needs. For consumptive projects and methods, the CWCB worked with water providers and the basin roundtables to update the Statewide Water Supply Initiative (SWSI) 1 identified projects and processes (IPPs) from a planning horizon of 2030 to 2050. This effort is summarized in Section 5 of this report. For nonconsumptive needs, the CWCB has conducted an analogous outreach effort with the environmental and recreational community and the basin roundtables to identify nonconsumptive projects and methods similar to the municipal and industrial (M&I) consumptive IPPs. CWCB digitized the project information into geographic information system (GIS) and compared this information with the nonconsumptive focus areas summarized in Section 2. With this information, CWCB was able to preliminarily identify nonconsumptive focus areas with and without projects and methods. It is important to note that if a focus area does not have an associated project and method it does not mean that the area needs protective projects and methods. It is also important to note that CWCB did not judge the sufficiency of the projects and methods in each reach; rather, as with the M&I IPPs, CWCB did not judge the merits of the nonconsumptive projects and methods being pursued by local organizations. This information gathered was intended to assist the basin roundtables in addressing the following questions:

1. Are there existing protections/efforts for environmental and recreational focus areas?
2. Are there areas without protections that need further study?
3. What strategies are needed to support nonconsumptive priority areas?
4. Are there areas where new flow or water level quantification is appropriate?
5. Are there areas where a project, whether structural (e.g., river restoration) or nonstructural, can be identified and implemented?
6. Are there areas where no action is needed at this time?

Section 3.5 describes the methodology used to gather nonconsumptive projects and methods across the state. Section 3.6 summarizes the methodology used to analyze the project and method information and presents results for the Gunnison Basin Roundtable.

3.5 CWCB Nonconsumptive Projects and Methods Methodology

In January 2010, CWCB developed a survey to collect information on where there are existing or planned nonconsumptive projects, methods, and studies. Studies were included since they may recommend or inform the implementation of projects or methods that will provide protection or enhancement of environmental and recreational attributes. This survey was distributed through CWCB's basin roundtable and email database. On February 10, 2010, CWCB conducted a workshop in Silverthorne, Colorado to discuss the Phase II efforts and to collect information on nonconsumptive projects, methods, and studies from the workshop attendees. At the workshop, information on 116 stream segments and 209 projects, methods, or studies was provided to CWCB. In addition, CWCB also gathered information on individuals

and organizations to follow up with the data collection effort. Since the February 2010 meeting, an additional 57 meetings have occurred to gather data on additional projects, methods, and studies. **Table 3-1** summarizes the number of individuals or organizations contacted since the February 2010 meeting; the number of follow-up meetings held; and the number of projects, methods, and studies identified to date for each basin. Table 3-1 details the number of projects, methods, and studies that are in the focus areas and the number of projects outside of the focus areas. In total, 648 projects were identified from the outreach effort. Examples of the types of projects collected during this outreach effort include:

- Habitat restoration projects such as bank stabilization projects or instream habitat restoration such as pool and riffle development. Another example of habitat restoration area projects that focus on the maintaining connectivity for fish passage such as fish ladders.
- Flow protection projects such as voluntary flow agreements, ISF donations, or voluntary re-operation of reservoirs for releases for environmental or recreational needs.

Table 3-1 Summary of Meetings to Collect Nonconsumptive Project and Methods Information

Basin Roundtable	No. of Individuals or Organizations Contacted	No. of Meetings	No. Projects and Methods in Focus Areas	No. Projects and Methods Outside Focus Areas	Total No. Projects and Methods
Arkansas	7	5	40	0	40
Colorado	21	12	168	35	203
Gunnison	**9**	**4**	**44**	**15**	**59**
Metro	See South Platte	See South Platte	See South Platte	See South Platte	See South Platte
North Platte	1	1	41	7	48
Rio Grande	10	5	59	0	59
South Platte	17	14	54	53	107
Southwest	17	12	84	10	94
Yampa-White	9	4	22	16	38
TOTAL	91	57	512	136	648

In addition, there is a great deal of information gathered from divisions within the Colorado Department of Natural Resources (DNR) that have been integrated into the projects and methods database. For instance, **Table 3-2** summarizes CWCB's ISFs for each basin roundtable. Decreed ISFs have been confirmed by the water court. Pending ISFs have been approved by the CWCB Board and are going through the water court process. Recommended ISFs include those areas submitted to CWCB as a recommendation, but not yet approved by the CWCB Board at this time.

Table 3-2 Summary of CWCB Instream Flows and Natural Lake Levels

Basin Roundtable	Natural Lakes	ISF Decreed	Pending ISF	Recommended ISF
Arkansas	86	171	11	8
Colorado	150	404	12	6
Gunnison	**82**	**259**	**15**	**2**
Metro	0	24	0	0
North Platte	31	45	1	3
Rio Grande	49	141	0	0
South Platte	31	208	2	2
Southwest	50	151	4	6
Yampa-White	150	175	7	5
TOTAL	**494**	**1,578**	**52**	**32**

The CWCB's Watershed Protection and Flood Mitigation section oversees the agency's watershed restoration efforts. In addition, many of the Water Supply Reserve Account (WSRA) grants fully or partially address nonconsumptive needs. **Table 3-3** shows the funding programs implemented by CWCB and project type associated with each program. The table shows the status of the projects; pending in this case means that either the contract has not yet been signed, but has CWCB approval, or that applicants have applied, but are not yet approved by the CWCB.

Table 3-3 Summary of CWCB's Watershed Restoration and Nonconsumptive WSRA Projects

Funding Source	Type	Complete	On-going	Pending	Total
Colorado Healthy Rivers Fund	Report	19	9	3	31
Colorado Healthy Rivers Fund	Restoration Project	15	7	6	28
Colorado Watershed Restoration Program	Report	1	3	0	4
Colorado Watershed Restoration Program	Restoration Project	2	9	1	12
Fish and Wildlife Resources Fund	Restoration Project	2	2	0	4
Multi-Objective Watershed Protection Plan	Report	5	0	1	6
Multi-Objective Watershed Protection Plan	Restoration Project	6	0	4	10
WSRA Nonconsumptive Related Grants	Report	8	15	3	26
WSRA Nonconsumptive Related Grants	Restoration Project	13	12	4	29
TOTAL		**71**	**57**	**22**	**150**
Total Restoration Projects	**Restoration Project**	**38**	**30**	**15**	**83**
Total Reports	**Report**	**33**	**27**	**7**	**67**
TOTAL CWCB Dollars Spent/Encumbered		$14,499,625			
TOTAL Estimated Match Dollars		$34,323,697			
TOTAL Approximate Expenditures		**$ 48,823,322**			

Finally, CWCB included the Southwest Regional Gap Analysis Project (SRGAP), coordinated by U.S. Geological Survey (USGS) into the projects and methods database. The SRGAP created detailed, seamless GIS data layers of land cover, all native terrestrial vertebrate species, land stewardship, and management status values. The management status values quantify the relationship between land management and biodiversity throughout the State of Colorado. Four management status values are as described below:

- Status 4 lands are where there are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.
- Status 3 lands comprise areas having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally-listed endangered and threatened species throughout the area.
- Status 2 lands are areas having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
- Status 1 lands include areas having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

For this effort, CWCB include areas with a status between 1 and 2.5 as a project and method in the nonconsumptive projects database.

3.6 Colorado Division of Wildlife Gunnison River Basin Priorities

In addition to CWCB's efforts, the CDOW is mandated by statute to manage the state's fishery and wildlife resources for the benefit of the citizens and visitors to the State of Colorado. The CDOW Aquatic Section takes the lead for fishery management for the agency, and to this end has mapped every waterbody, stream or river segment in Colorado and associated a water management classification relating back to fishery objectives for that waterbody. The CDOW has participated in the basin roundtable processes throughout the state in order to provide data and information on basin fisheries, indicate fishery management priorities, and also to communicate where the most significant threats are currently located. CDOW recognizes that human uses of water will often conflict directly or indirectly with the ability to manage fisheries to meet these objectives. CDOW anticipates that as water resources are more intensively managed in the future, that pre-emptive coordination between water developers and conservation interests can minimize and in some cases improve their ability to meet fishery objectives in Colorado.

As has been recognized elsewhere in this document and others, the fisheries in Colorado are nationally renowned; as such, the economy of many headwater communities, especially in the Gunnison River Basin, are substantially enhanced by the health and viability of the aquatic community. Blue Mesa Reservoir is also nationally recognized as a multi-faceted recreational resource, and the fall Kokanee salmon run from Blue Mesa up the Gunnison and East Rivers is annual event, resulting in spawn take from the hatchery at Roaring Judy that is the state's largest egg source for rearing fingerlings to stock the following summer. The Gunnison Gorge below Crystal Reservoir is an internationally renowned Gold Medal fishery, famous for large wild trout in a spectacular canyon setting. Still lower in the basin, the Gunnison River from Delta to the confluence with the Colorado River is 'Critical Habitat' listed under the Endangered Species Act, necessary to support endangered populations of Colorado pikeminnow and razorback sucker inhabiting this reach. Managing recreational, listed, and nonlisted conservation species (e.g., Colorado River cutthroat trout, roundtail chub) are the primary goals for the Aquatic Section staff, and include a substantial commitment to raising fish in hatcheries for recreational and conservation purposes. Included below is a bulleted list of tasks that fishery managers and staff routinely undertake to manage fisheries:

- Monitoring of fisheries for population estimates, measures of 'quality' (e.g., Gold Medal Waters), and species composition;
- Growth and stocking of recreational and conservation cold- and warm-water species;
- Aquatic nuisance species monitoring and control (e.g., quagga and zebra mussels; virile crayfish; non-native predatory fish);
- Fishery regulatory review and implementation (i.e., establishment of and updates to fishery bag and possession limits);
- Participation in Federal Endangered Fish Recovery Programs;
- Serving as the CWCB's 'biological consultants' for instream flow appropriations;
- Aquatic pathogen and water quality contamination research, response, and spill investigation;

- Work with local communities and stakeholder groups to implement local projects, such as removing migration barriers (or in the case of native cutthroat trout, installing migration barriers to stratify native and non-native populations of trout) or stream habitat improvement projects;
- Formal regulatory processes governed by state or federal statute (county 1041 consultation, National Environmental Policy Act, U.S. Army Corps of Engineers Section 404 permitting; Water Quality Control Commission hearings);
- Participation as official liaisons to the basin roundtable processes.

The CDOW is aware of the inherent conflict between additional development of water resources and its mandate to manage fishery resources for the people of Colorado and its visitors. However, there are also many examples of a beneficial synergy between fishery management objectives and water development, such as below certain dams where enhanced tailwater fisheries develop with augmented summer and fall streamflows; the benefits of certain agricultural practices that divert a relatively small portion of the high volume flows that return slowly through fields and alluvial aquifers to supplement streamflow later in the year; or flow management agreements with water providers that meet multiple objectives. As noted, CDOW is continually engaged in projects and processes that are intended to meet non-consumptive environmental needs, specifically, the management of fisheries statewide. Itemizing only specific projects CDOW is working on at the time of this publication may create a misunderstanding about the direct role CDOW continually plays preserving and protecting non-consumptive environmental attributes.

Following are the CDOW's Gunnison River Basin Priorities:

Blue Mesa Reservoir Fishery Management – Blue Mesa attracts visitors from around the country for a high-elevation reservoir fishing experience, famous for kokanee salmon and large lake trout. Balancing the fishery at Blue Mesa Reservoir for the benefit of resident and nonresident anglers is the goal of the CDOW. The reservoir is managed first and foremost for kokanee salmon, but is also managed for rainbow, brown, and lake trout. Currently, CDOW is working balance the sustainability of the kokanee population and spawn run to the Roaring Judy State Fish Unit with the desire to maintain a healthy lake trout fishery. Over the last decade, the population of lake trout has grown substantially while kokanee has plummeted due to heavy predation on young salmon. Lake trout population growth has reduced the viability of the salmon run to near critical thresholds such that the CDOW has implemented increased 'slot' bag limits for lake trout in order to reduce the numbers of juvenile and younger adults, and annual culling goals to restore better balance between these important fish. In addition, the illegal introduction of yellow perch, another predacious sport fish, is complicating the management of Blue Mesa fisheries. CDOW and their Blue Mesa partners have also had to mount an aggressive Aquatic Nuisance Species abatement, mitigation, and education campaign in order to prevent this non-native mollusk from invading Blue Mesa waters.

Taylor River Operations Agreement – The Taylor River remains a high-value coldwater trout fishery from the tailwater below Taylor Park Reservoir to its confluence with the East River. Unique instream flow decrees (W-1991 and 87CW264) protect both late summer baseflows, winter flows, and flushing flows. CDOW also participates in the annual operations meetings that outline how Taylor Park first and second fills will be operated to provide maximum benefit to the beneficiaries, which include the trout fishery in this reach of the stream. CDOW supports continuing these management protocols, and appreciates the long-term partnerships that have developed between the operators, water users, and recreational interests in the upper basin.

Boreal Toad Management – Certain tributary watersheds above Taylor Park Reservoir contain isolated populations of breeding boreal toads, a State listed endangered species. CDOW wrote the first conservation

plan for this species in 1994 and continues to update this plan, monitor populations of boreal toads, and conduct research on the boreal toad and the pathogens that affect it.

Gunnison Gorge/ Black Canyon of the Gunnison Trout Fishery – As noted above, this Gold Medal reach of the Gunnison River from below Crystal Dam, through the Black Canyon of the Gunnison National Park and on through the Gunnison Gorge National Recreation Area continues to be a high priority for CDOW fishery managers. Over the last few years, the BOR's Aspinall Project (Blue Mesa, Morrow Point, and Crystal Reservoir) has been involved in a re-operations management plan EIS to meet a number of needs related to water rights and endangered species protections for federally listed native species in the lower Gunnison. CDOW helped the BOR design a flow management plan that will preserve this significant trout fishery and the physical processes that support it.

Colorado River Cutthroat –Trout Many headwater tributaries of the Upper Gunnison River and Uncompahgre River contain native populations of cutthroat trout. In nearly every case, the CDOW is actively pursuing preservation and in many cases, expansion and protection of these rare fish (state-listed Species of Concern). These activities include working with: 1) federal land managers to protect riparian processes; 2) industry and private entities to prevent dewatering, sedimentation, and water quality degradation and in some cases in the Uncompahgre, remediate prior metals contamination; and 3) conservation groups and other fishery managers to prevent hybridization with nonnative fish and to expand populations to increase genetic resiliency.

Native Warm Water Species Conservation – The roundtail chub, flannelmouth sucker, and bluehead sucker are not listed under the Endangered Species Act, but these fish are the topic of a Six-State Conservation Agreement (Utah, Wyoming, New Mexico, Arizona, Nevada, and Colorado) also signed by several federal agencies (BOR, USFS, BLM). The '3 Species Conservation Agreement' articulates the need to develop specific regional strategies to protect and preserve these species against the combined threats of non-native competition and predation, hydrologic alteration, and habitat fragmentation. CDOW is actively engaged in drafting of a three-species conservation strategy for Colorado, monitoring for population status and trends, and conducting research on inter-species effects and critical life-stage requirements.

3.7 CWCB Nonconsumptive Projects and Methods GIS Mapping and Analysis Methodology and Results

The project and method information collected by CWCB, as described in Section 3.2, was spatially digitized in GIS. Each project was digitized separately using an existing stream database called National Hydrography Dataset (NHD) 12-digit segments. The average length of a NHD segment is 1.5 miles. Depending on the length of the project, multiple NHD segments could represent one project. Also, depending on the project location, multiple projects could exist on the same NHD segment. A unique Project Identification and Segment Identification were given to all surveyed and interviewed projects within the Nonconsumptive Needs Assessment database. In addition, the WSRA grant project locations were digitized in a similar fashion. The CWCB ISFs and natural lake levels, CWCB restoration projects, and the USGS SRGAP information had previously been summarized using GIS; therefore, this data did not have to be digitized. The USGS SRGAP information was analyzed further to calculate a weighted management status value for each NHD segment. This value was calculated in GIS for each NHD 12-digit Hydrologic Unit Code (HUC) by a weighted average of each land management status within the HUC.

Following are the assumptions used in digitizing the nonconsumptive projects and methods:

- No NHD segment was edited (i.e., if the project was smaller than an NHD segment, the whole NHD segment was used to represent the project location).

- Projects were digitized based on hand-drawn locations and/or brief descriptions. This information is still under review by the basin roundtables.

Following are the types of information included in the GIS geodatabase for each project:

- Project or Method Name
- Project or Method Type (i.e., study, flow protection, or restoration project)
- Project or Method Location
- Comments
- Project or Method Status (i.e., ongoing, planned, or completed)
- Project or Method Identification Number
- Project or Method Contact Name
- Project or Method Contact Identification Number

Figure 3-2 is a summary of the projects and methods developed to date by CWCB and represents the spatial information for all nonconsumptive projects and methods that are planned, ongoing, or completed in the Gunnison Basin. This map contains all nonconsumptive projects and methods including—1) CWCB interviews and workshops, 2) CWCB watershed restoration projects, 3) WSRA grants, 4) ISFs, 5) USGS SRGAP information, and 6) CDOW projects. This map includes projects and methods inside the designated focus areas to spatially display the full extent of any project collected by CWCB. This information is also summarized in **Table 3-4** at the end of this section. This table summarizes the project name, location, type, and status. In addition, it summarizes the attributes located within the project boundary and also summarizes information about the type of protections the project provides as defined below.

In addition to identifying the spatial extent and status of the identified projects and methods, CWCB also examined what type of protection the project or method may provide to a given environmental or recreational attribute. CWCB has classified the projects as having direct or indirect protections based on a given environmental or recreational attribute. The definitions used for direct and indirect protections are as follows:

- **Direct Protection** – Projects and methods with components designed intentionally to improve a specific attribute. For example, ISFs have direct protection of fish attributes. Additionally, restoration of a stream channel would also provide direct protections for aquatic species.

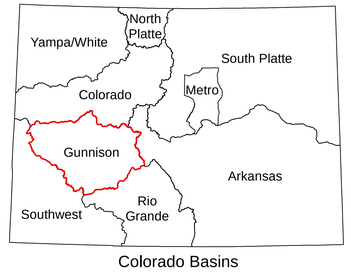
- **Indirect Protection** – Projects and methods with components that were not designed to directly improve the specific attribute but may still provide protection. For example, flow protection for a fish species may also indirectly protect riparian vegetation that is located in the area of the flow protection. Another example includes protective land stewardship or a wetland or bank stabilization effort that could indirectly protect aquatic species.

Legend

- River and Stream
- Lake and Reservoir
- City and Town
- Road
- County Boundary
- Basin

Projects

- CDOW
- CWCB
- ISF
- Stewardship
- WSRA



Colorado Basins

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Miles

Figure 3-2
Gunnison Basin
Nonconsumptive Needs Assessment
Focus Areas with
Projects and Methods

\\denjisvr1\cdmGIS\SW\NONCONSUMPTIVE\GUNNISON\MXD\Basin_Projects_Gunnison.mxd

The projects and methods identified through interviews were individually evaluated and compared to the environmental and recreational attributes gathered by the basin roundtables during their focus area mapping effort. This information is included in Table 3-4. CWCB examined the various attributes summarized by the roundtables in their focus area mapping efforts (Section 2) and indentified if these areas have projects and methods that provide direct or indirect protections. The interviewed projects and methods, instream flows, and stewardship information were assigned direct or indirect protections based on roundtable attribute. In the Gunnison Basin, the basin roundtable identified 1,700 miles of water bodies as focus areas. For these focus areas, 80 percent have an associated project or method. **Table 3-5** summarizes the project and method protections identified for the Gunnison Basin. In the attribute column of Table 3-5, the environmental and recreational attributes collected by the basin roundtable are summarized. The recreation attribute category includes attributes from whitewater and flatwater boating. The Warm Water Fish State Endangered, Threatened and Species of Special Concern category includes Flannelmouth Sucker, Bluehead Sucker and Roundtail Chub. Important Riparian and Wetland Areas category includes significant riparian areas, Audubon important bird areas, and rare plant communities. Finally, the fishing attribute category includes streams and identified lakes as fishing areas.

Table 3-5 Summary of Protections for Gunnison Basin Environmental and Recreational Attributes

Attribute Category	Percent of Attribute Length with Direct Protections	Percent of Attribute Length with Indirect Protections	Percent of Attribute Length with Direct and Indirect Protections	Total Percent of Attribute Length with Protections
Recreation	0%	0%	0%	0%
Colorado River Cutthroat Trout	10%	32%	58%	100%
Warm Water Fish State Endangered, Threatened and Species of Special Concern	12%	5%	51%	68%
Important Riparian and Wetland Areas	0%	72%	0%	72%
Waterfowl Viewing/Hunting	0%	0%	0%	0%
Federally Listed Fish Species	0%	6%	2%	8%

Table 3-4 Gunnison Basin Nonconsumptive Projects and Methods Summary

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
Gunnison and Colorado Rivers		Flow Protection	Completed	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, Colorado River Cutthroat Trout , CWCB instream flow water rights, CWCB natural lake level water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Geomorph_F, Gold Metal Trout Streams, Humpback Chub, Rafting/kayaking/flatwater reaches, Razorback Sucker, Rec_Boatin, Riparian/Wetlands, RipWet_Eco, Roundtail Chub, Significant Riparian/Wetland Communities, Water_Qual	Bluehead Sucker-D, Colorado Pikeminnow -D, Flannelmouth Sucker -D, Humpback Chub-D, Razorback Sucker-D, Roundtail Chub-D, Significant Plant Communities-I	4, 6, 9, 10, 11, 12, 13, 14, 16, 65
Coal Creek	Coal Creek Watershed Restoration Plan	Information	Planned	CWCB natural lake level water rights, Rare Aquatic-dependent plants, Significant Riparian/Wetland Communities		8
Coal Creek	Research natural area for rare fens and plants	Information	Ongoing	CWCB natural lake level water rights, Rare Aquatic-dependent plants, Significant Riparian/Wetland Communities		8
Coal Creek	Standard Superfund Site	Project	Ongoing	CWCB natural lake level water rights, Rare Aquatic-dependent plants, Significant Riparian/Wetland Communities		8
Colorado River Near the mouth of the Gunnison River	Upper Colorado Endangered Fish Program - 10825 Water Supply	Flow Protection	Planned	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Humpback Chub, Rafting/kayaking/flatwater reaches, Razorback Sucker, Riparian/Wetlands, Roundtail Chub, Water_Qual	Colorado Pikeminnow -D, Humpback Chub-D, Razorback Sucker-D	14, 65
Curecanti NRA - Aspinal Unit	Instream Flows Black Canyon	Flow Protection	Completed	Bluehead Sucker, Flannelmouth Sucker, Flatwater Boating, High Recreation Lakes and Reservoirs, High Recreation Rivers, Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-D, Flannelmouth Sucker -D, GMUG Wilderness Area Waters -D, Reservoir and Lake Fishing -D, Roundtail Chub-D	1
Dillon Reservoir	Dillon Reservoir Denver Water Minimum Releases	Flow Protection	Completed	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Humpback Chub, Rafting/kayaking/flatwater reaches, Razorback Sucker, Riparian/Wetlands, Roundtail Chub, Water_Qual	Bluehead Sucker-D, Boreal Toad -D, Colorado River Cutthroat Trout -D, CWCB Instream Flow Water Rights-D, Flannelmouth Sucker -D, Flatwater Boating -D, Other Fishing Streams and Lakes-D, Rafting / Kayaking / Flatwater Reaches-D, Recreational In-Channel Diversion Structures-D, River Otter-D, Roundtail Chub-D	14, 65
Big Dominguez Creek	Planned native fish population restoration project	Project	Planned	Bluehead Sucker, CWCB natural lake level water rights, Flannelmouth Sucker, GMUG Wilderness Area Waters , Northern Leopard Frog , Rare Aquatic-dependent plants, Significant Riparian/Wetland Communities	Bluehead Sucker-D, Flannelmouth Sucker -D, Humpback Chub-D, Roundtail Chub-D	7
Gunnison and Colorado Rivers	Recommended Minimum flows along the Gunnison and Colorado Rivers	Information	Completed	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, Colorado River Cutthroat Trout , CWCB instream flow water rights, CWCB natural lake level water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Geomorph_F, Gold Metal Trout Streams, Humpback Chub, Rafting/kayaking/flatwater reaches, Razorback Sucker, Rec_Boatin, Riparian/Wetlands, RipWet_Eco, Roundtail Chub, Significant Riparian/Wetland Communities, Water_Qual		4, 6, 9, 10, 11, 12, 13, 14, 16, 65
Gunnison River - 15 Mile Reach	15 Mile Reach Programmatic Biological Opinion	Flow Protection	Ongoing	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Humpback Chub, Rafting/kayaking/flatwater reaches, Razorback Sucker, Riparian/Wetlands, Roundtail Chub, Water_Qual	Colorado Pikeminnow -D, Humpback Chub-D, Rare Plants-I, Razorback Sucker-D, Significant Plant Communities-I	14, 65
Gunnison River - confluence with North Fork to Hartland diversion	Hartland diversion project will increase fish passage	Project	Planned	Audubon important bird areas, Bluehead Sucker, Federally Listed Critical Habitat, Flannelmouth Sucker, Gold Metal Trout Streams, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Razorback Sucker, Humpback Chub, Colorado Pikeminnow, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -D, Federally Listed Critical Habitat-D, Flannelmouth Sucker -D, Humpback Chub-D, Razorback Sucker-D, Roundtail Chub-D	4, 5

Table 3-4 Gunnison Basin Nonconsumptive Projects and Methods Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
Gunnison River - confluence with North Fork to Hartland diversion	Planned Selenium Management Plan	Flow Protection	Planned	Audubon important bird areas, Bluehead Sucker, Federally Listed Critical Habitat, Flannelmouth Sucker, Gold Metal Trout Streams, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Razorback Sucker, Humpback Chub, Colorado Pikeminnow, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-I, Flannelmouth Sucker -I, Humpback Chub-I, Roundtail Chub-I	4, 5
Deep Creek	Rebuilding diversion structure and fish screen for benefit of Colo CTT	Project	Ongoing	GMUG Wilderness Area Waters , WQCD Outstanding Waters	Bluehead Sucker-D	7
Chavez Creek	Culvert replacement work for fish passage	Project	Completed	Colorado River Cutthroat Trout , CWCB natural lake level water rights, Significant Riparian/Wetland Communities, WQCD Outstanding Waters	Bluehead Sucker-D	7
Gunnison river in Black Canyon National Park	National Park Service water rights utilized to preserve ecological values in park	Flow Protection	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Eligible Wild and Scenic, Flannelmouth Sucker, Flatwater Boating, Gold Metal Trout Streams, High Recreation Lakes and Reservoirs, High Recreation Rivers, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -D, Colorado River Cutthroat Trout -D, Ducks Unlimited Projects-D, Federally Listed Critical Habitat-D, Flannelmouth Sucker -D, GMUG Wilderness Area Waters -D, Humpback Chub-D, Razorback Sucker-D, Roundtail Chub-D	1, 2
Tributaries to Taylor Park Reservoir	Wilderness designation	Flow Protection	Ongoing	Boreal Toad, CWCB natural lake level water rights, High Recreation Rivers, Rare Aquatic-dependent plants, River and stream fishing, Significant Riparian/Wetland Communities	Ducks Unlimited Projects-I, GMUG Wilderness Area Waters -I, Rare Plants-D	14
Ouray Headwaters	Abandoned mined land inventory program - planned	Information	Planned	Audubon important bird areas, Rare Aquatic-dependent plants, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting		11
Pauline Creek	Culvert replacement work for fish passage	Project	Completed	CWCB natural lake level water rights, GMUG Wilderness Area Waters , Significant Riparian/Wetland Communities, WQCD Outstanding Waters		7
Perfecto Creek	Culvert replacement work for fish passage	Project	Completed	CWCB natural lake level water rights, Significant Riparian/Wetland Communities, WQCD Outstanding Waters		7
Ridgway Reservoir	Tri-County Water Conservancy District manages reservoir levels and releases for recreation and environmentl flows	Flow Protection	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Flatwater Boating, Northern Leopard Frog , Rafting/kayaking, Reservoir and Lake Fishing, River and stream fishing, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-D, High Recreation Lakes and Reservoirs -D, Reservoir and Lake Fishing -D, River Otter-D, Roundtail Chub-D	12
Stream Segments on Headwaters Wilderness	Wilderness designation	Flow Protection	Ongoing	Bluehead Sucker, Boreal Toad, Camelback/Roubideau Wilderness Study Area Waters, Colorado River Cutthroat Trout , CWCB natural lake level water rights, GMUG Wilderness Area Waters , High Recreation Rivers, Kayaking, Northern Leopard Frog , Rare Aquatic-dependent plants, River and stream fishing, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting, WQCD Outstanding Waters	Camelback/Roubideau Wilderness Study Area Waters-I, Ducks Unlimited Projects-I, Flatwater Boating -I, GMUG Wilderness Area Waters -I, Rare Plants-D, Whitewater Boating OR Rafting-I	7, 8, 10, 14, 21
Taylor Park Reservoir	4 party agreement controlling lake levels and stream flows - benefits fish and wildlife habitat and boating recreation	Flow Protection	Ongoing	Flatwater Boating, High Recreation Lakes and Reservoirs, High Recreation Rivers, Reservoir and Lake Fishing, Wildlife Viewing and Waterfowl hunting	High Recreation Lakes and Reservoirs -D, Other Fishing Streams and Lakes-D, River Otter-D	15
Gunnison River - Hartland Diversion to Colorado confluence	Planned Selenium Management Plan	Flow Protection	Planned	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Humpback Chub, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Razorback Sucker, Razorback Sucker, Humpback Chub, Colorado Pikeminnow, Riparian/Wetlands, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -I, Colorado River Cutthroat Trout -I, Ducks Unlimited Projects-I, Federally Listed Critical Habitat-I, Flannelmouth Sucker -I, GMUG Wilderness Area Waters -I, Humpback Chub-I, Razorback Sucker-I, Roundtail Chub-I	4, 65
Tributaries to Taylor Park Reservoir	Fen inventory and assessment	Information	Planned	Boreal Toad, CWCB natural lake level water rights, High Recreation Rivers, Rare Aquatic-dependent plants, River and stream fishing, Significant Riparian/Wetland Communities		14
North Fork of the Gunnison -- Paonia Dam to the confluence with the Gunnison	NFRIA Water quality Monitoring	Information	Ongoing	Bluehead Sucker, Flannelmouth Sucker, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, River and stream fishing, River Otter Sightings, Roundtail Chub, Wildlife Viewing and Waterfowl hunting		6

Table 3-4 Gunnison Basin Nonconsumptive Projects and Methods Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
Uncompaghre River and tributaries	Uncompaghre Watershed Planning Partnership - planned process to develop remediation plans	Project	Planned	Audubon important bird areas, Bald Eagle Sites, Bluehead Sucker, CWCB natural lake level water rights, Flatwater Boating, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-I, River Otter-D, Roundtail Chub-I	11, 12
Washington Gulch	Washington Gulch stream rehabilitation	Project	Ongoing	CWCB natural lake level water rights		8
West Brush Creek	Managing for boreal toad breeding ponds	Project	Ongoing	Boreal Toad, CWCB natural lake level water rights, GMUG Wilderness Area Waters , WQCD Outstanding Waters	Rare Plants-D	7
Willow Creek	instream flow assessment studies ongoing	Information	Ongoing	CWCB natural lake level water rights, High Recreation Rivers, Rare Aquatic-dependent plants, River and stream fishing		14
Taylor River	15 yr Flow Management Project Taylor River	Project	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Flannelmouth Sucker, High Recreation Rivers, Rafting/kayaking, Rare Aquatic-dependent plants, recreational in-channel diversion structures, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-D, GMUG Wilderness Area Waters -D, Reservoir and Lake Fishing -D	1, 16, 17
Gunnison river in Black Canyon National Park	Wilderness Designation	Flow Protection	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Eligible Wild and Scenic, Flannelmouth Sucker, Flatwater Boating, Gold Metal Trout Streams, High Recreation Lakes and Reservoirs, High Recreation Rivers, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -I, Colorado River Cutthroat Trout -I, Ducks Unlimited Projects-I, Federally Listed Critical Habitat-I, Flannelmouth Sucker -I, GMUG Wilderness Area Waters -I, Humpback Chub-I, Razorback Sucker-I, Roundtail Chub-I	1, 2
Gunnison River in Gunnison Gorge National Conservation Area to confluence with North Fork of Gunnison	Releases from Crystal Dam designed to protect values of Black Canyon	Flow Protection	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Eligible Wild and Scenic, Flannelmouth Sucker, Gold Metal Trout Streams, High Recreation Rivers, Northern Leopard Frog , Rafting/kayaking, River Otter Sightings, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -D, Colorado River Cutthroat Trout -D, Ducks Unlimited Projects-D, Federally Listed Critical Habitat-D, Flannelmouth Sucker -D, GMUG Wilderness Area Waters -D, Humpback Chub-D, Razorback Sucker-D, Roundtail Chub-D	2, 3
Gunnison River in Gunnison Gorge National Conservation Area to confluence with North Fork of Gunnison	Wilderness Designation	Flow Protection	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Eligible Wild and Scenic, Flannelmouth Sucker, Gold Metal Trout Streams, High Recreation Rivers, Northern Leopard Frog , Rafting/kayaking, River Otter Sightings, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -I, Colorado River Cutthroat Trout -I, Ducks Unlimited Projects-I, Federally Listed Critical Habitat-I, Flannelmouth Sucker -I, GMUG Wilderness Area Waters -I, Humpback Chub-I, Razorback Sucker-I, Roundtail Chub-I	2, 3
Gunnison River near confluence with Colorado River	Recommended Minimum flows for Gunnison River at the Confluence with the Colorado River	Information	Completed	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Humpback Chub, Razorback Sucker, Riparian/Wetlands, Roundtail Chub		4, 65
Henson Creek and tributaries	Planned mining remediation	Project	Planned	CWCB natural lake level water rights, Flannelmouth Sucker, GMUG Wilderness Area Waters , Kayaking, Rare Aquatic-dependent plants, Significant Riparian/Wetland Communities, WQCD Outstanding Waters	Camelback/Roubideau Wilderness Study Area Waters-I, Whitewater Boating OR Rafting-I	7, 10
Lake Fork -- Lake San Cristobal to confluence with the Gunnison	HCCA Project	Project	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Flannelmouth Sucker, High Recreation Lakes and Reservoirs, Kayaking, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting		18, 19
Lake Fork of the Gunnison	Lake Fork Trail Stair Project	Project	Planned	CWCB natural lake level water rights, Flannelmouth Sucker, Rafting/kayaking, River and stream fishing, Wildlife Viewing and Waterfowl hunting		19
Oh-Be-Joyful Creek	Bank Stabilization and fish habitat improvement	Project	Ongoing	CWCB natural lake level water rights, GMUG Wilderness Area Waters , Kayaking, Rare Aquatic-dependent plants, River and stream fishing, Significant Riparian/Wetland Communities, WQCD Outstanding Waters	Camelback/Roubideau Wilderness Study Area Waters-I, Ducks Unlimited Projects-D, Whitewater Boating OR Rafting-I	7, 8
North Fork of the Gunnison -- Paonia Dam to the confluence with the Gunnison	Paonia Reservior Siltation study	Information	Ongoing	Bluehead Sucker, Flannelmouth Sucker, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, River and stream fishing, River Otter Sightings, Roundtail Chub, Wildlife Viewing and Waterfowl hunting		6

Table 3-4 Gunnison Basin Nonconsumptive Projects and Methods Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
North Fork Gunnison River - Paonia Dam to confluence with Gunnison	North Fork River Improvement Association actively working to improve habitat	Project	Ongoing	Bluehead Sucker, CWCB natural lake level water rights, Flannelmouth Sucker, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting		6
North Fork of Gunnison	North Fork Rehabilitation	Project	Completed	Bluehead Sucker, CWCB natural lake level water rights, Flannelmouth Sucker, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Flannelmouth Sucker -I, Humpback Chub-I, Roundtail Chub-I, Waterfowl Hunting / Viewing-I	6
North Fork of the Gunnison -- Paonia Dam to the confluence with the Gunnison	Gunnison Basin Selenium task Force	Project	Ongoing	Bluehead Sucker, Flannelmouth Sucker, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, River and stream fishing, River Otter Sightings, Roundtail Chub, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-I, Flannelmouth Sucker -I, Humpback Chub-I, Roundtail Chub-I	6
Lake San Cristobal	Intergovernmental Agreement coordinating outlet to control lake level and stream flows in Lake Fork - benefits trout ponds and instream flows	Flow Protection	Ongoing	CWCB natural lake level water rights, High Recreation Lakes and Reservoirs, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, Significant Riparian/Wetland Communities	Other Fishing Streams and Lakes-D	18
	CWCB ISF Proposals for Dominguez Canyon Wilderness area & NCA	Flow Protection	Completed	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, CWCB natural lake level water rights, Eligible Wild and Scenic, Federally Listed Critical Habitat, Flannelmouth Sucker, Flatwater Boating, Gold Metal Trout Streams, High Recreation Lakes and Reservoirs, High Recreation Rivers, Humpback Chub, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Razorback Sucker, Razorback Sucker, Humpback Chub, Colorado Pikeminnow, Reservoir and Lake Fishing, Riparian/Wetlands, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting		1, 2, 3, 4, 5, 65
	Gunnison Basin Selenium task Force	Project	Ongoing	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, CWCB natural lake level water rights, Eligible Wild and Scenic, Federally Listed Critical Habitat, Flannelmouth Sucker, Flatwater Boating, Gold Metal Trout Streams, High Recreation Lakes and Reservoirs, High Recreation Rivers, Humpback Chub, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Razorback Sucker, Razorback Sucker, Humpback Chub, Colorado Pikeminnow, Reservoir and Lake Fishing, Riparian/Wetlands, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Audubon Important Bird Areas-I, Colorado Pikeminnow -I, Colorado River Cutthroat Trout -I, Ducks Unlimited Projects-I, Federally Listed Critical Habitat-I, Flannelmouth Sucker -I, Humpback Chub-I, Razorback Sucker-I, Roundtail Chub-I, Waterfowl Hunting / Viewing-I	1, 2, 3, 4, 5, 65
"Blue Mesa, Morrow Point, Crystal Reservoirs and Gunnison River from Blue Mesa to Colorado confluence"	Gunnison River Basin Final Programmatic Biological Opinion	Flow Protection	Completed	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, CWCB natural lake level water rights, Eligible Wild and Scenic, Federally Listed Critical Habitat, Flannelmouth Sucker, Flatwater Boating, Gold Metal Trout Streams, High Recreation Lakes and Reservoirs, High Recreation Rivers, Humpback Chub, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Razorback Sucker, Razorback Sucker, Humpback Chub, Colorado Pikeminnow, Reservoir and Lake Fishing, Riparian/Wetlands, River and stream fishing, River Otter Sightings, Roundtail Chub, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Colorado Pikeminnow -D, Colorado River Cutthroat Trout -D, Ducks Unlimited Projects-D, Federally Listed Critical Habitat-D, Flannelmouth Sucker -D, GMUG Wilderness Area Waters -D, Humpback Chub-D, Razorback Sucker-D, Roundtail Chub-D	1, 2, 3, 4, 5, 65
"Blue Mesa, Morrow Point, Crystal Reservoirs and Gunnison River from Blue Mesa to Colorado confluence"	"Managing Lake Trout populations of brown trout, rainbow trout and kokanee salmon"	Flow Protection	Ongoing	Bluehead Sucker, Flannelmouth Sucker, Flatwater Boating, High Recreation Lakes and Reservoirs, High Recreation Rivers, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Other Fishing Streams and Lakes-D	1

Table 3-4 Gunnison Basin Nonconsumptive Projects and Methods Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
0	SWSI Aquatic Wildlife Management Plan	Project	Planned	Aquatic_Ec, Audubon important bird areas, Bluehead Sucker, Bonytail Chub, Colorado Pikeminnow, CWCB instream flow water rights, Federally Listed Critical Habitat, Flannelmouth Sucker, Humpback Chub, Rafting/kayaking/flatwater reaches, Razorback Sucker, Riparian/Wetlands, Roundtail Chub, Significant Riparian/Wetland Communities, Water_Qual		14, 65
	SWSI Aspinall Unit Operations EIS	Flow Protection	Ongoing	Bluehead Sucker, Flannelmouth Sucker, High Recreation Rivers, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Ducks Unlimited Projects-D, Flannelmouth Sucker - D, Roundtail Chub-D	1
"Blue Mesa, Morrow Point, Crystal Reservoirs and Gunnison River from Blue Mesa to Colorado confluence"	Invasive species control program - quagga and zebra mussels	Project	Ongoing	Bluehead Sucker, Flannelmouth Sucker, Flatwater Boating, High Recreation Lakes and Reservoirs, High Recreation Rivers, Northern Leopard Frog , Rafting/kayaking, Rare Aquatic-dependent plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Wildlife Viewing and Waterfowl hunting	Other Fishing Streams and Lakes-D	1

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Section 4
Gunnison Basin Consumptive Needs Assessment

4.1 Overview of Consumptive Needs Assessment Process

Water in Colorado is managed to meet the needs of Colorado's citizens, agriculture, and environment. Colorado's economy, quality of life, recreational opportunities, and the environment are all dependent on water. The broad diversity of water uses in Colorado is indicative of the many ways in which we are affected by the water that is available to us and our environment, and how we choose to use it. Severe and continuing drought conditions throughout the state in the early 2000s in conjunction with rapid economic growth and concern over interstate compact obligations have brought focus to the constraints on our state's water resources and the challenges associated with meeting multiple objectives and needs.

The objectives of the consumptive needs part of this Gunnison Basin Needs Assessment Report is to:

- Update population projections and extend them to 2050
- Update municipal and industrial (M&I) per capita estimates including passive conservation
- Extend the Statewide Water Supply Initiative (SWSI) 1 consumptive water use projections to 2050 for the M&I sector
- Update the self-supplied industrial (SSI) sector forecast to 2050
- Update the current tally of irrigated acres throughout Colorado and forecast irrigated acres in 2050
- Update current agricultural demands and shortages
- Update the consumptive demand forecast to 2050 for the agricultural sector

The analyses summarized in this section use a water forecast horizon of 2050 for a number of reasons. The Colorado Water Conservation Board (CWCB) determined that the forecast horizon for the water demand projections needed to be extended to the year 2050 to better represent the long-term water needs that the state will face.

The following sections provide an overview of the methods used in determining reconnaissance level consumptive water use projections for 2050, and the results of those analyses. Sections 4.2.1 and 4.2.2 describe the methods and results of projecting M&I demands, including population forecasting, estimation of per capita water use, and the application of passive conservation measures. The methods used to estimate SSI demands, and the results thereof, are presented in Section 4.2.3. Section 4.2.4 summarizes the statewide results of the M&I and SSI demand projections. Section 4.3 summarizes the same for agricultural demands. Detailed descriptions of these methodologies and results are available in Appendices H and I of the SWSI 2010 Report.

4.2 M&I and SSI Consumptive Needs

Standard methods were used for projecting future M&I and SSI water demands in the Gunnison Basin. The objectives were to develop a reconnaissance level water use forecast that employs consistency in data collection and forecast methodology across the state and maximizes available data. The methods utilized in this approach are for the purpose of general statewide and basinwide planning and are not intended to replace demand projections prepared by local entities for project-specific purposes.

The M&I water demands forecast takes on a "driver multiplied by rate of use" approach. This is a commonly accepted forecast methodology that accounts for changes in water demand resulting from changes in the driver. County and statewide population projections are the most accepted predictor of future growth for the state. Therefore, the driver for the M&I water demands forecast is population and the rate of use is gallons per capita per day (gpcd).

4.2.1 Future Population Projections

Population projections were estimated using the forecasting process and models utilized by the Colorado State Demographer's Office (SDO). Because of the uncertainty in projecting economic conditions and employment levels in 2050, low, medium, and high scenario population projections were developed. A detailed analysis of the population projections is included in Appendix H of the SWSI 2010 Report.

4.2.1.1 2050 Population Projection Methodology

The first step in developing 2050 population projections was to identify a population forecasting methodology that could meet the needs of the 2050 water demand projections. To be suitable, the water demand projections would need to satisfy the following criteria:

- The forecasting methodology must be valid and widely acceptable, both by users of the results and demographic forecasting practitioners.
- The forecasting approach must be transparent and understandable to the extent possible.
- The projections must be replicable.
- In keeping with state-of-the-art practice employed by the SDO, the projections must be economically based and then linked to demographic factors in an integrated manner.
- The projections must be able to produce population forecasts for each county to the year 2050 under high, medium, and low economic development assumptions.

It was determined that the forecasting process and models utilized by the SDO, in conjunction with its consultant, the Center for Business and Economic Forecasting (CBEF), met all of those criteria. Therefore, the SDO forecasting process was adopted for the 2050 effort.

As of 2010, the SDO/CBEF projections are available through the year 2035. It was determined that the forecasting models, equations, and algorithms could be extended or adjusted as needed from 2035 to 2050. To adjust the models from 2035 to 2050 assumptions regarding national and international driving forces behind Colorado's basic economic sectors were developed.

Basic economic sectors include those activities that bring money and economic stimulus into a geographic area. Employment was projected for each of Colorado's basic economic sectors on the basis of the assumptions for the driving forces behind those basic sectors. With projections of basic employment, industry-specific employment multipliers were applied to arrive at total Colorado jobs.

Because of the uncertainty in projecting economic conditions and employment levels in 2050, low, medium, and high employment scenarios were developed for each key employment sector, leading to low, medium, and high population projections. Each of the scenarios reflects unique assumptions for the economy and for each employment sector. These assumptions are detailed in Appendix H of the SWSI 2010 Report. Additionally, populations for counties that lie within two or more basins were allocated to the respective basins based on estimates from known population centers within each basin.

4.2.1.2 2050 Population Projection Results

Between the years 2008 and 2050, the State of Colorado is projected to grow from approximately 5.1 million people to between 8.6 million and 10 million people. Under low economic development assumptions, state population is projected to grow to about 8.6 million people, or by about 71 percent. Under high economic development assumptions, including a 550,000 barrel per day oil shale industry, the state's population is projected to grow to just over 10 million people, or by 98 percent, as compared to Colorado's 2008 population. On average, statewide population projections from 2008 forward indicate an increase of about 1.4 million people every 15 years.

Table 4-1 shows how population growth will vary across the state during the next 40 years. Based on these projections, the Arkansas, Metro, and South Platte Basins will continue to have the largest population in the state. However, the West Slope will continue to grow at a faster rate than the Front Range of Colorado. **Figure 4-1** shows how population growth will vary throughout the Gunnison Basin at the county level. This figure includes the entire population of Mesa County as the Gunnison River is utilized by Grand Junction in meeting its M&I Demands. The Gunnison River Basin is projected to grow by about 2.1 times between 2008 and 2050, under the medium scenario, with Mesa and Montrose Counties being the most populous in that region. Household basic jobs will grow at the fastest rate of any basic sector and will remain the largest source of employment in the Gunnison Basin by 2050, followed by tourism and regional and national services. Other sectors will grow at slower rates, with decreased employment anticipated in the mining sector by 2050.

Table 4-1 Population Projections by River Basin

Basin	2008	2035	Percent Change 2008 to 2035	Percent Average Annual Growth Rate	2050			Percent Change 2008 to 2050	Percent Average Annual Growth Rate
					Low	Medium	High		
Arkansas	948,000	1,451,000	53	1.6	1,581,000	1,688,000	1,841,000	67-94	1.2-1.6
Colorado	307,000	558,000	82	2.2	661,000	725,000	832,000	115-171	1.8-2.4
Gunnison	**105,000**	**184,000**	**75**	**2.1**	**206,000**	**220,000**	**240,000**	**96-129**	**1.6-2.0**
Metro	2,513,000	3,622,000	44	1.4	4,018,000	4,144,000	4,534,000	60-80	1.1-1.4
North Platte	1,500	1,800	20	0.7	2,000	2,200	2,500	33-67	0.7-1.2
Rio Grande	50,000	68,000	36	1.2	74,000	80,000	87,000	48-74	0.9-1.3
South Platte	977,000	1,622,000	66	1.9	1,808,000	1,902,000	2,065,000	85-111	1.5-1.8
Southwest	105,000	185,000	76	2.1	204,000	224,000	249,000	94-137	1.6-2.1
Yampa-White	45,000	81,000	80	2.2	94,000	117,000	153,000	109-240	1.8-3.0
TOTAL	**5,051,500**	**7,772,800**	**54**	**1.6**	**8,648,000**	**9,102,200**	**10,000,000**	**71-98**	**1.3-1.6**

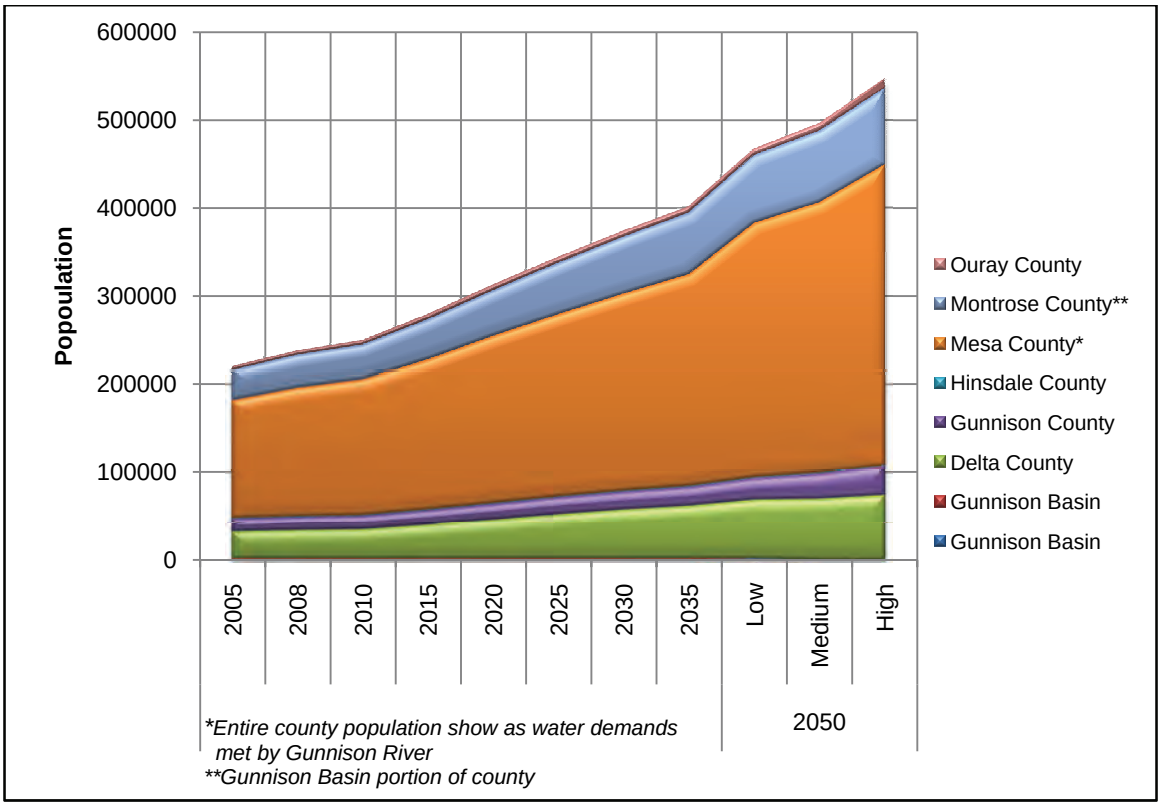

Figure 4-1 Gunnison Basin Population Projections through 2050

4.2.2 Future M&I Water Demands

The M&I demand forecast is aimed at capturing the water needs of an increased population. M&I demands are the water uses typical of municipal systems, including residential, commercial, light industrial, non-agricultural related irrigation, non-revenue water, and firefighting. For the current effort, the M&I demand forecast also captures households across the basin that are self-supplied and thus not connected to a public water supply system. **Table 4-2** contains the definitions of the M&I demand terms used throughout this report.

Table 4-2 Definition of M&I Demand Terms

Demand Terminology	Definition
M&I Demand	All the water uses of typical municipal systems, including residential, commercial, industrial, irrigation, and firefighting
SSI Demand	Large industrial water uses that have their own water supplies or lease raw water from others
M&I Demand and SSI Demand	The sum of M&I and SSI demand

The updated demands presented in this document include both baseline demands (without passive conservation) and baseline demands minus passive conservation. It is important to note that the M&I demand forecasts do not include potential increases in demand due to climate change or potential decreases in demand due to active conservation programs.

4.2.2.1 2050 M&I Water Demands Methodology

The methodology used for the M&I water demands forecast in this update is nearly identical to the methodology employed in SWSI 1. The method is based on a sample of water providers throughout the state as described in this section. The estimated per capita water use rates for each county were multiplied by the projected population of each county to estimate current and future municipal water demand (i.e., the residential, commercial, and industrial water use) of each county.

It is critical to note that the methods utilized in this approach are for the purpose of general basinwide and statewide planning and are not intended to replace demand projections prepared by local entities for project-specific purposes. County and statewide population projections are the most accepted predictor of future growth for the state. Therefore, it was determined the SWSI 1 methodology was most appropriate. The methodology employed is a commonly accepted forecast methodology for statewide water supply planning purposes, but is not appropriate for project-specific purposes or for direct comparisons between basins or counties.

Estimates of Per Capita M&I Water Use

The M&I water demands forecast is developed by multiplying the population projections outlined in Section 4.2.1 by a rate of use. The rate of use is systemwide gpcd. Numerous factors affect per capita water use rates, and through the course of SWSI 1 and the current SWSI 2010, differences in the water use components that are included or excluded from individual entities' per capita estimates clearly affected the resulting values. Per capita water use rates are in large part a function of:

- Number of households
- Persons per household
- Median household income
- Mean maximum temperature
- Total precipitation
- Total employment
- Ratio of irrigated public land areas (e.g., parks) to population in service area
- Mix of residential and commercial water use and types of commercial use
- Level of tourism and/or second homes
- Ratio of employment by sector (e.g., agriculture, commercial, industrial)
- Urban/rural nature of county

Provider water use and service population data were gathered from various sources and organized to create a database. The database built upon existing information from 254 water providers gathered for SWSI 1. Efforts were made to update the data for these providers as part of analyses completed in 2009 and 2010. The CWCB also worked with water providers and basin roundtables across the state through the first part of 2010 to collect additional data. Based on these efforts, updated per capita estimates were collected for 214 water providers covering 87 percent of the population in Colorado. A systemwide gpcd estimate was calculated for each participating local water provider by dividing the total water deliveries by the service area population.

Because 2050 population projects were developed at the county level, the systemwide gpcd values needed to be aggregated from the water provider level to the county level. A weighting process was applied to develop a county average systemwide gpcd based upon the portion of the county population serviced by each water provider. Once the county level M&I demand forecast was developed, basin level M&I water use rates were calculated for the nine basin roundtable areas. Basin M&I demands were aggregated from the county demands based on the portion of the county within the basin. For four counties (Cheyenne, Lake,

Saguache, and San Juan), no provider-level data were obtained. For these counties, the weighted basin average was assigned.

The population estimates developed for this update and the gpcd values determined through data collection are multiplied to estimate county demands. The population estimates represent permanent populations of each county; thus the water use rates are based on total water use divided by the permanent population. The resulting gpcd water use rates incorporate water used by tourists, students, and other transient populations in that the water used by the transient population is indexed to the permanent population along with the water use of the permanent population. The resulting gpcd also incorporates commercial and light industrial water use supplied by the water provider. For statewide planning purposes, this is a consistent approach to account for water use by transient populations, commercial, and light industry. Comparisons of gpcds between counties and basins should not be made directly, since differences in the amount of industry, tourism, and outdoor water use varies significantly between geographic regions.

Passive Water Conservation Savings

The methodology for the M&I water demands projections outlined above develops baseline water demand estimates. In addition, CWCB has updated the passive conservation analysis, and these water savings are subtracted from the baseline estimates. This section provides an overview of passive water conservation savings, which chiefly relate to the water demand reductions associated with the impacts of state and federal policy measures and do not include active conservation measures and programs sponsored by water providers. A detailed description of this analysis is provided in the *SWSI Conservation Levels Analysis Report*.

Several pieces of key federal and state legislation were considered in the development of the passive conservation savings estimates, including the 1992 National Energy Policy Act, the 2002 California Energy Commission Water Efficiency Standards, and the 2007 California Assembly Bill 715.

For this analysis, passive water savings were calculated to occur as a result of retrofitting housing stock and businesses that exist prior to 2016 through the replacement of washing machines, toilets, and dishwashers. Future water demand reductions associated with passive savings were calculated for each year beginning in 1996, which was when benchmark toilet flushing volume data from Denver was available. The calculations used to estimate future demand reductions from passive conservation were developed for minimum and maximum scenarios based on the assumptions related to the retrofit of existing housing and commercial construction with high-efficiency toilets, clothes washers, and dishwashers.

The calculations based on these assumptions were used to estimate a range of future passive water savings in each county for each year starting in 2000 and continuing until 2050. The total range of savings expected from passive conservation through 2050 is 19 to 33 gpcd. The upper range of these savings were applied to the county level baseline estimates described above to assess what the 2050 demands would be on a low, medium, and high basis with passive conservation. As stated in the *SWSI Conservation Levels Analysis Report*, there are three major reasons for applying the high passive conservation savings:

1. Water and energy savings will become increasingly important to water customers as water and fuel costs rise. As water customers seek more efficiency in their homes and businesses, high efficiency fixtures and appliances will become increasingly efficient as technology improves and customers strive to reduce their variable costs related to water and energy.

2. The potential exists to realize substantial permanent water demand reductions in the future if appropriate regulations and ordinances are developed to address water use in existing and new construction.

3. The impact of commercial retrofits (e.g., restaurants, motels, ski area condominiums, centralized laundries, commercial laundries, bars, etc.), is not well captured in the passive savings analyses since information regarding numbers of and ages of individual types of commercial properties were not available.

4.2.2.2 2050 M&I Water Demands Results

Colorado's population is projected to nearly double by the year 2050. Because the major driver for water use is population growth, M&I water usage is also expected to nearly double, even with savings from passive conservation. Statewide municipal water demands are estimated to increase from 975,000 acre-feet per year (AFY) to 1.36 million AFY by 2035 requiring an additional 383,000 AFY of water to meet Colorado's municipal water needs in 2035.

Based on the population projections discussed in Section 4.2.1, total statewide 2050 M&I water demands with passive conservation could range from 1.5 to 1.8 million AFY. By 2050, Colorado will need between 538,000 and 812,000 AFY of additional water to meet M&I demands. Passive conservation savings will result in approximately 154,000 AFY reduction statewide or just over 8 percent decrease in M&I water demands by 2050 for the medium demand scenario.

Table 4-3 and **Figure 4-2** illustrates the M&I water demand projections with passive conservation savings for each of the counties in the Gunnison Basin. Water demands in the Gunnison Basin are expected to nearly double by 2050 with Montrose County projected to have the highest M&I water demands. Figure 4-2 includes the full M&I water demands for Mesa County as these demands are largely met from the Gunnison River.

Table 4-3 M&I Forecast by River Basin

County	Water Demand (AF)	Baseline Water Demands (AFY)				Water Demands with Passive Conservation (AFY)			
	2008	2035	2050 Low	2050 Medium	2050 High	2035	2050 Low	2050 Medium	2050 High
Delta County	6,000	11,000	12,000	13,000	14,000	10,000	11,000	12,000	13,000
Gunnison County	3,400	4,700	5,300	6,200	7,200	4,300	4,900	5,700	6,800
Hinsdale County	370	590	630	680	750	560	600	660	720
Mesa County-Gunnison Basin Portion	7,900	13,000	16,000	17,000	19,000	11,000	14,000	15,000	17,000
Montrose County-Gunnison Basin Portion	750	1,400	1,500	1,600	1,700	1,300	1,400	1,500	1,600
Ouray County	840	1,200	1,300	1,500	1,800	1,100	1,100	1,400	1,600
Total	**19,000**	**32,000**	**37,000**	**40,000**	**44,000**	**28,000**	**33,000**	**36,000**	**41,000**

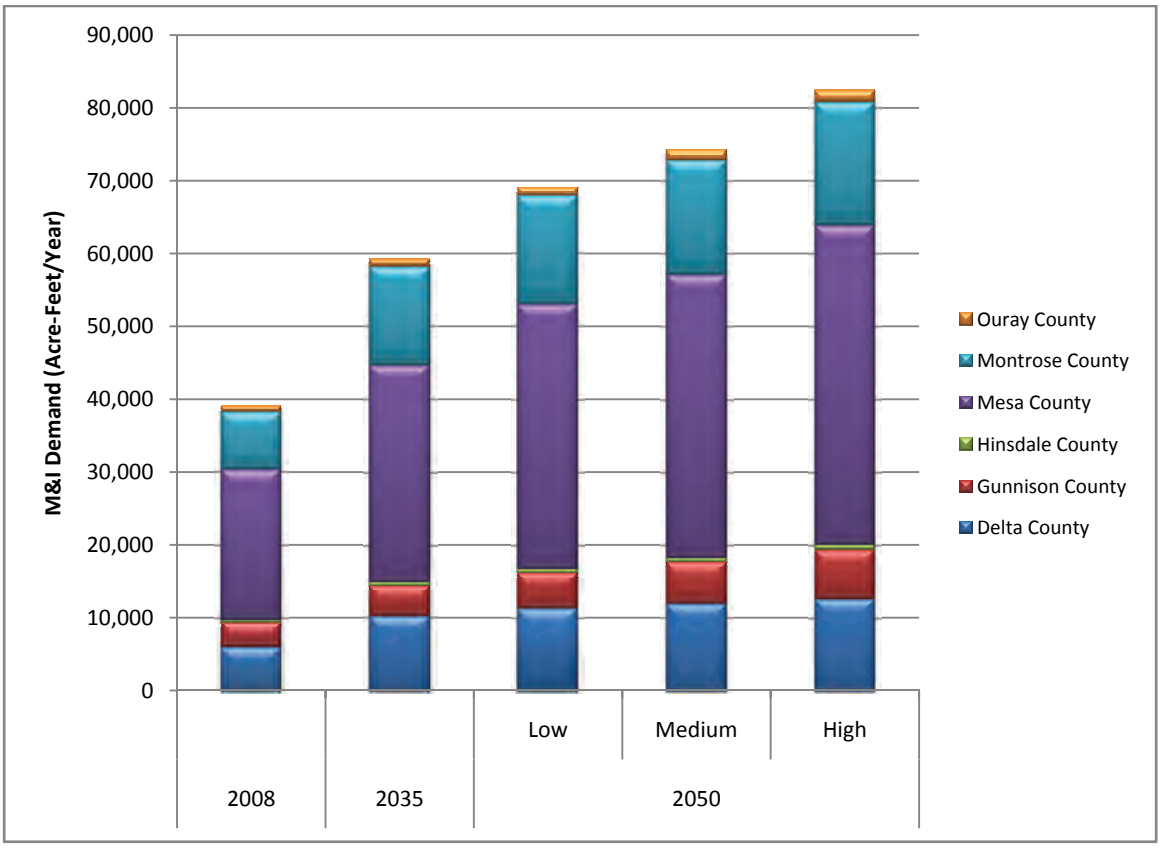

Figure 4-2 Gunnison Basin M&I Water Demands

4.2.3 SSI Water Demands

Standard methods were adapted for use in SWSI 1 for estimating future SSI water demands throughout Colorado. SSI water demands include water use by self-supplied and municipal provided large industries. The subsectors that are included in SSI are:

- Large industries, including mining, manufacturing, brewing, and food processing
- Water needed for snowmaking
- Thermoelectric power generation at coal- and natural gas-fired facilities
- Energy development, including the extraction and production of natural gas, coal, uranium, and oil shale

These industries represent economic growth within the state and the availability of water resources is imperative to their growth. Because of the diversity of the SSI subsectors, this section is organized to summarize each subsector separately, including data collection efforts and results. Detailed discussions of data sources, methodologies, and results are provided in Appendix H of the SWSI 2010 Report.

The Gunnison Basin's SSI water demands are comprised of water demands from snowmaking. The ski industry in Colorado is the cornerstone of tourism and economic activity for a large region of the state. While the water used by the ski resorts does not have a high consumption rate, it is water removed from the stream system and thus important to estimate. The forecast methodology employed in this update

differs from the SWSI 1 forecast methodology. Additional data were identified that proved useful in developing water use demands for snowmaking.

For this effort, several pieces of information were obtained—current snowmaking acres for each ski resort, current amount of water used for snowmaking, and expected future water use for snowmaking. Water use information was not available for all ski resorts. For these resorts, the known water use data were used to estimate current and future snowmaking demand. To stay within the bounds of the known data, water use was held constant for resorts with no known future expansions.

Also, for resorts with known expansions, build out was assumed to be 2050. Results of the forecast for the snowmaking industry are shown in **Table 4-4**. At this time, no low, medium, or high growth scenario is considered for 2050.

Table 4-4 Estimated Snowmaking Water Demands (AFY)

County	2008	2050
Gunnison	260	650

The Gunnison Basin SSI water demands are displayed in **Figure 4-3**. SSI demands are expected to more than double in the Gunnison Basin by 2050.

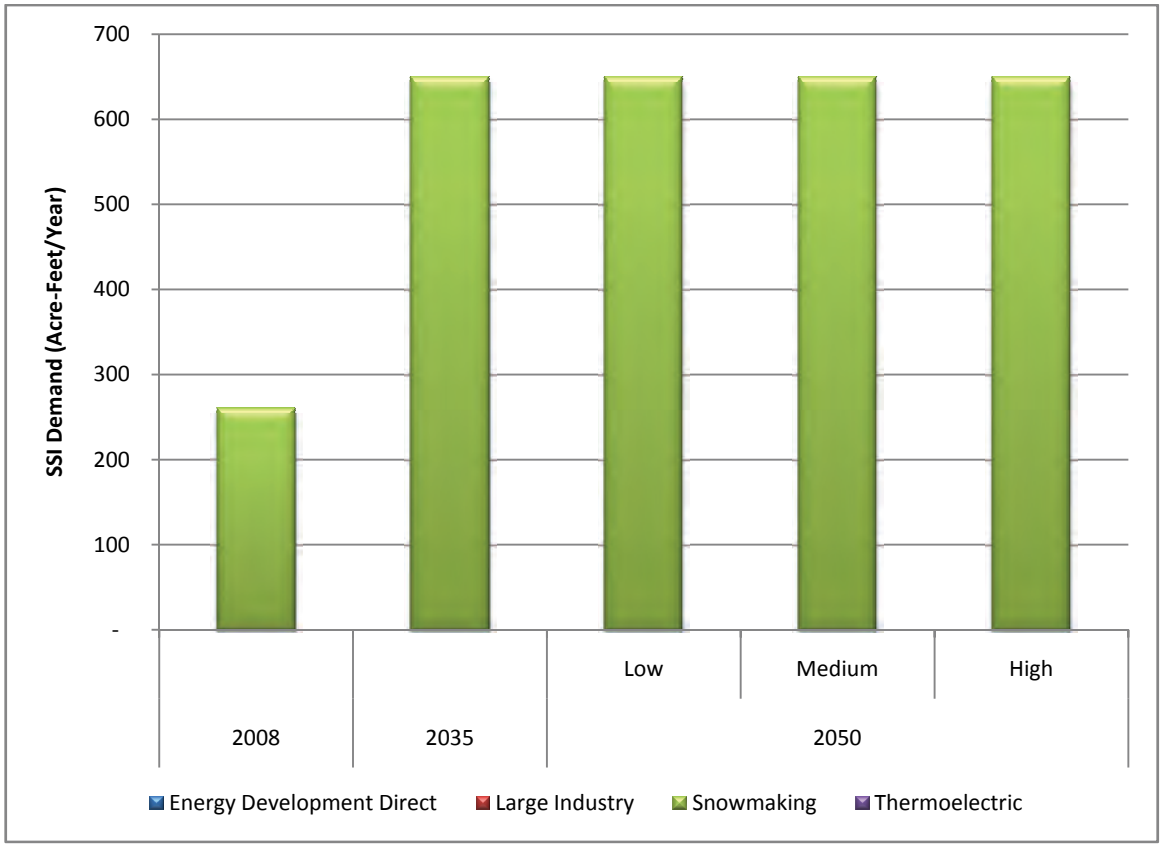

Figure 4-3 Gunnison Basin SSI Water Demands

4.2.4 Gunnison Basin 2050 M&I and SSI Consumptive Needs Summary

Of the many factors affecting M&I water use, the projected increases in population clearly drive the increases in M&I use from 2000 to 2050. **Table 4-5** and **Figure 4-4** summarize the Gunnison Basin's M&I and SSI water use for 2008 and projections including reductions as a result of passive conservation measures for 2035 and the 2050 low, medium, and high scenarios. In the Gunnison Basin, M&I and SSI demands are expected to increase from 21,000 AFY to between 37,000 AFY and 44,000 AFY by 2050. Figure 4-4 also shows that M&I water demands are estimated to exceed SSI demands for all of the future projections. Figure 4-4 includes M&I demands for all of Mesa County as needs for this county are met mainly from the Gunnison River.

Table 4-5 Summary of M&I and SSI Demands for Gunnison Basin (AFY)

Basin	Demand Type[1,2]	2008	2035	2050 Low	2050 Med	2050 High
Gunnison	M&I	20,000	33,000	36,000	39,000	43,000
	SSI	260	650	650	650	650
	Total	20,260	33,650	36,650	39,650	43,650
Statewide	M&I	974,500	1,357,600	1,512,700	1,607,700	1,786,800
	SSI	187,760	235,990	235,890	261,490	322,090
	Total	1,162,260	1,593,590	1,748,590	1,869,190	2,108,890

[1] M&I demands for 2035 and 2050 include passive conservation savings.
[2] SSI demands include energy development, large industry, snowmaking, and thermoelectric.

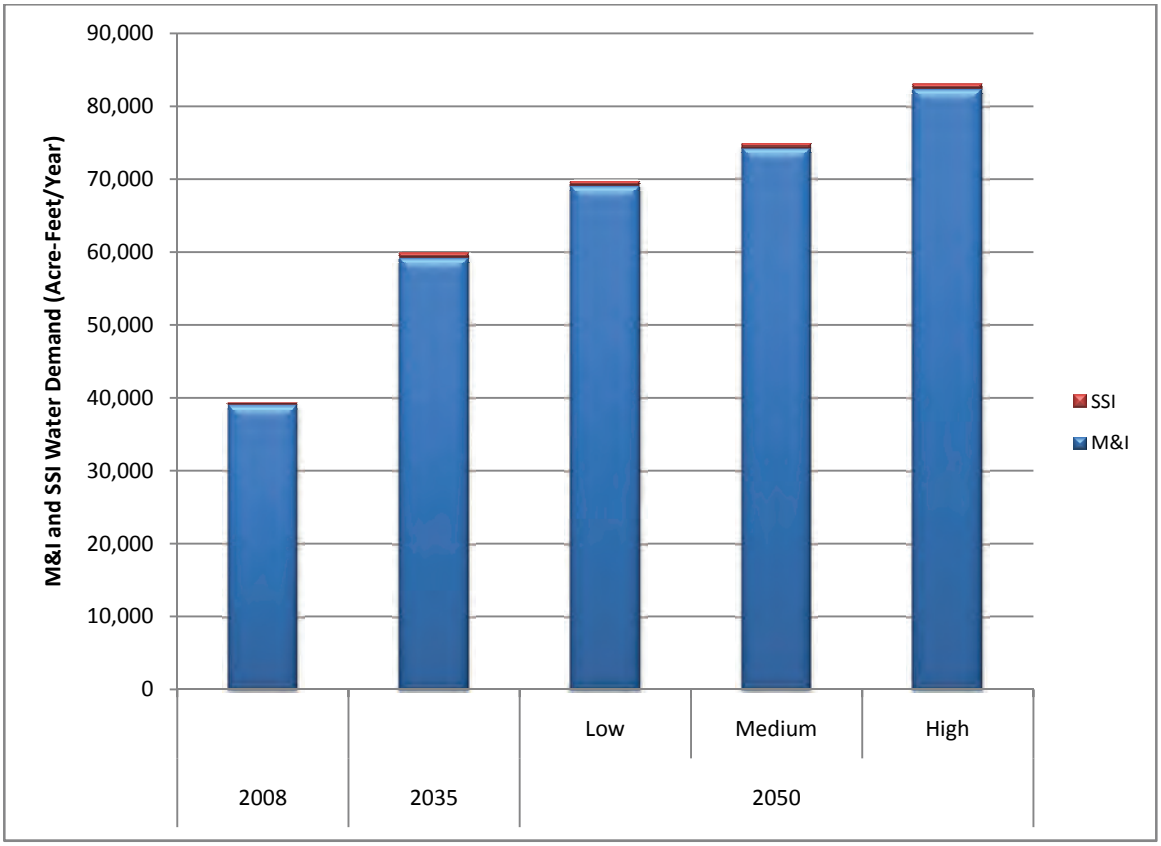

Figure 4-4. Gunnison Basin M&I and SSI Water Demands

4.3 Agricultural Consumptive Needs

This section provides information about the methodologies utilized to develop a current tally of irrigated acres and summarizes how 2050 irrigated acres were estimated. In addition, this section provides an overview of existing and 2050 agricultural demands.

4.3.1 Agricultural Demand Methodology

This section describes the methods used to estimate the water needed to support Colorado's agriculture, both currently and in 2050. The estimates include consumptive use (CU) water only—rather than the generally larger volumes of water pumped or diverted—both for the irrigation of crops and for livestock production. CU includes the amount of diverted water that is used by plants through evapotranspiration processes, as well as water that is "lost" to soil evaporation or deep percolation into the groundwater aquifer. A portion of the total diverted amount returns to the stream through surface runoff or lagged groundwater return flows and therefore is not consumptively used.

Colorado's water needs for irrigation are characterized in this analysis by the Irrigation Water Requirement (IWR), Water Supply Limited Consumptive Use (WSL CU), and the difference between these two numbers. CU modeling was executed using a recent decade of climate and water supply information. The objective was not to simulate what occurred over the past 10 years, but to estimate IWR and WSL CU for today's agricultural conditions and a plausible sample of climate and hydrology, exemplified by the recent decade. Future irrigation demand was examined by assuming that historical climate conditions will continue. The analysis assumed that agricultural demand is directly and linearly related to the number of acres irrigated.

In addition to the crop consumption described above, Colorado's agricultural demand includes three other types of CU that are associated with agricultural activity:

- Livestock CU
- Stockpond evaporation
- Losses incidental to delivering irrigation water

The Colorado Decision Support System (CDSS) program has developed processes for quantifying these uses in the context of developing basinwide water budgets, and water resources planning models. For this analysis, CDSS procedures were used to update the SWSI 1 estimates. The following subsections provide an overview of the methodologies used to estimate current and future irrigated acres and agricultural water demands and the results. A detailed description of these methodologies and results is in Appendix I of the SWSI 2010 Report.

4.3.1.1 Current Irrigated Acres Methodology

The CDSS program has produced irrigated lands mapping and crop CU models in the Gunnison Basin. The maps are available as spatial databases, and include crop types, irrigation practices, and association with diversion structures or wells. The structure identifier associated with the irrigated land indicates the location of the headgate that serves the land. Irrigated acres are assigned to the water district where the diversion is located, which may not be where the irrigated acreage lies. Dates of the irrigated lands information varied with the basins including the number of years information was collected.

4.3.1.2 2050 Irrigated Acres Methodology

Using the most current irrigated acres for each basin as defined in the previous section as a baseline, estimates of 2050 irrigated acres were based on the following factors:

- Urbanization of existing irrigated lands
- Agricultural to municipal water transfers
- Water management decisions
- Demographic factors
- Biofuels production
- Climate change
- Farm programs
- Subdivision of agricultural lands and lifestyle farms
- Yield and productivity
- Open space and conservation easements
- Economics of agriculture

The first three factors (urbanization of existing irrigated lands, agricultural to municipal water transfers, and water management decisions) were quantified based on future growth estimates, municipal water demand gaps that will be met by 2050, and interviews with water management agencies across the state. The remaining factors were qualitatively addressed based on information provided by the CWCB and the Colorado Department of Agriculture.

The urbanization of existing irrigated lands was established using 2050 population projections, estimation of future urban area size, and the current irrigated acres as described in the previous section. As discussed above, current irrigated acres in each administrative water district were determined from geographic information system data sources. However, certain types of data (e.g., future population forecasts) were only available on a county basis. Therefore, future losses of irrigated acres were calculated first for each county, and then re-distributed by water district. The methodology is described in detail in Appendix I of the SWSI 2010 Report.

The M&I gap analysis (described in Section 5) was used as the basis for the analysis of irrigated acreage changes associated with agricultural to municipal water transfers. For each of Colorado's major river basins the amount of the M&I gap was summarized in AFY on a low, medium, and high basis. For the purposes of predicting future irrigated acres it was assumed that 70 percent of M&I gap would be met from agricultural to municipal transfers. This percentage is a conservative estimate based on the assumption of 100 percent yield success rate for IPPs (see Section 5). Therefore, it does not take into account the projects or methods that may not be successful in meeting Colorado's future M&I demands; if IPPs are unsuccessful, it is likely that M&I water providers will turn to increased agricultural transfers to meet future demands. The following equation was used to estimate irrigated acres that would be needed for agricultural to municipal transfers to address M&I gaps:

Irrigated Acres Transferred = M&I Gap ÷ Transferrable Consumptive Use x (1 – Safety Factor)

A safety factor of 25 percent was applied to account for the additional amount of irrigated acres that may be needed to provide the transferred water on a firm yield basis.

For the remaining factors (demographic factors, biofuels production, climate change, farm programs, subdivision of agricultural lands and lifestyle farms, yield and productivity, open space and conservation easements, economics of agriculture), CWCB identified trends that are expected to occur within each area over the next 40 years and then developed a qualitative assessment on whether each factor would cause a

negative or positive impact on irrigated agriculture by 2050. A detailed description of this qualitative assessment is available in Appendix I of SWSI 2010.

4.3.1.3 Current Agricultural Demand Methodology

Current irrigation demand for water in Colorado can be defined as the average amount of water consumptively used by crops on land currently under irrigation. Typically, water supply is plentiful early in the irrigation year, crop CU is not limited and is equal to the crop IWR. As the irrigation season continues, the available water supply generally decreases, becoming less than the crops' uptake capacity, and CU is limited by supply. In order to quantify crop CU, one must have credible estimates or measurements of the crops' average capacity to use irrigation water, referred to as IWR, as well as the average water supply. The minima of these two values over a series of time increments (typically months) is the WSL CU.

For this analysis, both average IWR and average WSL CU are reported. The latter may be considered to be the current agricultural demand; that is, the water required to sustain current levels of farming. IWR provides perspective on the amount of water that would be used, if it was physically and legally available. It is an upper limit on consumption by current agriculture, and a reminder that Colorado is a dry state with over-appropriated streams.

IWR estimation requires time series of climate information, particularly precipitation and temperature, over the study period; WSL CU estimation requires information about the time-varying water supply available to the crop. For this analysis, a recent 10-year study period was used in each basin, although the exact decade differed from basin to basin depending on available data. The 10-year period allowed for estimation of average conditions with respect to both climate and hydrology. IWR and WSL CU were calculated assuming that the most current estimate of number of irrigated acres, and most recent information on crop types, prevailed during each year of the study period. The results show demand for "today's" agricultural conditions in Colorado, based on a 10-year sample of climate and hydrology.

Where applicable, CDSS methodologies were applied to estimate non-irrigation agricultural consumptive demands (e.g., livestock and stockpond evaporation) as well. Livestock CU is estimated by multiplying the number of cattle, sheep, and hogs located within a basin by their corresponding per capita use. Stockpond evaporation is based on net evaporation rates and stock pond surface area estimates. Details differ among the basins, but in general, the method estimates net reservoir evaporation by subtracting average monthly effective precipitation from the estimated gross monthly free water surface evaporation.

Lastly, incidental losses may include, but are not limited to, vegetative CU that occurs along canals and in tailwater areas. The CDSS program, in preparing Consumptive Uses and Losses (CU&L) Reports for the state, has adopted 10 percent as the factor for computing incidental losses associated with irrigation CU. The value is in the middle of the range of factors (5 percent to 29 percent) used by the U.S. Bureau of Reclamation in their parallel CU&L accounting throughout the upper basin states.

4.3.1.4 2050 Agricultural Demand Methodology

Following the techniques described in Section 4.3.1.2, changes in numbers of acres irrigated have been developed for each water district. Since this study intentionally avoids identifying specific water rights or ditches for change of use, there is no basis for calculating the structure-specific CU by which a water district's irrigation demand will change. CU per irrigated acre varies from structure to structure, and depends on available supply, seniority of a water right, and system efficiency. The variability of these factors makes it impossible to predict future losses of irrigated land on a structure-by-structure basis. Consequently, simplifying assumptions were made such that irrigation demand was considered directly proportional to number of acres irrigated. To derive future irrigation demand, current irrigation demand for each water district was scaled by the ratio of future irrigated acreage to current irrigated acreage.

Similarly, non-irrigation demand was estimated as being in proportion to irrigated acres. The relationship between losses incidental to irrigation and number of acres irrigated is proportional. With respect to stockponds and stock watering, it is assumed that predicted changes in irrigated acreage will be accompanied by similar changes in stock raising activities. To derive future non-irrigation demand, current non-irrigation demand was scaled by the ratio of future irrigated acreage to current irrigated acreage.

4.3.2 Agricultural Demand Results

The following sections describe the results of the current and future agricultural demand analyses, which were performed based on the methodologies described above. These analyses included assessments of both irrigated acreage and associated agricultural consumptive water demands. Maps are included to identify the locations of existing irrigated lands across the state, as well as to show the range of irrigated acreage losses anticipated in each basin by 2050.

4.3.2.1 Current Irrigated Acres Results

Information developed for this effort was generated at the water district level. **Figure 4-5** shows the locations of Colorado's water districts and the spatial distribution of current irrigated acres in Colorado based on the methods presented previously. Note that spatial information was not available for the irrigated lands in the Republican River water districts.

Table 4-6 presents the number of irrigated acres by water district in the Gunnison Basin and the percentage of total acres in the basin that each water district represents. The Gunnison Basin currently has about 270,000 irrigated acres. Water District 40 (North Fork/Tributaries) has the majority of irrigated acres in the basin.

Table 4-6 Current Irrigated Acres by River Basin

Water District	Irrigated Acres	Percentage of Gunnison Basin's Irrigated Acres
District 28: Tomichi Creek	28,000	10%
District 40: North Fork/Tributaries	90,000	33%
District 41: Lower Uncompahgre River	80,000	30%
District 42: Lower Gunnison River	8,300	3%
District 59: East River Basin	34,000	13%
District 62: Upper Gunnison River	17,000	6%
District 68: Upper Uncompahgre River	15,000	5%
Basinwide Total	270,000	100%

4.3.2.2 Future Irrigated Acres Results

Table 4-7 shows the results of future irrigated acres analysis. Future irrigated acres in Colorado may decrease by 115,000 to 155,000 acres due to urbanization alone, under low and high population growth scenarios, respectively. The basins with largest expected loss of irrigated acres due to urbanization are the South Platte, Colorado, and Gunnison Basins.

Finally, Table 4-7 identifies approximately 26,000 acres that will be dried-up in the Arkansas, Colorado, and South Platte River Basins as a result of planned agricultural to municipal transfers. Additional transfers that may be required to meet M&I gaps are expected to decrease irrigated acreage from 160,000 acres to 334,000 acres statewide.

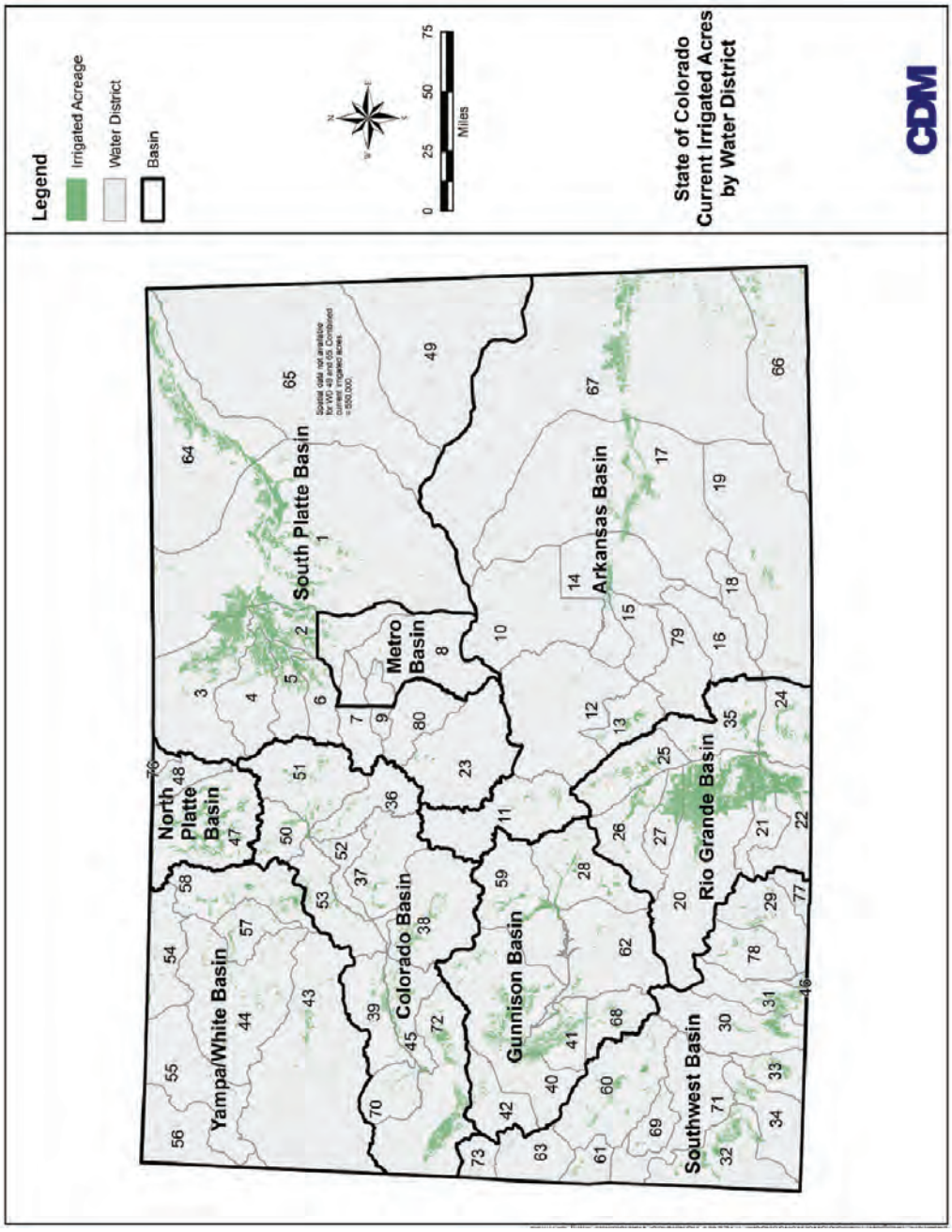

Figure 4-5 State of Colorado Current Irrigated Acres by Water District

Table 4-7 Future Irrigated Acres by River Basin

Basin	Current Irrigated Acres	Decrease in Irrigated Acres Due to Urbanization		Decreases in Irrigated Acres Due to Other Reasons	Decreases in Irrigated Acres from Planned Agricultural to Municipal Transfers	Decreases in Irrigated Acres from Agricultural to Municipal Transfers to Address M&I Gap		Estimated 2050 Irrigated Acres	
		Low	High			Low	High	Low	High
Arkansas	428,000	2,000	3,000	—	7,000	26,000	63,000	355,000	393,000
Colorado	268,000	40,000	58,000	—	200	11,000	19,000	190,800	216,800
Gunnison	**272,000**	**20,000**	**26,000**	**—**	**—**	**1,000**	**2,000**	**244,000**	**251,000**
North Platte	117,000	—	—	—	—	—	—	117,000	117,000
Republican	550,000	300	600	109,000	—	—	—	440,400	440,700
Rio Grande	622,000	800	1,000	80,000	—	2,000	3,000	538,000	539,200
South Platte	831,000	47,000	58,000	14,000	19,000	100,000	176,000	564,000	651,000
Southwest	259,000	4,000	6,000	—	—	3,000	7,000	246,000	252,000
Yampa-White	119,000	1,000	2,000	—	—	3,000	64,000	53,000	115,000
Statewide Total	**3,466,000**	**115,100**	**154,600**	**203,000**	**26,200**	**146,000**	**334,000**	**2,748,200**	**2,975,700**

Overall, the future irrigation analysis shows that Colorado may lose about 500,000 to 700,000 acres of its irrigated lands by 2050 due to all factors combined. These acreages represent 15 to 20 percent of the current total irrigated lands. **Figure 4-6** on the following page shows the range of potential changes by basin. **Figure 4-7** shows the comparison between current irrigated acres and 2050 irrigated acres as both numbers of acres and percent change. Note that the basin with the highest percent change (Yampa-White, 34,000 acres, 29 percent) is not the same as the basin with the highest change in total acres (South Platte, 224,000 acres, 27 percent).

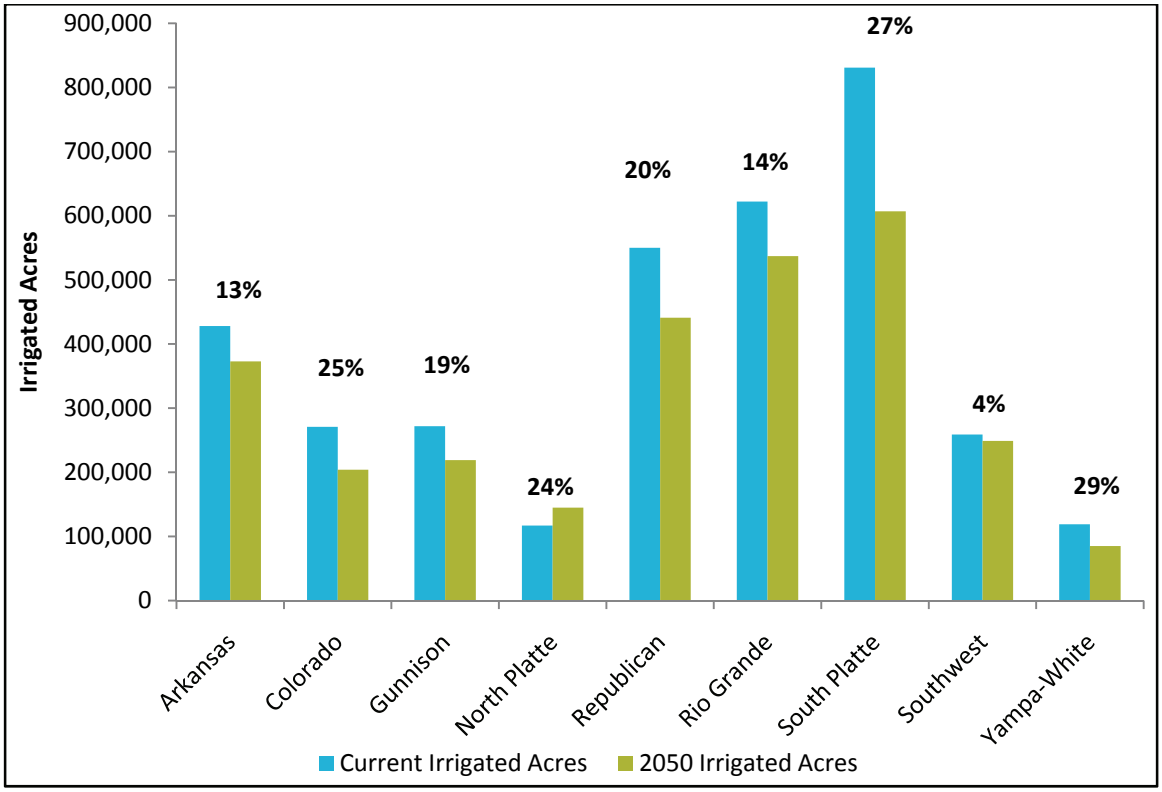

Figure 4-7 Comparison of Current and 2050 Irrigated Acres

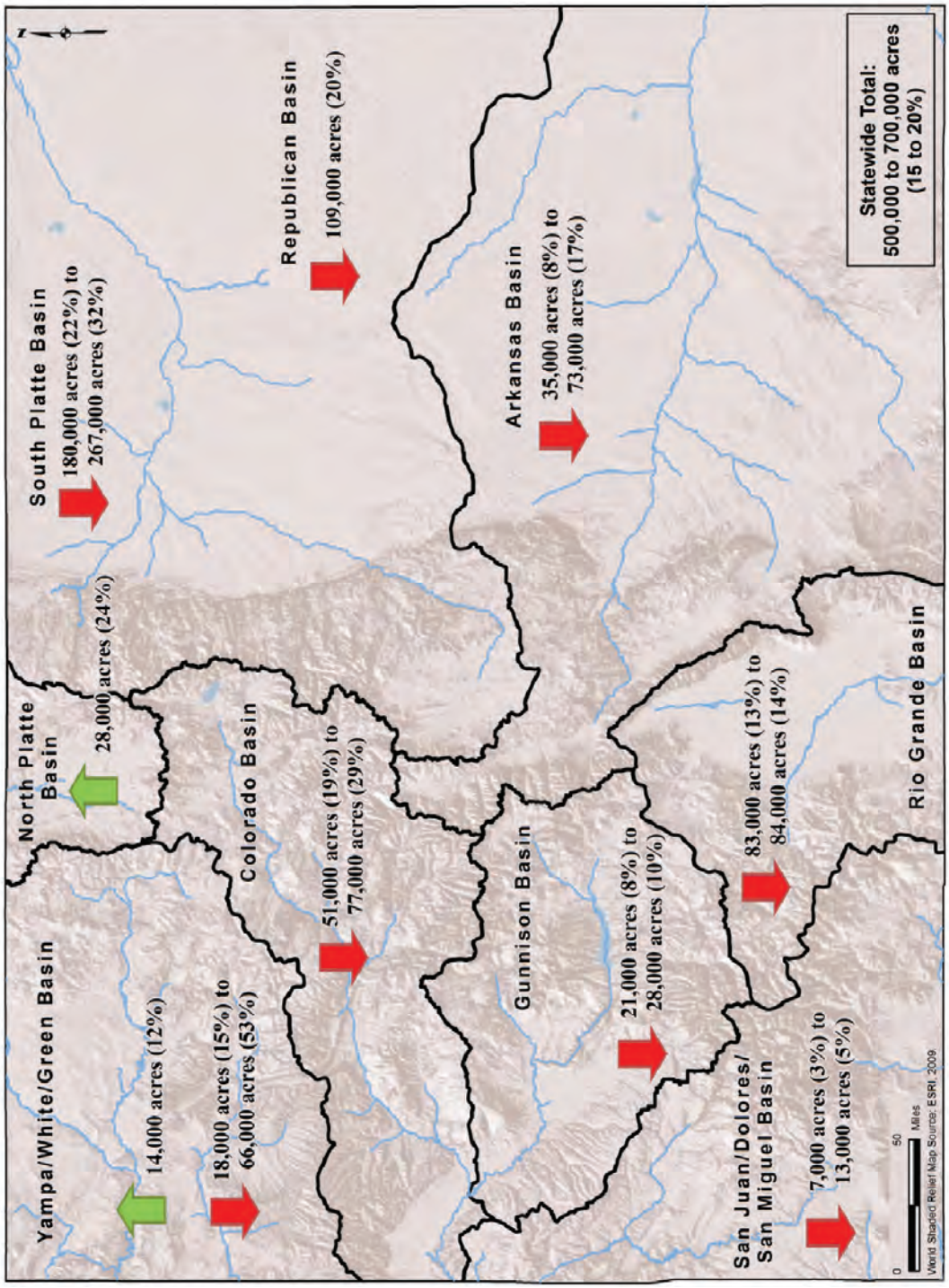

Figure 4-6 Potential Changes in Irrigated Acres by 2050

4.3.2.3 Current Agricultural Demand Results

Table 4-8 summarizes results of the average annual current agricultural demand by basin across the state. It shows irrigated acres, IWR, WSL CU, and shortage (difference between IWR and WSL CU). Nonirrigation demand is also shown by basin. **Figures 4-8** and **4-9** show the current WSL CU and shortage amounts across the state and by water district. In the Gunnison Basin, the water district with the highest agricultural demand and highest shortages is Water District 40 (North Fork/Tributaries). In addition to the water district summary in Figure 4-9, mapping was developed (**Figures 4-11** through **4-24** at the end of this section) to show at the diversion structure level the average and maximum shortages as well as the amount of acres irrigated by a particular structure. An issue that was noted by the Gunnison Basin Roundtable is that aggregate diversions are likely being modeled as diversions from areas downstream of the smaller tributaries (larger streams) where flow is not as limited and thus are not appearing as water short as has experience on the ground by water users in the basin. The other issue noted is that the model does not represent seasonal shortages that occur and irrigation that could be achieved during these times and associated demands are not represented.

Table 4-8 Estimated Current Agricultural Demand by Basin

Basin	Irrigated Acres	Irrigation Water Requirement (AFY)	Water Supply-Limited Consumptive Use (AFY)	Shortage (AFY)	Non-Irrigation Demand (AFY)
Arkansas	428,000	995,000	542,000	453,000	56,000
Colorado	268,000	584,000	485,000	100,000	51,000
Gunnison	**272,000**	**633,000**	**505,000**	**128,000**	**54,000**
North Platte	117,000	202,000	113,000	89,000	12,000
Republican	550,000	802,000	602,000	200,000	67,000
Rio Grande	622,000	1,283,000	855,000	428,000	45,000
South Platte	831,000	1,496,000	1,117,000	379,000	115,000
Southwest	259,000	580,000	382,000	198,000	46,000
Yampa-White	119,000	235,000	181,000	54,000	24,000
Statewide Total	**3,466,000**	**6,819,000**	**4,791,000**	**2,028,000**	**470,000**

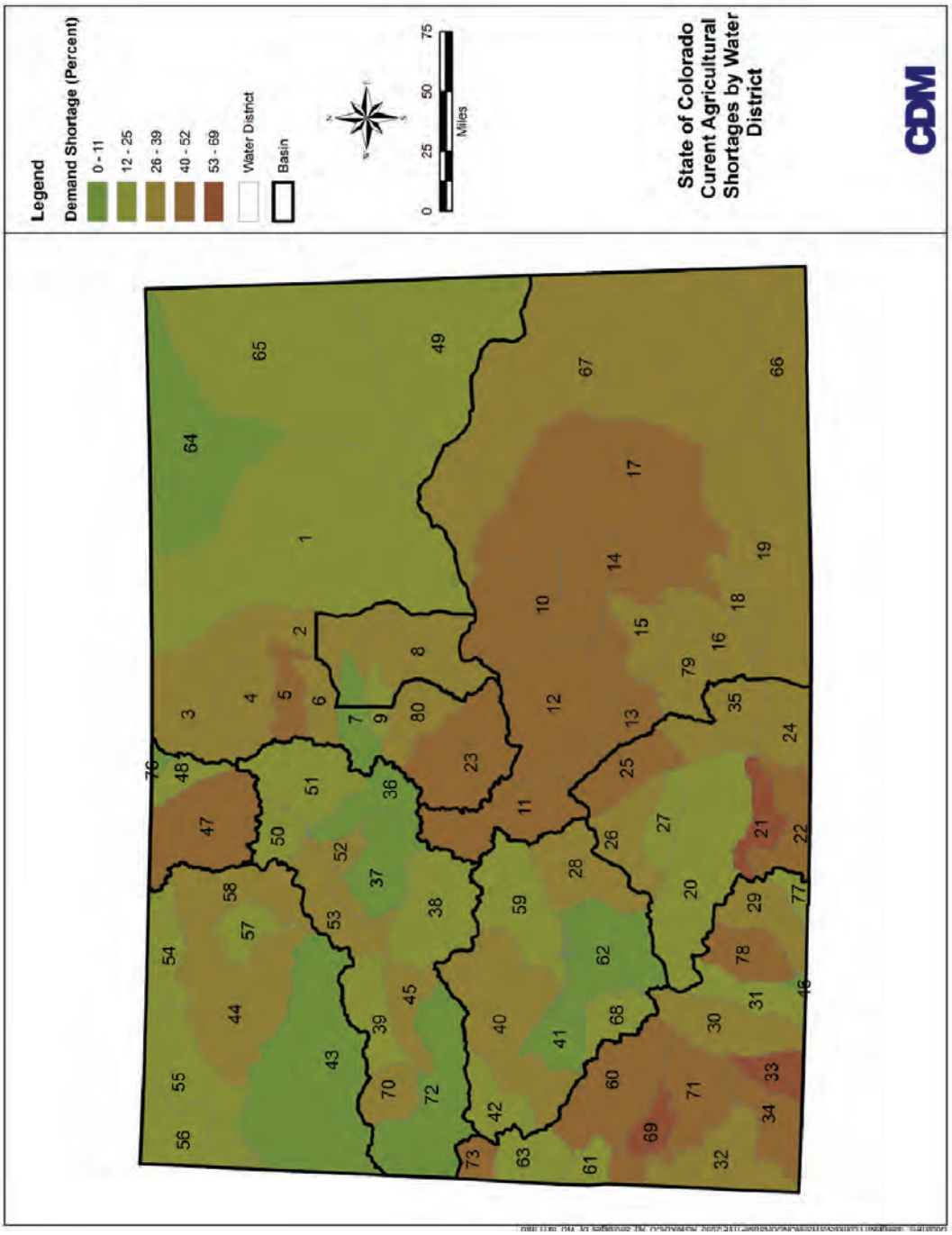

Figure 4-8 State of Colorado Current Agricultural Shortages by Water District

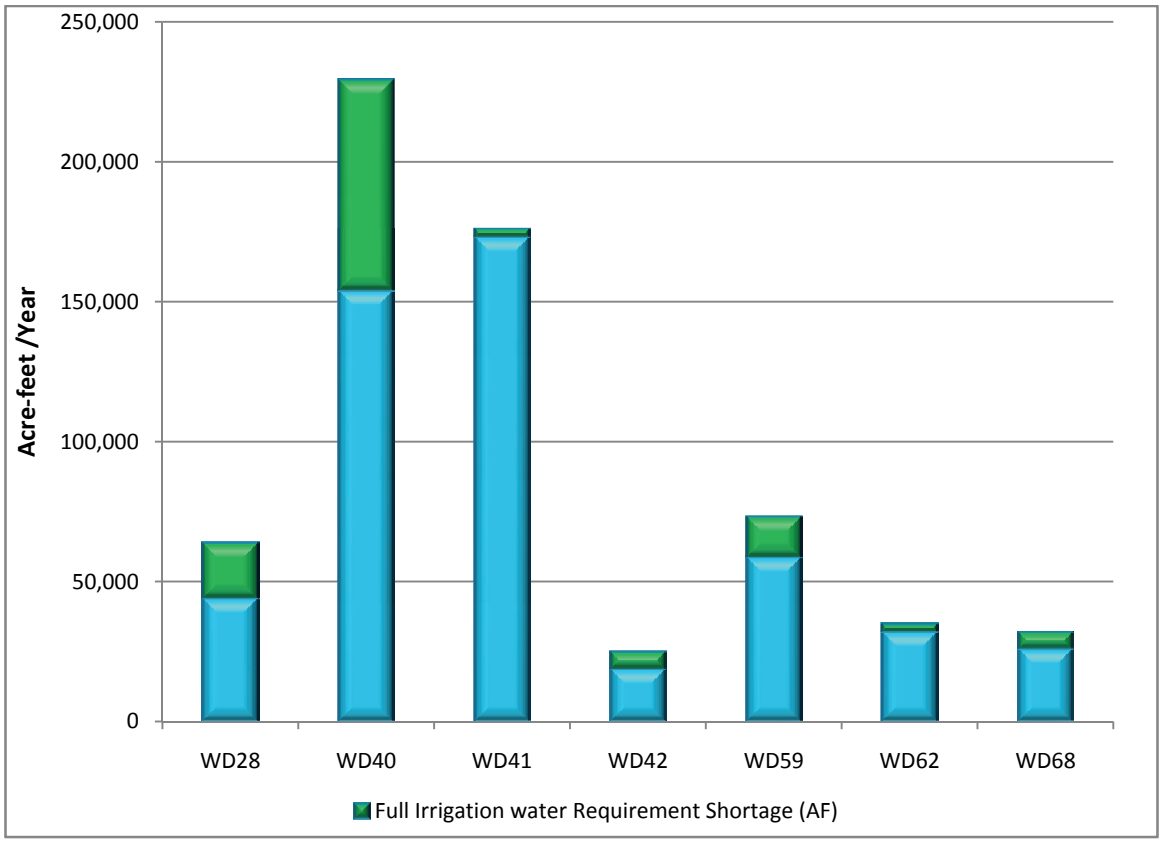

Figure 4-9 Gunnison Basin Current Agricultural Demands and Shortages

4.3.2.4 Future Agricultural Demand Results

Table 4-9 summarizes the estimated average annual agricultural demand by basin for the year 2050, assuming that historical climate and hydrology continue into the future. It shows irrigated acres, IWR, WSL CU, shortage, and non-irrigation demand. **Figure 4-10** shows the WSL CU and shortages by basin for the 2050 irrigated acres. Consistent with the projected decline in irrigated acres, declines in both irrigation and non-irrigation agricultural water demands are anticipated to occur in all basins except for the North Platte.

Table 4-9 Estimated 2050 Agricultural Demand by Basin

Basin	Irrigated Acres	Irrigation Water Requirement (AFY)	Water Supply-Limited Consumptive Use (AFY)	Shortage (AFY)	Non-Irrigation Demand (AFY)
Arkansas	373,000	862,000	476,000	386,000	49,000
Colorado	204,000	443,000	366,000	77,000	38,000
Gunnison	**219,000**	**573,000**	**457,000**	**116,000**	**48,000**
North Platte	145,000	250,000	140,000	110,000	14,000
Republican	441,000	640,000	480,000	160,000	5,000
Rio Grande	537,000	1,108,000	739,000	369,000	38,000
South Platte	607,000	1,094,000	820,000	274,000	84,000
Southwest	249,000	558,000	367,000	191,000	44,000
Yampa-White	85,000	209,000	170,000	39,000	17,000
Statewide Total	**2,860,000**	**5,737,000**	**4,015,000**	**1,722,000**	**337,000**

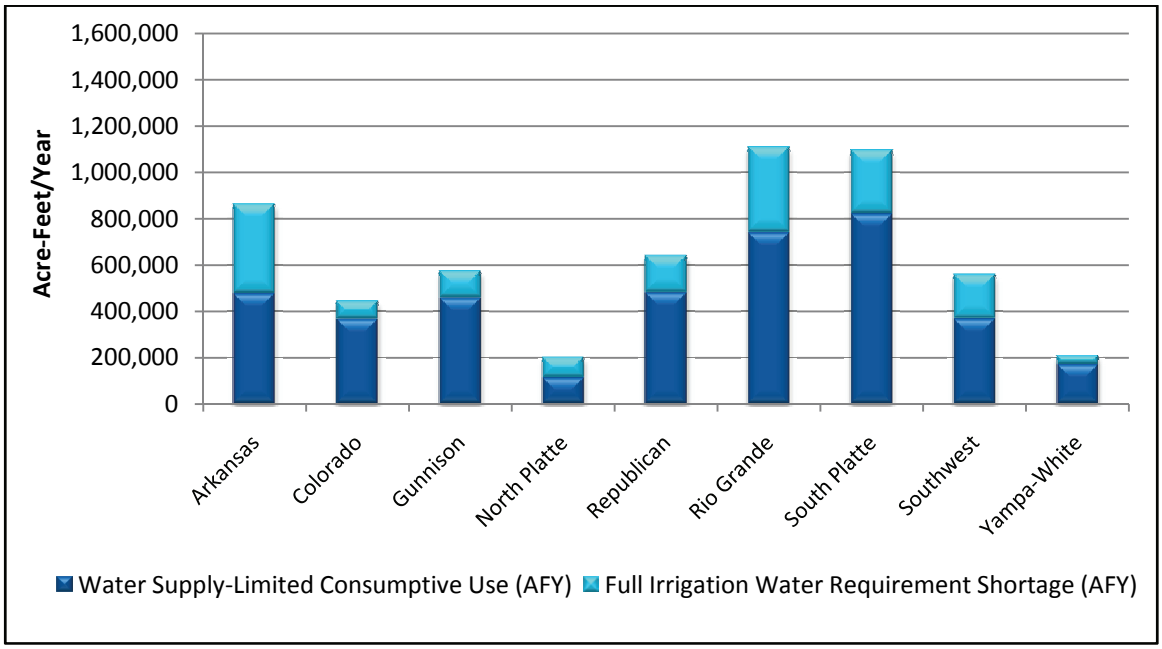

Figure 4-10 2050 Agricultural Demands and Shortages

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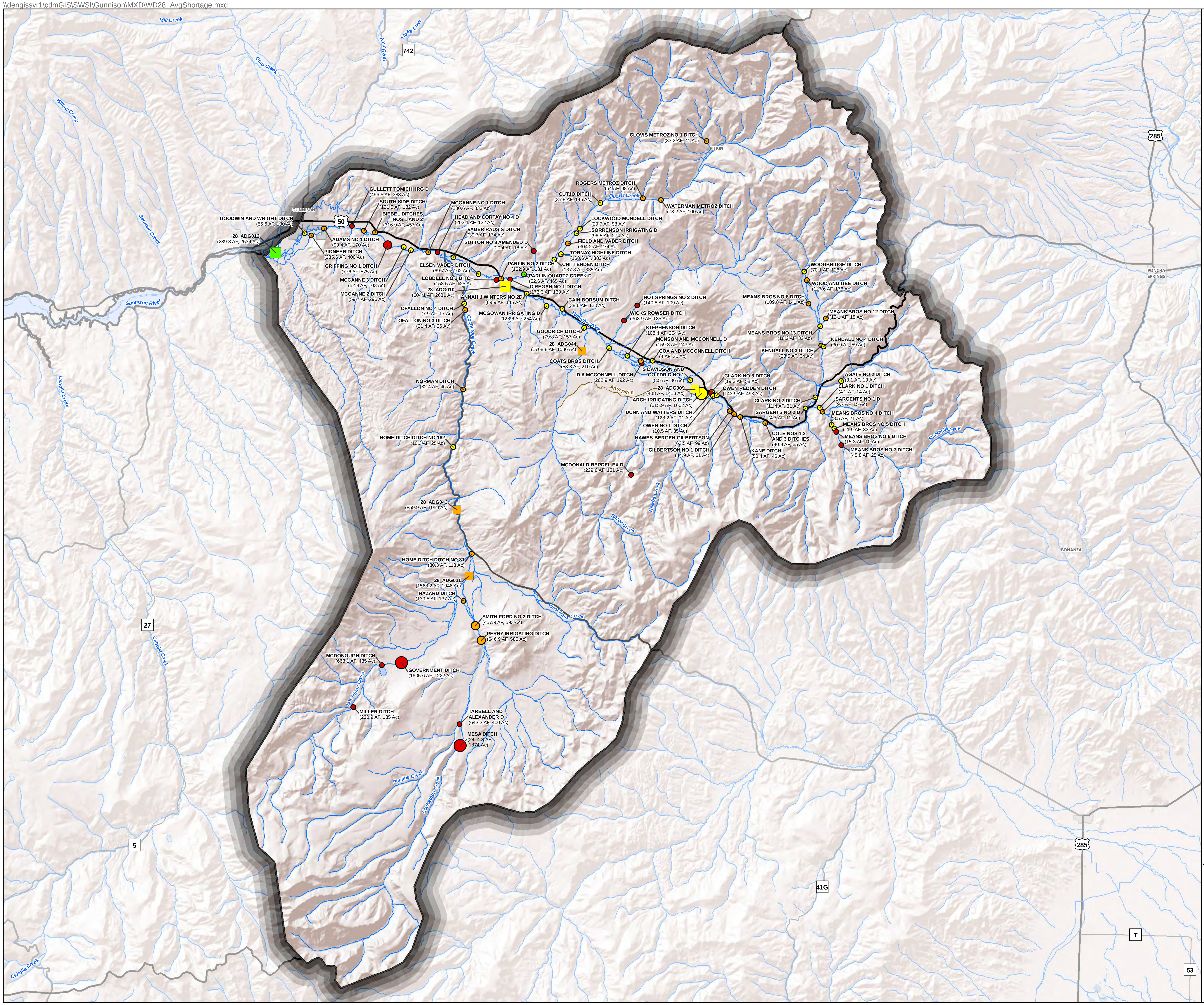

CLOVIS METROZ NO 1 DITCH (33.2 AF, 41 Ac)
ROGERS METROZ DITCH (64 AF, 98 Ac)
CUTJO DITCH (35.8 AF, 146 Ac)
WATERMAN METROZ DITCH (73.2 AF, 100 Ac)
LOCKWOOD MUNDELL DITCH (29.7 AF, 98 Ac)
SORRENSON IRRIGATING D (96.5 AF, 274 Ac)
FIELD AND VADER DITCH (304.2 AF, 274 Ac)
TORNAY HIGHLINE DITCH (168.6 AF, 382 Ac)
CHITTENDEN DITCH (137.8 AF, 335 Ac)
PARLIN QUARTZ CREEK D (52.6 AF, 465 Ac)
O'REGAN NO 1 DITCH (173.3 AF, 139 Ac)
PARLIN NO 2 DITCH (162.9 AF, 181 Ac)
GULLETT TOMICHI IRG D (496.5 AF, 383 Ac)
SOUTH SIDE DITCH (121.5 AF, 182 Ac)
BIEBEL DITCHES NOS 1 AND 2 (316.9 AF, 457 Ac)
MCCANNE NO 1 DITCH (230.6 AF, 333 Ac)
HEAD AND CORTAY NO 4 D (203.1 AF, 132 Ac)
VADER RAUSIS DITCH (39.7 AF, 174 Ac)
SUTTON NO 3 AMENDED D (20.4 AF, 18 Ac)
GOODWIN AND WRIGHT DITCH (55.6 AF, 130 Ac)
28_ADG012 (239.8 AF, 2534 Ac)
ADAMS NO 1 DITCH (99.4 AF, 170 Ac)
PIONEER DITCH (235.6 AF, 400 Ac)
GRIFFING NO 1 DITCH (776 AF, 575 Ac)
MCCANNE 3 DITCH (52.8 AF, 103 Ac)
MCCANNE 2 DITCH (59.7 AF, 296 Ac)
ELSEN VADER DITCH (69.7 AF, 162 Ac)
LOBDELL NO 2 DITCH (158.5 AF, 125 Ac)
28_ADG010 (604.1 AF, 2681 Ac)
HANNAH J WINTERS NO 2D (69.9 AF, 145 Ac)
OFALLON NO 4 DITCH (7.9 AF, 17 Ac)
OFALLON NO 3 DITCH (21.4 AF, 26 Ac)
MCGOWAN IRRIGATING D (128.6 AF, 254 Ac)
CAIN BORSUM DITCH (38.6 AF, 120 Ac)
HOT SPRINGS NO 2 DITCH (140.8 AF, 109 Ac)
WICKS ROWSER DITCH (363.9 AF, 185 Ac)
GOODRICH DITCH (79.8 AF, 157 Ac)
28_ADG044 (1768.8 AF, 1586 Ac)
STEPHENSON DITCH (108.4 AF, 204 Ac)
MONSON AND MCCONNELL D (159.8 AF, 243 Ac)
COX AND MCCONNELL DITCH (4 AF, 30 Ac)
COATS BROS DITCH (58.3 AF, 210 Ac)
S DAVIDSON AND CO FDR D NO 1 (8.5 AF, 36 Ac)
D A MCCONNELL DITCH (262.9 AF, 192 Ac)
28_ADG009 (408 AF, 1413 Ac)
ARCH IRRIGATING DITCH (615.9 AF, 1662 Ac)
DUNN AND WATTERS DITCH (128.2 AF, 91 Ac)
OWEN NO 1 DITCH (10.5 AF, 35 Ac)
HAWES-BERGEN-GILBERTSON (63.5 AF, 99 Ac)
GILBERTSON NO 1 DITCH (44.9 AF, 61 Ac)
CLARK NO 3 DITCH (19.3 AF, 58 Ac)
OWEN REDDEN DITCH (143.9 AF, 493 Ac)
CLARK NO 2 DITCH (11.4 AF, 31 Ac)
SARGENTS NO 2 D (4.7 AF, 12 Ac)
COLE NOS 1 2 AND 3 DITCHES (40.9 AF, 65 Ac)
KANE DITCH (50.4 AF, 46 Ac)
NORMAN DITCH (32.4 AF, 46 Ac)
HOME DITCH DITCH NO 182 (10.3 AF, 25 Ac)
MCDONALD BERDEL EX D (229.6 AF, 131 Ac)
WOODBRIDGE DITCH (70.1 AF, 126 Ac)
WOOD AND GEE DITCH (127.6 AF, 175 Ac)
MEANS BROS NO 8 DITCH (109.8 AF, 141 Ac)
MEANS BROS NO 12 DITCH (12.3 AF, 18 Ac)
MEANS BROS NO 13 DITCH (18.2 AF, 32 Ac)
KENDALL NO 4 DITCH (30.9 AF, 59 Ac)
KENDALL NO 3 DITCH (23.5 AF, 34 Ac)
AGATE NO 2 DITCH (8.1 AF, 19 Ac)
CLARK NO 1 DITCH (4.2 AF, 14 Ac)
SARGENTS NO 1 D (9.7 AF, 15 Ac)
MEANS BROS NO 4 DITCH (8.5 AF, 21 Ac)
MEANS BROS NO 5 DITCH (11.9 AF, 33 Ac)
MEANS BROS NO 6 DITCH (15.3 AF, 10 Ac)
MEANS BROS NO 7 DITCH (45.8 AF, 25 Ac)
28_ADG043 (859.9 AF, 1054 Ac)
HOME DITCH DITCH NO 81 (80.3 AF, 118 Ac)
28_ADG011 (1568.2 AF, 1946 Ac)
HAZARD DITCH (139.5 AF, 137 Ac)
SMITH FORD NO 2 DITCH (457.9 AF, 593 Ac)
PERRY IRRIGATING DITCH (646.9 AF, 585 Ac)
MCDONOUGH DITCH (663.1 AF, 435 Ac)
GOVERNMENT DITCH (1605.6 AF, 1222 Ac)
MILLER DITCH (230.9 AF, 185 Ac)
TARBELL AND ALEXANDER D (643.3 AF, 400 Ac)
MESA DITCH (2414.3 AF, 1874 Ac)
GUNNISON
PITKIN
PONCHA SPRINGS
BONANZA
Gunnison River
Tomichi Creek
Quartz Creek
Cochetopa Creek
West Pass Creek
Marshall Creek
Razor Creek
Needle Creek
Pauline Creek
Cochetopa Creek
Los Pinos Creek
Cebolla Creek
Steuben Creek
Willow Creek
Ohio Creek
Mill Creek
East River
Taylor River
Arch Ditch
50
742
285
27
5
41G
T
53

Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 1.5 3 6
Miles

Figure 4-11

Gunnison Basin: Water District 28 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N W E S

0 2 4 8
Miles

Figure 4-12

Gunnison Basin: Water District 40 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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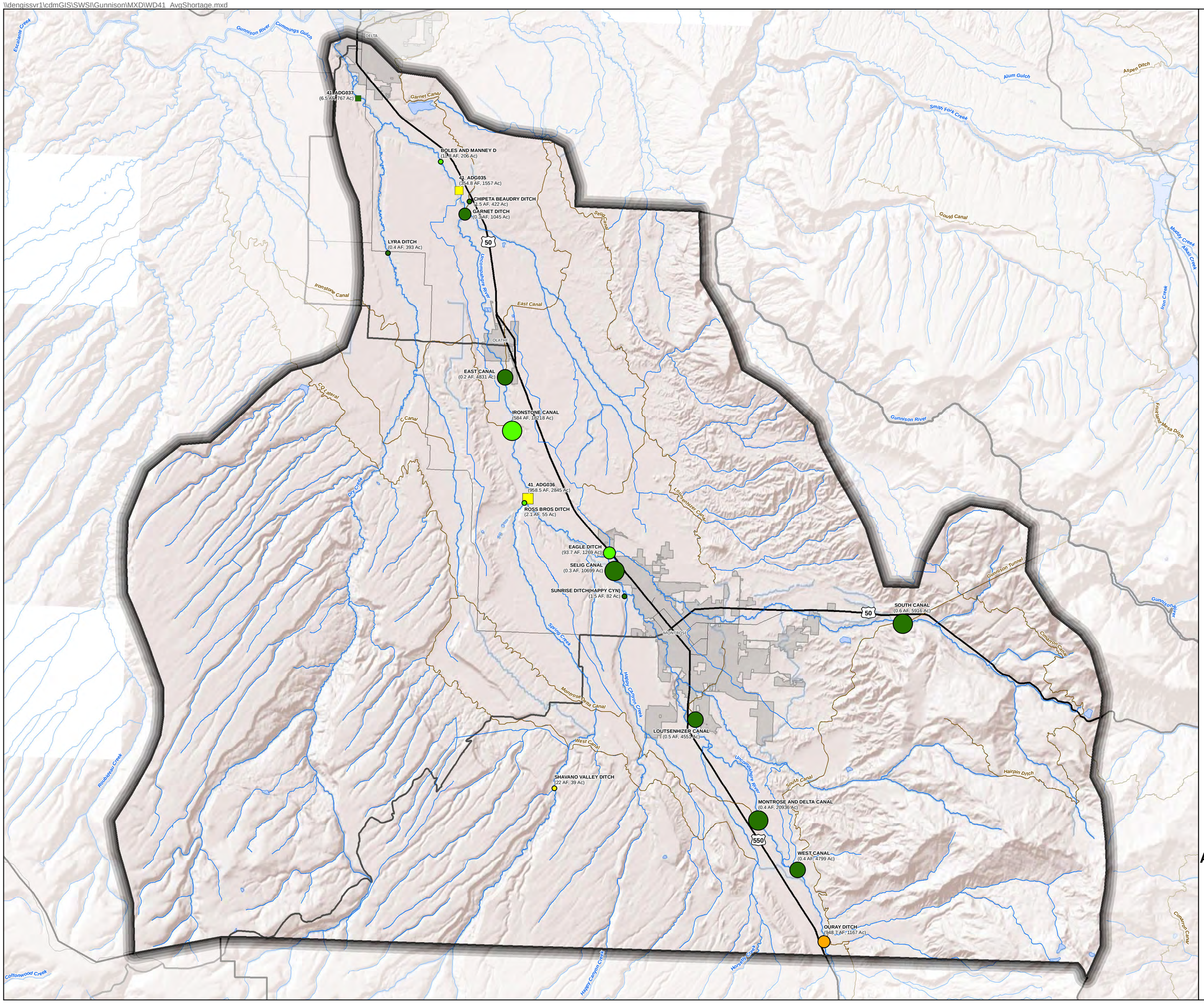

Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 0.5 1 2
Miles

Figure 4-13

Gunnison Basin: Water District 41 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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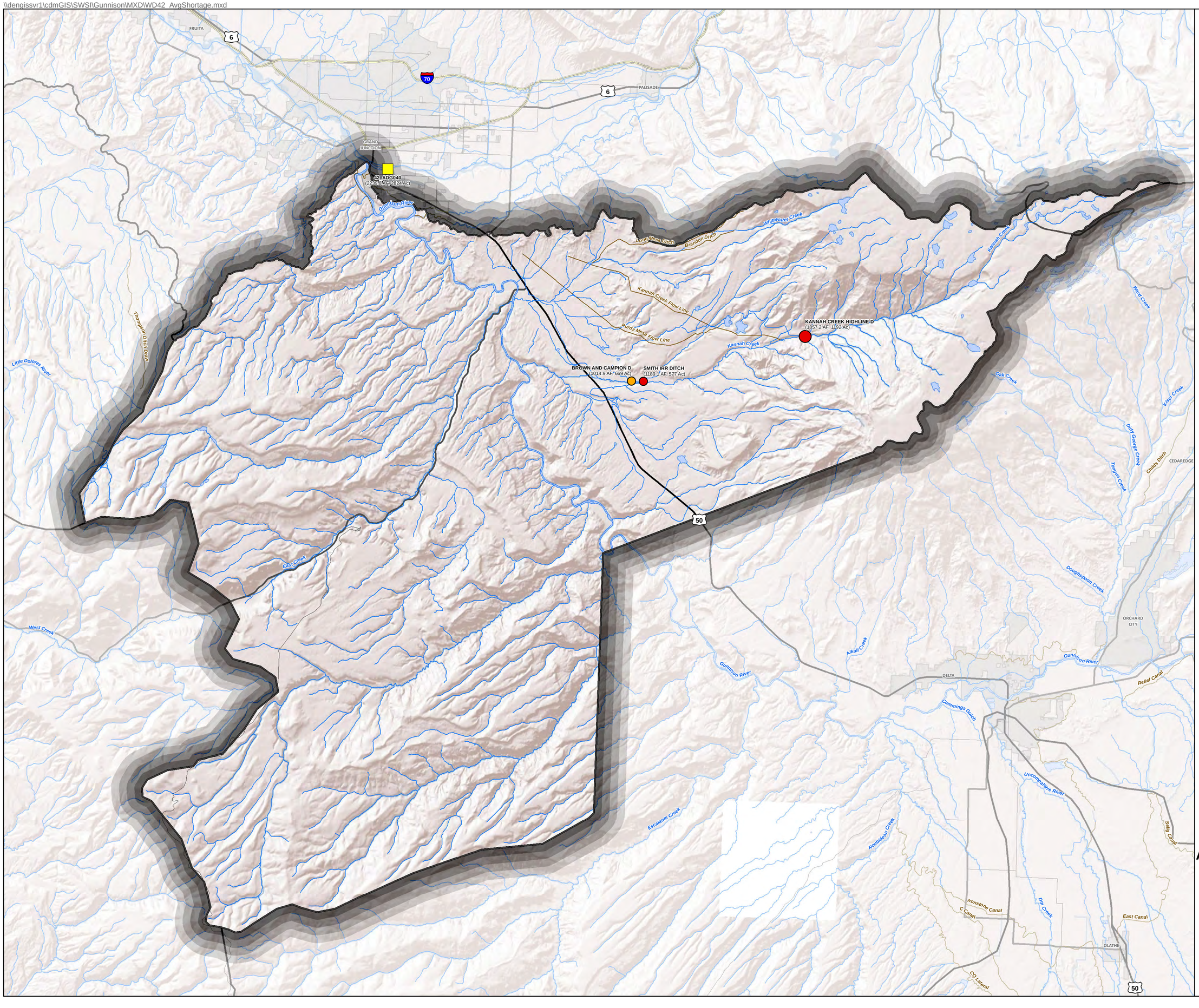

Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 1 2 4
Miles

Figure 4-14

Gunnison Basin: Water District 42 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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SNOWMASS VILLAGE
MT. CRESTED BUTTE
GUNNISON
PITKIN

VERZUH YOUNG BIFANO D (3.8 AF, 403 Ac)
STRAND DITCH NO 1 (24.4 AF, 186 Ac)
MCCORMICK DITCH (388.3 AF, 232 Ac)
59_ADG002 (251.6 AF, 1296 Ac)
VERZUH DITCH (0.3 AF, 117 Ac)
59_ADG003 (2192.2 AF, 1469 Ac)
ANNA ROZMAN DITCH (5.7 AF, 72 Ac)
EAST RIVER NO 2 DITCH (0.4 AF, 511 Ac)
DILLSWORTH DITCH (0.3 AF, 365 Ac)
BOCKER DITCH (0.5 AF, 208 Ac)
CEMENT CREEK DITCH (0.9 AF, 171 Ac)
IMOBERSTEG DITCH (17.5 AF, 185 Ac)
PASS CREEK DITCH (20.2 AF, 61 Ac)
SLIDE DITCH (1.5 AF, 262 Ac)
59_ADG004 (434.8 AF, 2178 Ac)
EAST RIVER NO 1 DITCH (63.2 AF, 985 Ac)
ACME DITCH (714.4 AF, 857 Ac)
59_ADG006 (193.9 AF, 918 Ac)
KUBIACK DITCH (1.5 AF, 150 Ac)
HOPE RESICH DITCH (319.9 AF, 334 Ac)
HOWE AND SHERWOOD IRR D (1 AF, 232 Ac)
HIGHLAND DITCH (11.1 AF, 46 Ac)
SIMINEO DITCH (204.1 AF, 189 Ac)
BOURNE DITCH (100.1 AF, 154 Ac)
JAMES WATT DITCH (15.4 AF, 197 Ac)
RICHARD BALL DITCH (1.5 AF, 371 Ac)
WILLOW RUN DITCH (113.6 AF, 125 Ac)
ANDERS BOTTOM D (20 AF, 19 Ac)
OHIO CREEK NO 2 DITCH (250.2 AF, 162 Ac)
SQUIRREL CREEK NO1 DITCH (149.4 AF, 90 Ac)
WILSON OHIO CREEK DITCH (128 AF, 298 Ac)
FISHER DITCH ENLARGEMENT (12.6 AF, 351 Ac)
SPRING CR IRG DITCH (23.8 AF, 280 Ac)
MCGLASHAN N SIDE MILL CR (214.3 AF, 140 Ac)
HINKLE HAMILTON DITCH (204 AF, 355 Ac)
JUDY NORTH HIGH LINE D (238.8 AF, 280 Ac)
SCHUPP DITCH (101.4 AF, 163 Ac)
HINKLE IRG DITCH (56.3 AF, 97 Ac)
59_ADG005 (49.3 AF, 693 Ac)
CUNNINGHAM DITCH (829.5 AF, 525 Ac)
TEACHOUT DITCH (311.6 AF, 711 Ac)
59_ADG007 (1677.1 AF, 1944 Ac)
59_ADG001 (26.9 AF, 738 Ac)
BUCKEY DITCH (529.4 AF, 373 Ac)
BUCKEY LEHMAN DITCH (125.7 AF, 121 Ac)
LONE PINE DITCH (473.9 AF, 762 Ac)
MARSTON DITCH (27 AF, 99 Ac)
MCGLASHAN S SIDE MILL CR (142 AF, 196 Ac)
MAY BOHM AND ENLD M B H P (926.1 AF, 921 Ac)
TEACHOUT-FAIRCHILD DITCH (77.7 AF, 225 Ac)
POWER DITCH (0.2 AF, 237 Ac)
HENRY PURRIER OHIO CR D (373.5 AF, 174 Ac)
GUNNISON R OHIO CR IRG D (0 AF, 1160 Ac)
GOOSEBERRY MESA IRG D (17.5 AF, 287 Ac)
PURRIER DITCH (173.8 AF, 144 Ac)
LIGHTLEY D AND LINTON ENLT (16.6 AF, 288 Ac)
HENRY PURRIER OHIO CR 2D (173.2 AF, 125 Ac)
PIONEER DITCH (147.1 AF, 125 Ac)
MARSHALL NO 1 DITCH (42.9 AF, 214 Ac)
HARRIS BOHM POTATO DITCH (148 AF, 612 Ac)
OTIS MOORE DITCH (203.1 AF, 243 Ac)
HILDEBRAND NO 2 DITCH (85.5 AF, 146 Ac)
WILSON DITCH (82.2 AF, 126 Ac)
MARSHALL NO 2 DITCH (131.5 AF, 425 Ac)
GLEASON IRRIGATING DITCH (344.5 AF, 460 Ac)
GUNNISON AND OHIO CR CANAL (50.6 AF, 953 Ac)
HYZER VIDAL MILLER D (146.7 AF, 377 Ac)
JOHN B OUTCALT NO 2 D (81.7 AF, 484 Ac)
CUNNINGHAM WASTEWATER D (2.6 AF, 140 Ac)
GARDEN DITCH (97.2 AF, 346 Ac)
PILONI DITCH (445.2 AF, 505 Ac)
WHIPP DITCH (841 AF, 354 Ac)
PALISADES DITCH (38.3 AF, 90 Ac)
GUNNISON TOWN DITCH (0 AF, 84 Ac)
DEAN IRRIGATING DITCH (48.7 AF, 110 Ac)
59_ADG008 (0.3 AF, 2056 Ac)
KELMEL OWENS NO 2 DITCH (7.7 AF, 390 Ac)
FRANK ADAMS NO 1 DITCH (14.7 AF, 317 Ac)
SEVENTY FIVE DITCH (0.4 AF, 458 Ac)
KELMEL OWENS NO 1 DITCH (76.2 AF, 542 Ac)

Cottonwood Creek
Bear Creek
Thompson Creek
Hubbard Creek
Hawkeye Creek
North Fork Gunnison
Deep Creek
Anthracite Creek
Terror Creek
Fire Mountain Canal
Stewart Ditch
Minnesota Creek
German Creek
Bell Creek
Smith Fork Creek
Mill Creek
Soap Creek
Muddy Creek
Alkali Creek
Dyer Ditch
Crystal Creek
Cottonwood Ditch
Mill Creek
Cimarron Creek
Cimarron River
Big Blue Creek
Cebolla Creek
Gunnison River
Stephens Creek
East River
Slate River
Ohio Creek
Carbon Creek
Willow Creek
Taylor River
Spring Creek
Willow Creek
Quartz Creek
Tomichi Creek
Hot Springs Creek
Razor Creek
Arch Ditch
Needle Creek
Cochetopa Creek
Marshall Creek

265
3
317
12
24
209
306
742
50

Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
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0 1.5 3 6
Miles

Figure 4-15

Gunnison Basin: Water District 59 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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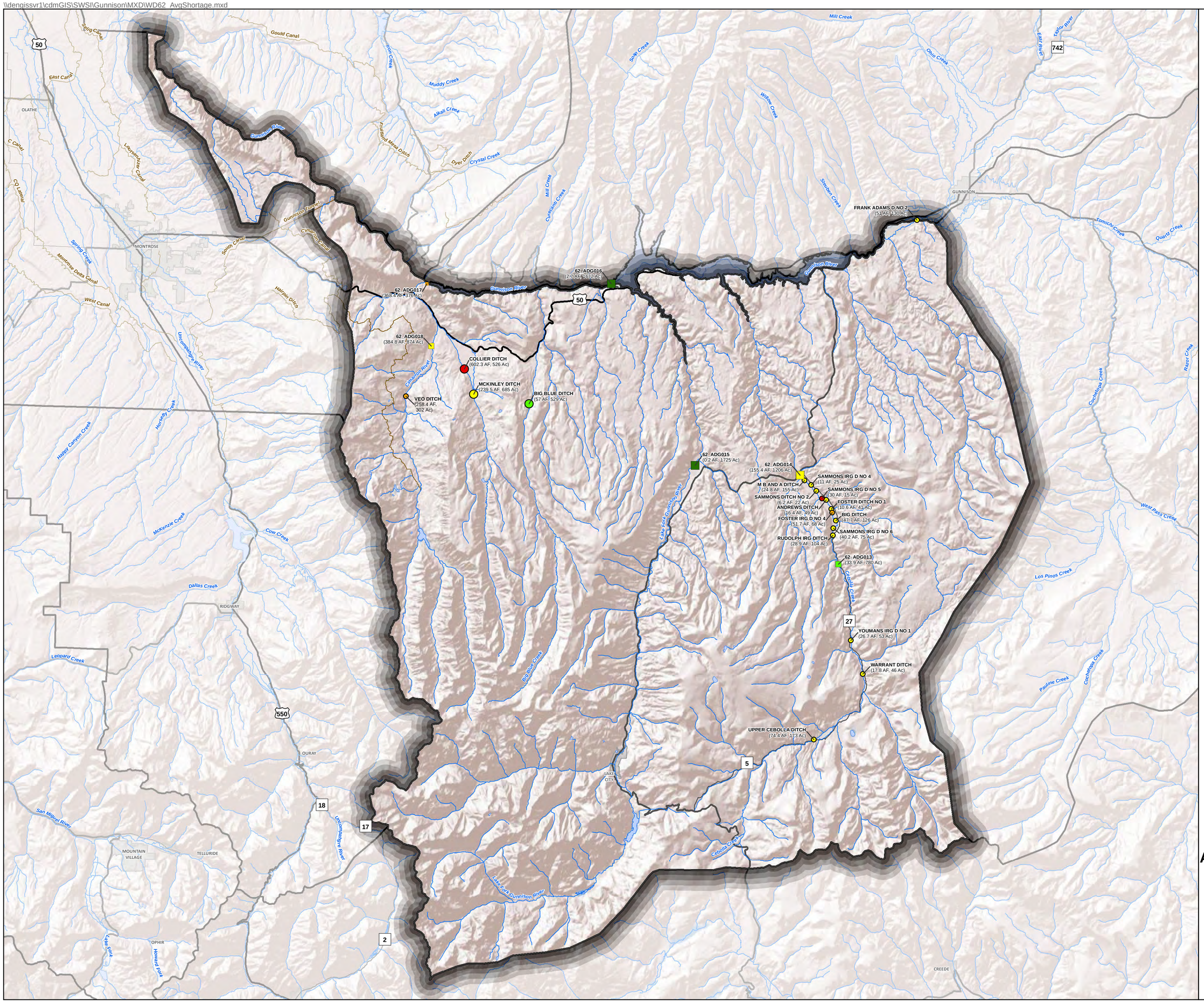

Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 1.5 3 6
Miles

Figure 4-16

Gunnison Basin: Water District 62 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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68_ADG034
(9.8 AF, 2505 Ac)
ROSWELL HOTCHKISS DITCH
(7.1 AF, 200 Ac)
UPPER UNCOMPAHGRE DITCH
(0.3 AF, 274 Ac)
PINION DITCH
(10.2 AF, 293 Ac)
OLD AGENCY DITCH
(0.2 AF, 320 Ac)
HOMESTRETCH DITCH
(15.7 AF, 292 Ac)
SHORTLINE D COW CREEK
(103.5 AF, 82 Ac)
68_ADG032
(21.6 AF, 1014 Ac)
MARTIN DITCH
(57.4 AF, 140 Ac)
ALKALI NO 2 DITCH
(284.9 AF, 724 Ac)
OWL CREEK DITCH
(44.8 AF, 193 Ac)
ALKALI DITCH D NO 80
(1135.8 AF, 1470 Ac)
SNEVA DITCH
(439.9 AF, 939 Ac)
68_ADG033
(156.3 AF, 1281 Ac)
HYDE SNEVA DITCH
(471.4 AF, 455 Ac)
HOSNER ROWELL DITCH
(186.6 AF, 432 Ac)
HENRY TRENCHARD DITCH
(35.7 AF, 147 Ac)
DALLAS DITCH
(248.4 AF, 755 Ac)
MAYOL LATERAL DITCH
(36.8 AF, 75 Ac)
MAYOL SISSON DITCH
(11.6 AF, 85 Ac)
REED OVERMAN DITCH
(14.3 AF, 91 Ac)
BURKHART EDDY DITCH
(440.8 AF, 606 Ac)
DOC WADE DITCH
(357.2 AF, 430 Ac)
MOODY NO1 DITCH
(148.2 AF, 441 Ac)
MOODY DITCH
(49.9 AF, 213 Ac)
MORRISON DITCH
(16.7 AF, 59 Ac)
PARK DITCH
(23.2 AF, 259 Ac)
CHARLEY LOGAN DITCH
(31.6 AF, 153 Ac)
HOSNER BROWNYARD DITCH
(2.7 AF, 93 Ac)
LEOPARD CREEK DITCH
(272.4 AF, 627 Ac)
CRONENBERG DITCH
(382.8 AF, 221 Ac)
RIDGWAY DITCH
(76.9 AF, 57 Ac)
RIDGWAY
OURAY
TELLURIDE
MOUNTAIN VILLAGE
550
18
17
2

Uncompahgre River
Cimarron River
Roubideau Creek
Spring Creek
Happy Canyon Creek
Horsefly Creek
McKenzie Creek
Cow Creek
Dallas Creek
Leopard Creek
San Miguel River
Saltado Creek
Fall Creek
Hughes Draw
Big Blue Creek
Lake Fork Gunnison River
Ridgway Canal
Cimarron Canal

Legend

- Stream / River
- Canal
- Municipality
- Lake

Average Percent Shortage

- 0% - 1%
- 1% - 5%
- 5% - 25%
- 25% - 50%
- 50% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
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Miles

Figure 4-17

Gunnison Basin: Water District 68 Average Agricultural Shortages and Irrigated Acres by Structure

CDM

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GULLETT TOMICHI IRG D (765 AF, 383 Ac)
SOUTH SIDE DITCH (371 AF, 182 Ac)
BIEBEL DITCHES NOS 1 AND 2 (700 AF, 457 Ac)
GOODWIN AND WRIGHT DITCH (109 AF, 130 Ac)
28_ADG012 (1964 AF, 2534 Ac)
ADAMS NO 1 DITCH (409 AF, 170 Ac)
PIONEER DITCH (796 AF, 400 Ac)
GRIFFING NO 1 DITCH (1284 AF, 575 Ac)
MCCANNE 3 DITCH (192 AF, 103 Ac)
MCCANNE 2 DITCH (329 AF, 296 Ac)
MCCANNE NO 1 DITCH (553 AF, 333 Ac)
HEAD AND CORTAY NO 4 D (326 AF, 132 Ac)
VADER RAUSIS DITCH (194 AF, 174 Ac)
SUTTON NO 3 AMENDED D (40 AF, 18 Ac)
ELSEN VADER DITCH (194 AF, 162 Ac)
LOBDELL NO 2 DITCH (218 AF, 129 Ac)
28_ADG010 (3328 AF, 2681 Ac)
HANNAH J WINTERS NO 2D (266 AF, 145 Ac)
OFALLON NO 4 DITCH (18 AF, 17 Ac)
OFALLON NO 3 DITCH (60 AF, 26 Ac)
NORMAN DITCH (60 AF, 46 Ac)
HOME DITCH DITCH NO 182 (26 AF, 25 Ac)
28_ADG043 (1694 AF, 1054 Ac)
HOME DITCH DITCH NO.81 (258 AF, 118 Ac)
28_ADG011 (3282 AF, 1946 Ac)
HAZARD DITCH (324 AF, 137 Ac)
SMITH FORD NO 2 DITCH (837 AF, 593 Ac)
PERRY IRRIGATING DITCH (1140 AF, 585 Ac)
MCDONOUGH DITCH (957 AF, 435 Ac)
GOVERNMENT DITCH (2564 AF, 1222 Ac)
MILLER DITCH (456 AF, 185 Ac)
TARBELL AND ALEXANDER D (883 AF, 400 Ac)
MESA DITCH (4114 AF, 1874 Ac)
PARLIN NO 2 DITCH (319 AF, 181 Ac)
PARLIN QUARTZ CREEK D (316 AF, 465 Ac)
O'REGAN NO 1 DITCH (339 AF, 139 Ac)
MCGOWAN IRRIGATING D (485 AF, 254 Ac)
GOODRICH DITCH (342 AF, 157 Ac)
28_ADG044 (3548 AF, 1586 Ac)
COATS BROS DITCH (278 AF, 210 Ac)
D A MCCONNELL DITCH (444 AF, 192 Ac)
CAIN BORSUM DITCH (152 AF, 120 Ac)
CLOVIS METROZ NO 1 DITCH (92 AF, 41 Ac)
ROGERS METROZ DITCH (187 AF, 98 Ac)
CUTJO DITCH (147 AF, 146 Ac)
WATERMAN METROZ DITCH (221 AF, 100 Ac)
LOCKWOOD MUNDELL DITCH (65 AF, 98 Ac)
SORRENSON IRRIGATING D (453 AF, 274 Ac)
FIELD AND VADER DITCH (667 AF, 274 Ac)
TORNAY HIGHLINE DITCH (642 AF, 382 Ac)
CHITTENDEN DITCH (552 AF, 335 Ac)
HOT SPRINGS NO 2 DITCH (227 AF, 109 Ac)
WICKS ROWSER DITCH (449 AF, 185 Ac)
STEPHENSON DITCH (312 AF, 204 Ac)
MONSON AND MCCONNELL D (365 AF, 243 Ac)
COX AND MCCONNELL DITCH (15 AF, 30 Ac)
S DAVIDSON AND CO FOR D NO 1 (72 AF, 36 Ac)
28_ADG009 (3075 AF, 1413 Ac)
ARCH IRRIGATING DITCH (3543 AF, 1662 Ac)
DUNN AND WATTERS DITCH (224 AF, 91 Ac)
OWEN NO 1 DITCH (28 AF, 35 Ac)
HAWES-BERGEN-GILBERTSON (182 AF, 99 Ac)
GILBERTSON NO 1 DITCH (121 AF, 61 Ac)
MCDONALD BERDEL EX D (299 AF, 131 Ac)
WOODBRIDGE DITCH (254 AF, 126 Ac)
WOOD AND GEE DITCH (297 AF, 176 Ac)
MEANS BROS NO 8 DITCH (307 AF, 141 Ac)
MEANS BROS NO 12 DITCH (37 AF, 18 Ac)
MEANS BROS NO 13 DITCH (64 AF, 32 Ac)
KENDALL NO 4 DITCH (124 AF, 59 Ac)
KENDALL NO 3 DITCH (66 AF, 34 Ac)
CLARK NO 3 DITCH (78 AF, 58 Ac)
OWEN REDDEN DITCH (296 AF, 493 Ac)
CLARK NO 2 DITCH (43 AF, 31 Ac)
SARGENTS NO 2 D (18 AF, 12 Ac)
COLE NOS 1 2 AND 3 DITCHES (136 AF, 65 Ac)
KANE DITCH (105 AF, 46 Ac)
AGATE NO 2 DITCH (42 AF, 19 Ac)
CLARK NO 1 DITCH (11 AF, 14 Ac)
SARGENTS NO 1 D (33 AF, 15 Ac)
MEANS BROS NO 4 DITCH (21 AF, 21 Ac)
MEANS BROS NO 5 DITCH (26 AF, 33 Ac)
MEANS BROS NO 6 DITCH (24 AF, 10 Ac)
MEANS BROS NO 7 DITCH (61 AF, 25 Ac)

Mill Creek
Ohio Creek
Willow Creek
Steuben Creek
Gunnison River
Cerro Creek
East River
Taylor River
Quartz Creek
Tomichi Creek
Cochetopa Creek
Archuleta Creek
Nicholl Creek
Razor Creek
West Pass Creek
Marshall Creek
Pauline Creek
Los Pinos Creek
Cebolla Creek

GUNNISON
PITKIN
PONCHA SPRINGS
BONANZA

742
50
285
27
5
41G
T
53

Legend

- Stream / River
- Canal
- Municipality
- Lake

Maximum Percent Shortage

- 0% - 20%
- 20% - 40%
- 40% - 60%
- 60% - 80%
- 80% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 1.5 3 6
Miles

Figure 4-18
Gunnison Basin: Water District 28 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

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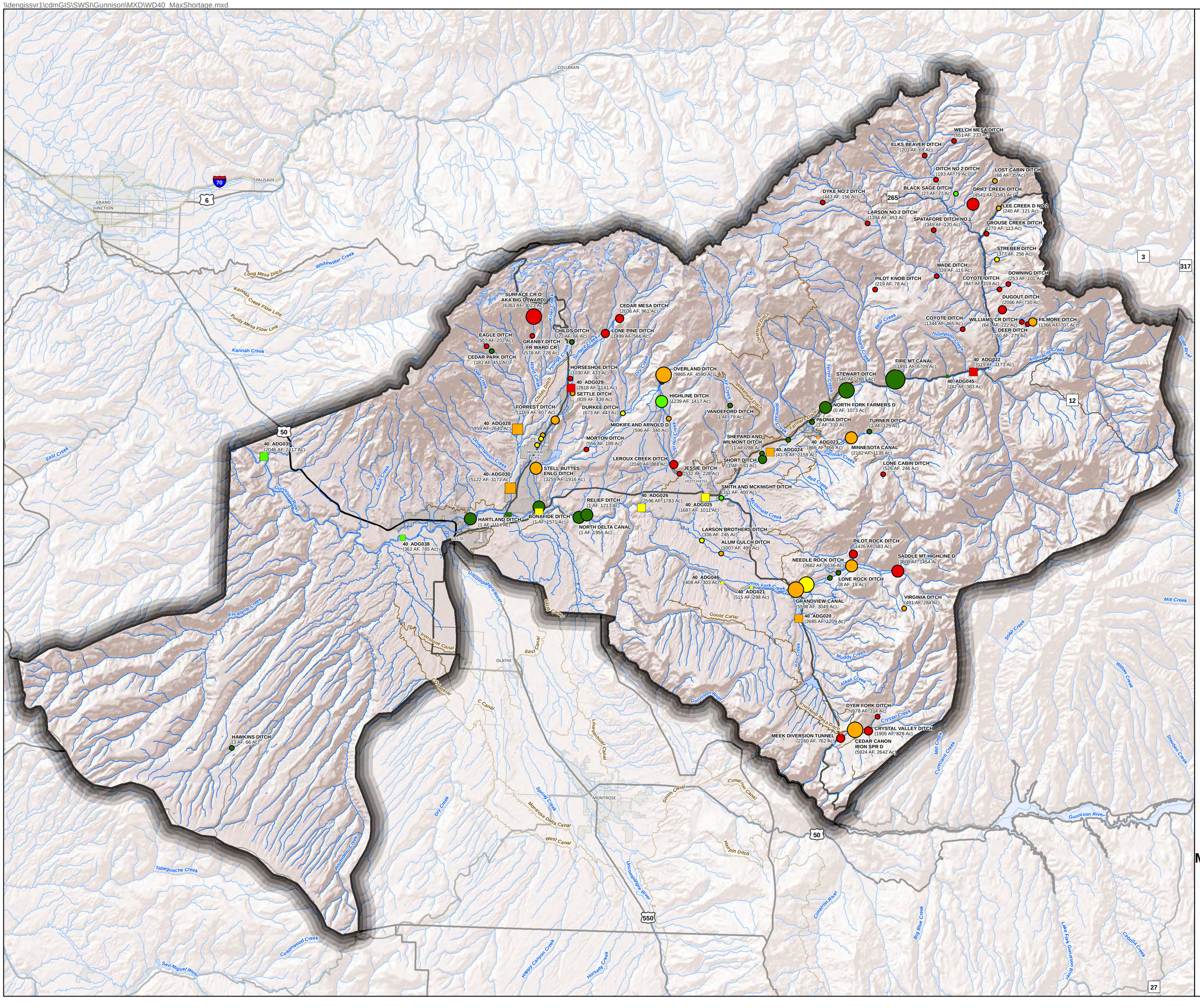

Figure 4-19

Gunnison Basin: Water District 40 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

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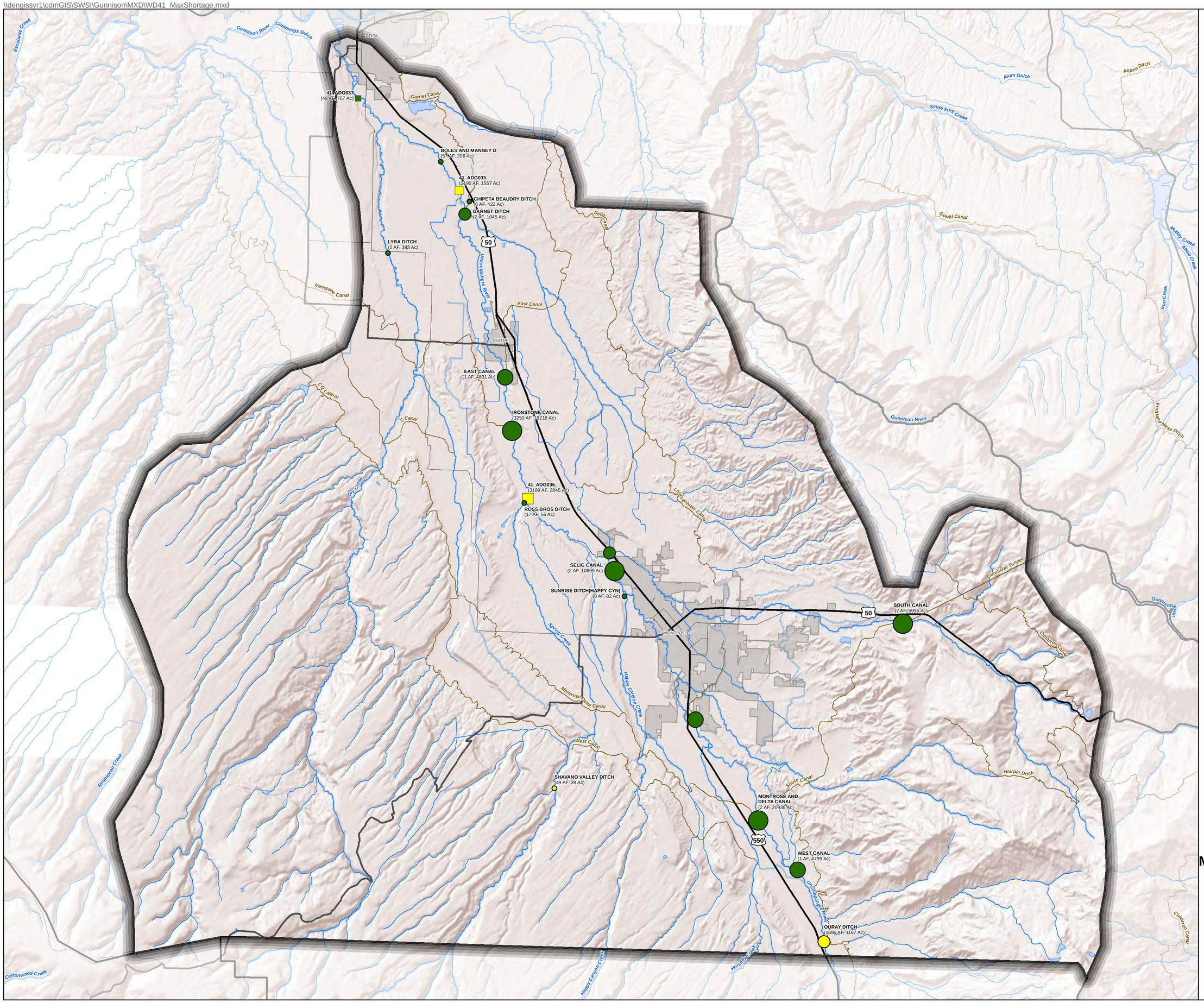
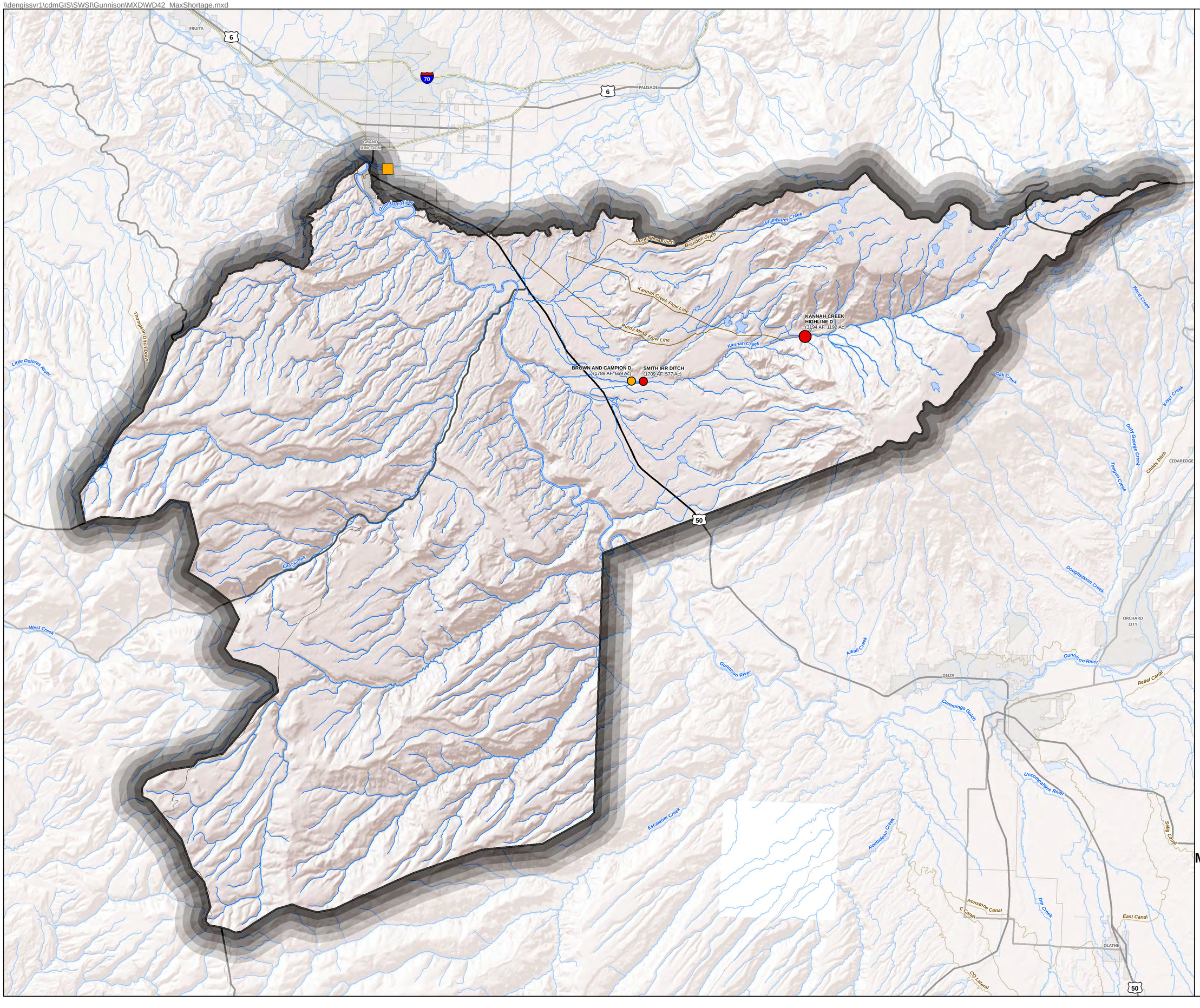


Figure 4-20
Gunnison Basin: Water District 41 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

\\dengissvr1\cdmGIS\SWSI\Gunnison\MXD\WD42_MaxShortage.mxd



Legend

- Stream / River
- Canal
- Municipality
- Lake

Maximum Percent Shortage

- 0% - 20%
- 20% - 40%
- 40% - 60%
- 60% - 80%
- 80% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 1 2 4
Miles

Figure 4-21
Gunnison Basin: Water District 42 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

\\dengissvr1\cdmGIS\SWSI\Gunnison\MXD\WD59_MaxShortage.mxd

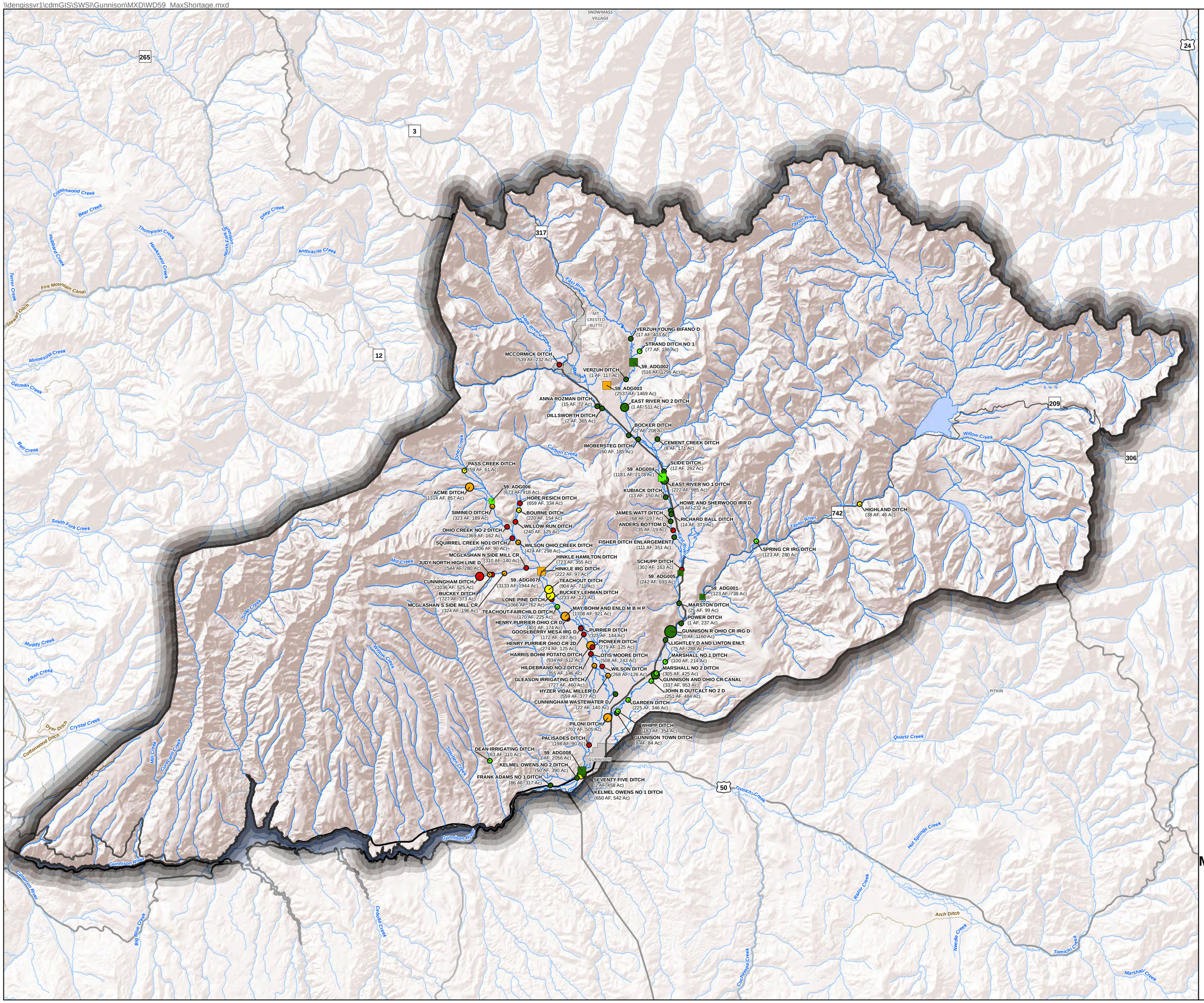


Figure 4-22

Gunnison Basin: Water District 59 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

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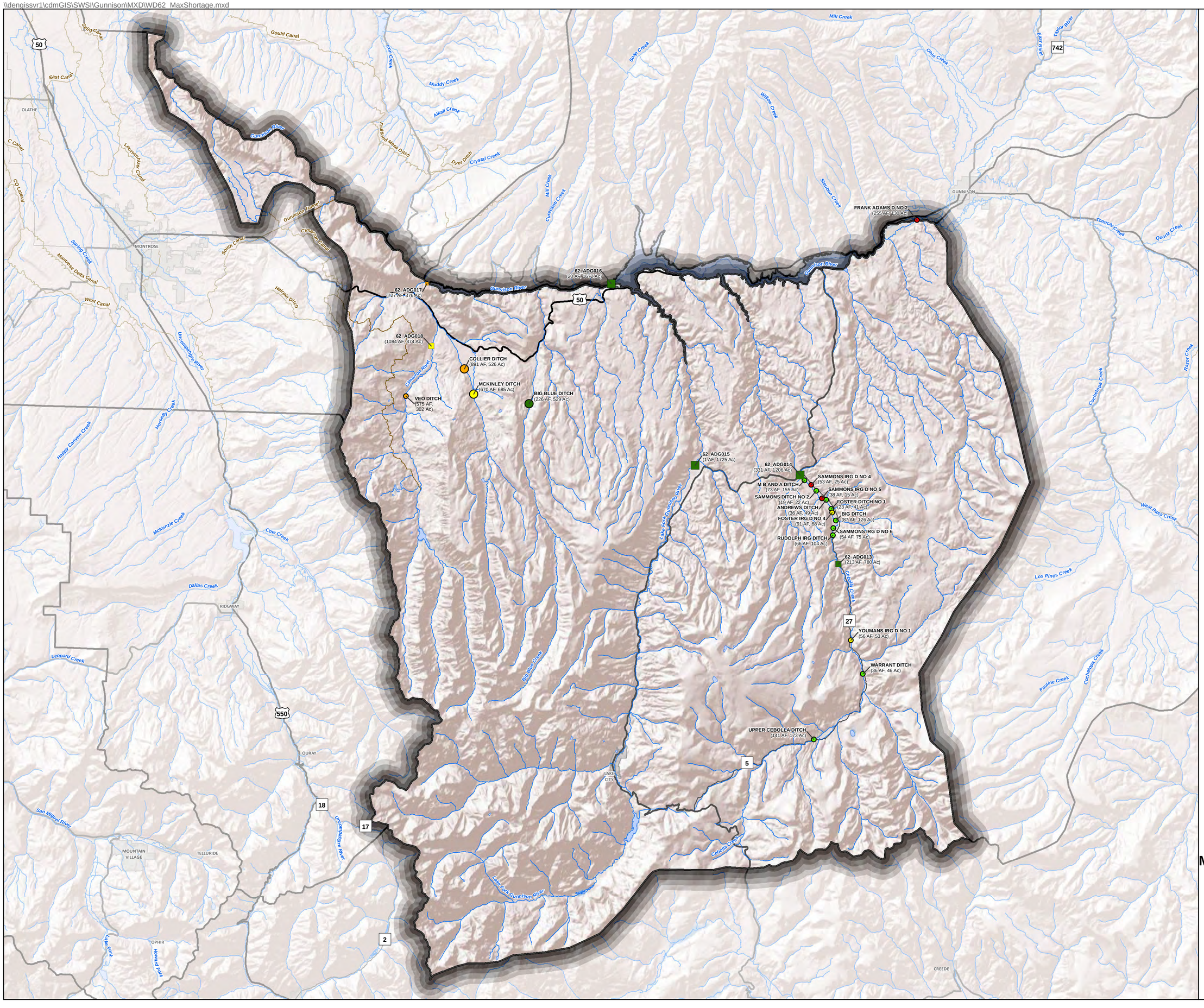

Figure 4-23

Gunnison Basin: Water District 62 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

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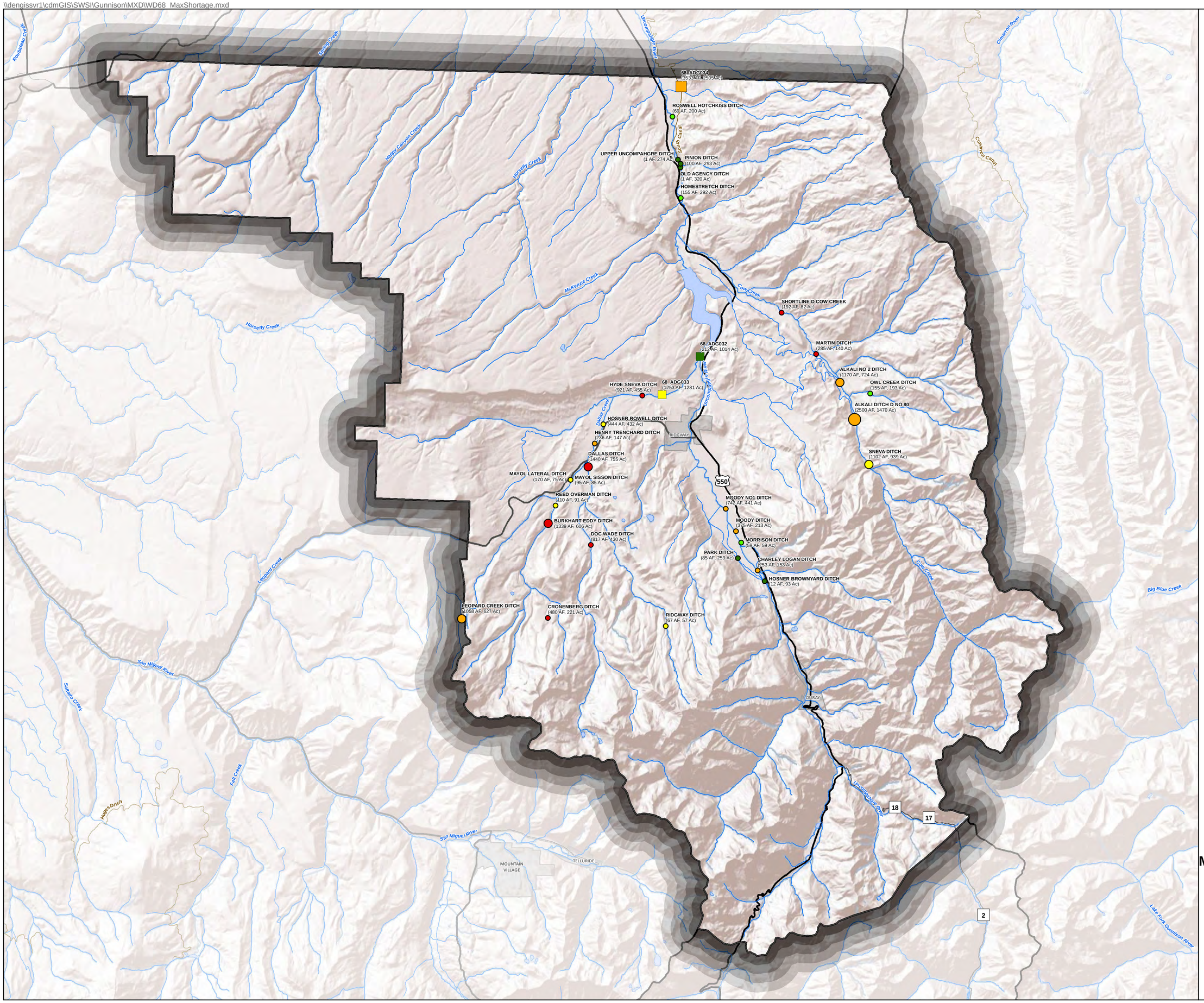

Legend

- Stream / River
- Canal
- Municipality
- Lake

Maximum Percent Shortage

- 0% - 20%
- 20% - 40%
- 40% - 60%
- 60% - 80%
- 80% - 100%

Crop Area Acres

- Less Than 500 Acres
- 500 - 1,000 Acres
- 1,000 - 2,500 Acres
- 2,500 - 5,000 Acres
- Greater Than 5,000 Acres

Structure Type

- Explicitly Modeled Structure
- Aggregated Structure

N
W E
S

0 1 2 4
Miles

Figure 4-24
Gunnison Basin: Water District 68 Maximum Agricultural Shortages and Irrigated Acres by Structure

CDM

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Section 5
Gunnison Basin Consumptive Projects and Methods and the M&I Gap

5.1 Projects and Methods to Address the M&I Gap Overview

Section 4 of this report summarizes the consumptive water needs across the State of Colorado and the Gunnison Basin. As discussed in Section 1, the Colorado Water for the 21st Century Act requires the basin roundtables to identify projects and methods to meet their consumptive needs.

Section 5.2 summarizes the major projects and methods identified to meet future municipal and industrial (M&I) consumptive needs; Section 5.3 documents the resulting assessment of M&I gaps.

In order to identify M&I projects and methods, the Colorado Water Conservation Board (CWCB) worked with water providers and the basin roundtables to update the Statewide Water Supply Initiative (SWSI) 1 identified projects and processes (IPPs). This information was used to estimate a low, medium, and high 2050 M&I gap corresponding to the M&I demand projections summarized in Section 4 and different IPP success rates. To be clear, an M&I "gap" in the context of this study is not indicative of a future water supply shortfall; rather, it is a future water supply need for which a project or method to meet that need is not presently identified.

It is important for the reader to recognize that the analyses documented in this section are intended for the purpose of "big picture" statewide planning. While data and other information were collected from individual water providers, the results presented herein are for the purpose of general statewide and basinwide planning and are not intended to be used for individual provider planning, site-specific analysis, or project-specific purposes.

5.2 Projects and Methods to Meet M&I Consumptive Needs

The Gunnison Basin Roundtable developed a map of their consumptive IPPs. These IPPs are projects that address both M&I and agricultural needs. This is shown in **Figure 5-1**. This map is in addition to the M&I IPPs that are discussed throughout the remainder of this section.

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Electric Mtn Res-28000 af
Overland Reservoir Enlargement
Surface Creek Reservoirs
Rehabilitation/Enlargement-28 Reservoirs LCWUA
Overland Ditch
Paonia Reservoir Sedimentation
Cactus Park Reservoir site
West Fork Reservoir
West Reservoir Enlargement
Fire Mtn Canal
Minnesota Reservoir Rehab
Beaver Reservoir Rehab
Fruitgrowers Reservoir Pumpback
Relief Ditch Diversion
Hartland Canal Headgate
North Delta Canal
East Beckwith Enlargement; Lost Lake Reservoir
Meridian Lake Reservoir Enlargement
Brush Creek Reservoir
Buckhorn Lake Enlargement
Cunningham Gulch Reservoir & Cunningham Lake Reservoir
Taylor River Canal
Leaps Gulch Reservoir
Taylor River Canal - Small Storage Sites 1-3
Fruitland Mesa Canal Siphon
UVWUA Ditch lining-Selenium control
Project 7/UVWUA off system storage reservoir
Long Branch Reservoir
Enlargement of McDonough Reservoir #1
Ridgeway Lake Otonawanda Enlargement
City of Ouray supply ditch improvement
Ouray storage/ hydro reservoir

50 265 317 12 209 742 550 27 5 18 17

Kannah Creek · Whitewater Creek · Ward Creek · Oak Creek · Adobe Creek · Chipps Ditch · Leroux Creek · Overland Ditch · Jay Creek · Farmers Ditch · Fire Mountain Canal · North Fork Gunnison · Deep Creek · Anthracite Creek · Slate River · East River · Taylor River · Willow Creek · Canyon Creek · Mill Creek · Ohio Creek · Wilson Creek · Spring Creek · Curecanti Creek · Soap Creek · Gunnison River · Tomichi Creek · Quartz Creek · Arch Ditch · Needle Creek · Marshall Creek · Razor Creek · West Muddy Creek · Cimarron Creek · Cimarron River · Cimarron Canal · Lake Fork Gunnison River · Cebolla Creek · Big Blue Creek · Los Pinos Creek · Pauline Creek · Crystal Creek · Muddy Creek · Alkali Creek · Smith Fork Creek · Alum Gulch · Gould Canal · Roubideau Creek · Escalante Creek · Alkali Creek · Gunnison River · Easy Creek · Dry Creek · Ironstone Canal · C-Q Lateral · Spilly Canal · Smith Creek · West Canal · Selim Canal · Uncompahgre River · Happy Canyon Creek · McKenzie Creek · Cow Creek

MT. CRESTED BUTTE · CRESTED BUTTE · ORCHARD CITY · DELTA · OLATHE · MONTROSE · GUNNISON · PITKIN · LAKE CITY

Legend

- Existing Reservoir Enlargement or Rehab
- Ditch or Headgate Improvement
- New Reservoir Site
- All Other Locations
- Stream / River
- Canal
- Municipality
- Lake

N W E S

0 3 6 12
Miles

Figure 5-1

Gunnison Basin Consumptive Projects and Methods

CDM

Water providers throughout Colorado are pursuing water supply projects and planning processes to help meet future water demands. These IPPs, if successfully implemented, have the ability to meet some, but not all of Colorado's 2050 M&I water needs. IPPs are defined as projects and methods local water providers are counting on to meet future water supply needs. Future M&I water supply needs that are not met by an IPP are considered an M&I water supply gap. The estimation of future M&I water supply gaps is dependent upon several factors, including current water use, forecasted future water use, and water provider predictions of new water supply that will be developed through IPPs.

Statewide, these analyses were performed on a countywide basis and aggregated by basin roundtable area. For the Front Range counties in the Arkansas, Metro, and South Platte Basins, the county results were aggregated to a regional subbasin level for presentation in this report and consistency with SWSI 1. The majority of population growth over the next 40 years is expected to occur in these basins.

5.2.1 Identified Projects and Processes Methodology

The first part of the M&I gap analysis is to calculate 2050 total new M&I water needs, which is described in Section 4. The second part of the 2050 M&I and SSI gap analysis is to calculate the anticipated yield from the water providers' 2050 IPPs, assuming 100 percent success rate. For counties with more than one surveyed water provider, all relevant information was compiled to create the most complete picture of projected water supplies in the county. This IPP yield is then subtracted from the 2050 net new water needs (i.e., demand increases above existing supplies) at the county level. Where the total water provider IPP yield in a county exceeded the projected county demand for the low, medium, or high scenarios, the extra water was assumed to not be available for redistribution to other counties unless otherwise noted.

Information on water providers' IPPs was obtained from the following sources:

- CWCB interviews and data collected from water providers throughout the state in 2009–2010
- Section 6 of the SWSI 1 report (published 2004, data based on projections to 2030)
- Basin roundtable updates (e.g., Arkansas 2008 report, June 2010 presentation by Applegate)

CWCB staff conducted outreach interviews in 2010 with most municipal water providers delivering 2,000 acre-feet per year (AFY) or more, including the top three water providers in each basin, where possible. Not every water provider responded; however, with significant basin roundtable assistance, many water providers submitted data in addition to the original list. This outreach was used to determine what projects and methods water providers are pursuing to meet their future needs along with confirmation of water demand data. In an effort to obtain more detailed data on providers' IPPs than was available for SWSI 1, interviewed entities were asked to delineate IPPs into the following categories:

- Agricultural water transfers
- Reuse of existing fully consumable supplies
- Growth into existing supplies
- Regional in-basin projects
- New transbasin projects
- Firming in-basin water rights
- Firming transbasin water rights

Passive and active conservation measures are not included in the categorized IPPs. Passive conservation is already factored into the 2050 M&I demand forecasts presented in Section 4.

The categorized IPP data presented in this section is based on information provided by the interviewed water providers on what their firm treated water deliveries will be for each category of IPP. While some IPPs include features that could be applied across more than one category, CWCB relied upon the water

providers' data to assign the various projects and methods to the single most appropriate category. For example, although not explicitly quantified herein, it is likely that the true yield anticipated from agricultural water transfers is higher, but many water providers have captured agricultural transfers in IPPs falling in other categories such as regional in-basin projects or firming in-basin water rights. Some entities may also own agricultural water rights that are presently being leased back to agricultural water users; future M&I use of these supplies may be considered by some water providers to be growth into existing supplies. Based on these efforts IPP data were updated for 75 providers covering approximately 80 percent of the population in Colorado. Many of the quantified IPPs specified by the interviewed M&I water providers are identified in Appendix J of the SWSI 2010 Report.

The interview summary provided by CWCB identified and quantified many of the water providers' IPPs associated with each category. Where IPP information was derived from other sources, professional judgment was used to assign predicted yield to the most appropriate category. This approach was primarily applied to IPP data from the SWSI 1 report, which tallied IPPs by county or subbasin, but generally did not categorize yields from specified types of IPPs.

Because of the need for flexibility, reliability, and future uncertainty, many water providers design projects to meet needs based on planning numbers, which are often greater than current per capita water usage rates. Some specific reasons include—1) ensuring water supply if another system fails, 2) planning for drought or climate change, 3) an expected increase in commercial water use, or 4) concerns that one or more planned project will not be successfully implemented. Furthermore, many water rights limit the use of water to the specific water right holder, causing legal barriers to sharing water supplies. For these reasons, where the total potential volume of IPPs exceeded either the 2050 total water needs or the 2050 total water needs minus any provider-specified gaps, a pro-rata share reduction was applied to each IPP category relevant to that county or subbasin. For example, total quantified IPPs for the interviewed providers in a particular county exceed 50,000 AFY, but IPPs required to meet 2050 net new water needs range from 18,000 AFY to 30,000 AFY. A percentage of the total 50,000 AFY yield from IPPs is associated with each of the seven categories of IPPs, but since less IPP yield is actually needed to meet demands, the same category distribution percentages were applied to the lesser need. In other words, the amount of yield from each IPP category is reduced such that only the amount actually necessary to meet 2050 new water needs is applied.

Note, however, that this methodology and data presentation does not in any way preclude water providers from developing IPPs in excess of their 2050 needs. Rather, it is beyond the scope of this gap analysis to present data for individual water providers whose demand projections, planning horizon, and system reliability may differ from the regional analysis presented here. Any excess IPP volume quantified for a particular county is assumed to not be available to meet water supply gaps in other counties, unless specified otherwise. Likewise, there was no intention of implying intra-county sharing among water providers, unless specifically noted. By proportionally scaling back each entity's 2050 IPP yields when the sum of all entities' IPPs in a particular county exceed the forecasted 2050 net new water needs for that county—and explicitly accounting for provider-specified gaps—it is CWCB's intention to avoid implying that any one provider's excess yield would be used to meet the shortfall (i.e., gap) of another water provider.

5.2.2 Estimation of 2050 IPP Yield by Basin

A broad range of water management solutions with varying levels of supply are planned for each of the basins. The following sections summarize the yields of IPPs statewide and for each county or region in each basin at the 100 percent success rate. As described above, due to the number of counties and distinct areas in the Arkansas, Metro, and South Platte Basins, those basins are summarized by region, whereas each of the other basins is discussed at a county level. Because of the overall volume of demand and the size of the

projected gaps in the South Platte and Arkansas Basins, those basins' IPPs lists are more populated than the other basins' lists.

Many water providers are pursuing multiple projects and will need to pursue all of these identified projects to meet their increased demand by the year 2050. This is due to the reality that each of the IPPs has associated risk and may not yield all of the anticipated water supply. Alternate IPP yield success rates (i.e., less than 100 percent) are addressed subsequently in Section 5.3.2. The results of calculations based on the alternate IPP success rates are incorporated into the gap analysis presented in Section 5.3.3. Additionally, many of these IPPs will benefit multiple beneficiaries and therefore address a number of objectives concurrently. However, challenges exist in determining funding sources and acquiring water rights to support the multiple uses. In addition to quantified IPP yields, the tables for each basin also include a general summary of the major projects and other IPPs in each county or region.

5.2.2.1 Statewide

Statewide, the new water supplies needed for M&I and self-supplied industrial (SSI) use by the year 2050—above and beyond all existing supplies—are estimated to range from about 600,000 AFY to nearly 1 million AFY (see Section 4). This range reflects the uncertainty associated with forecasting water demands 40 years into the future, in particular SSI demands associated with energy development and other market-driven commodities. Based on extensive interviews with water providers, input from basin roundtable and Interbasin Compact Committee (IBCC) members, and a thorough review of other pertinent information, IPPs have been identified that will meet a significant portion of these future new demands.

Applying the general methodology for assessing IPPs described in Section 5.2.1, the IPPs were grouped into seven primary categories. **Table 5-1** identifies the anticipated range of yield from each category for each basin. For this and many of the subsequent tables, values are presented as a range, with the low and high yield values shown. Where the yield values do not change from low to high, a single value is shown rather than a range. Although the interviewed water providers generally provided demand and IPP data for a 2050 medium growth scenario, the ranges presented herein derive from the use of low, medium, and high population and demand levels for 2050 for the various analyses associated with SWSI 2010.

As shown in Table 5-1, quantified IPPs at 100 percent yield success would provide approximately 430,000 AFY, or about 72 percent of the new demands under the low growth scenario. At the high end, again assuming 100 percent success rate, IPPs would total about 580,000 AFY and represent approximately 58 percent of the high demand increase. The largest categories of IPP yields by volume are projected to be regional in-basin projects (150,000 AFY to 170,000 AFY) and growth into existing supplies (100,000 AFY to 160,000 AFY). **Figure 5-2** depicts the data graphically; for the individual basins that follow, the corresponding figures can be found in Appendix J of the SWSI 2010 Report.

Table 5-1 Major Categories of Identified Projects and Processes by Basin (Yields at 100% Success Rate) [1]

Basin	Agricultural Transfer (AFY)	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	New Transbasin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	Total IPPs at 100% Success Rate (AFY)
Arkansas	9,200 – 11,000	23,000 – 32,000	2,300 – 2,600	37,000	0	6,100 – 7,300	10,000 – 11,000	88,000 – 100,000
Colorado	2,900 – 8,000	500	14,000 – 28,000	13,000 – 15,000	0	11,000 – 19,000	0	42,000 – 70,000
Gunnison	**400 – 500**	**0**	**1,100 – 1,700**	**11,000 – 15,000**	**0**	**900**	**0**	**14,000 – 18,000**
Metro	20,000 – 33,000	14,000 – 21,000	55,000 – 86,000	34,000 – 39,000	13,000 – 23,000	900 – 1,400	3,500 – 4,800	140,000 – 210,000
North Platte	0	0	100 – 300	0	0	0	0	100 – 300
Rio Grande	0	0	2,900 – 4,300	0	0	3,000 – 4,300	0	5,900 – 8,600
South Platte	19,000 – 20,000	5,000 – 7,000	20,000 – 30,000	37,000 – 39,000	0	22,000 – 26,000	18,000 – 21,000	120,000 – 140,000
Southwest	0	0	5,200 – 7,300	9,000 – 13,000	0	0	0	14,000 – 21,000
Yampa-White	0	0	3,500 – 4,900	6,600 – 9,000	0	0	0	10,000 – 14,000
Total	**51,000 – 73,000**	**43,000 – 61,000**	**100,000 – 160,000**	**150,000 – 170,000**	**13,000 – 23,000**	**44,000 – 58,000**	**32,000 – 37,000**	**430,000 – 580,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.

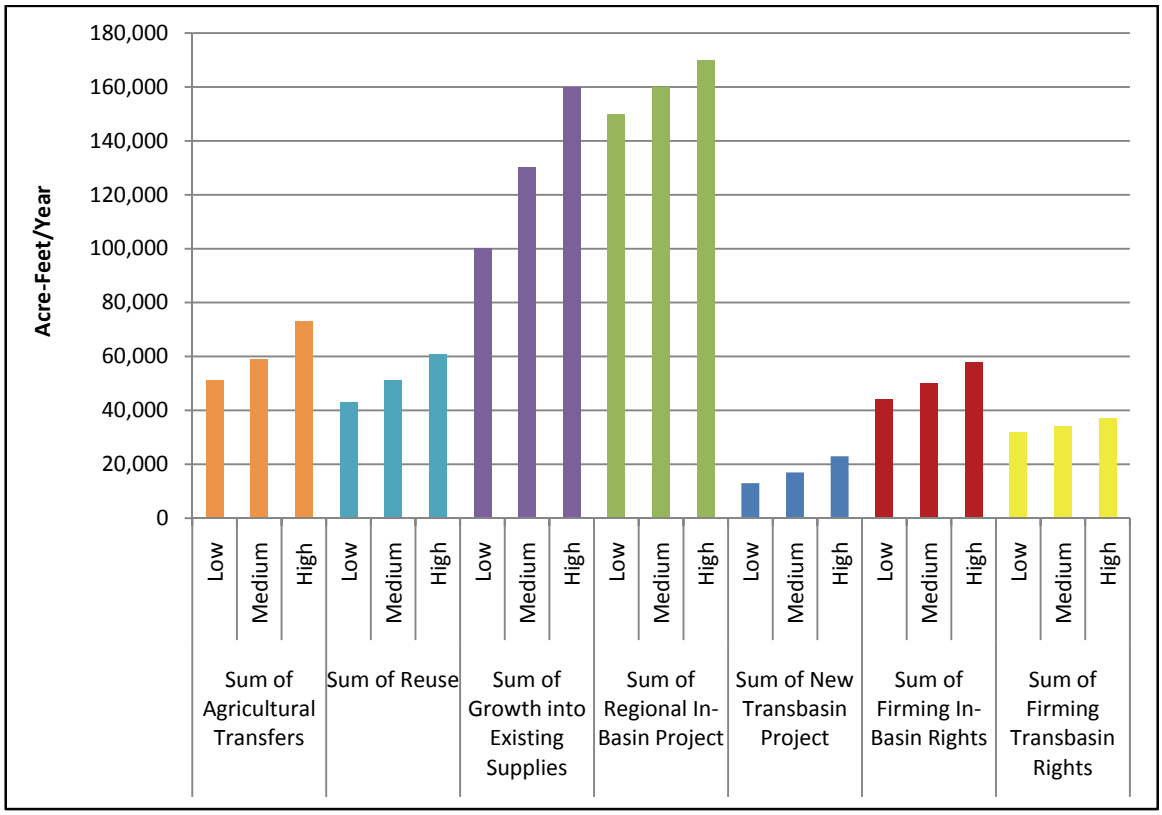

Figure 5-2 Statewide Summary of Yield for IPP Categories at 100% Success Rate

5.2.2.2 Gunnison Basin

In the Gunnison Basin, much of the M&I and SSI new water needs will be addressed through greater use of existing water rights and new regional in-basin projects. The Tri-County Water Conservancy District, which serves much of Montrose, Delta, and Ouray Counties, holds water rights in the Dallas Creek Project. Combined with water from the Project 7 Water Authority, these counties are anticipated to have adequate water supplies through 2050.

The Upper Gunnison River Water Conservancy District (UGRWCD) provides augmentation for wells in a portion of the upper basin. The upper Gunnison Basin is projected to experience high rates of population growth. The Crested Butte area may experience significant growth if adequate water supplies for M&I and snowmaking can be developed. Augmentation of existing or proposed environmental and recreational water rights, such as CWCB instream flow rights and recreational in-channel diversions (RICDs) and senior agricultural and M&I water rights, will likely require the construction of storage in upper areas of Gunnison River tributaries.

Through interviews conducted by CWCB, three projects sponsored by the UGRWCD and others were identified:

- UGRWCD/Hinsdale County Commissioners – Lake San Cristobal enlargement
- UGRWCD/Mt. Crested Butte – Augmentation storage
- UGRWCD – Augmentation plan for nonagricultural purposes using Aspinall Unit

The projected yield from the Lake San Cristobal enlargement is 950 AFY, far exceeding all levels of 2050 demand for Hinsdale County. Surplus supplies from this IPP were assumed to be made available to meet the gap in Gunnison County. Regarding the last project listed above, the UGRWCD has a 500 AFY pool in Blue Mesa Reservoir that can be used to replace depletions to downstream calls. The challenge for the UGRWCD will be to develop storage to replace depletions to CWCB instream flows, the Gunnison Whitewater Park RICD, and senior agricultural and M&I water rights upstream of Blue Mesa Reservoir. Collectively, these UGRWCD projects meet all or a part of the future water needs in Gunnison and Hinsdale Counties.

Anticipated yields from each category of IPPs at 100 percent success rate are summarized for the Gunnison Basin in **Table 5-2**.

Table 5-2 Gunnison Basin IPP Summary at 100% Success Rate

Region or County	Agricultural Transfer (AFY)	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	New Transbasin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	Total IPPs at 100% Success Rate (AFY)
Delta County	0	0	0	3,700 – 4,900	0	0	0	3,700 – 4,900
Delta County IPP • Project 7								
Gunnison County	0	0	0	700	0	900	0	1,600
Gunnison County IPPs • Lake San Cristobal water development • Augmentation for nonagricultural purposes using Aspinall Unit • Augmentation storage for Mt. Crested Butte								
Hinsdale County	0	0	0	200 – 300	0	0	0	200 - 300
Hinsdale County IPP • Lake San Cristobal water development								

Table 5-2 Gunnison Basin IPP Summary at 100% Success Rate, continued

Region or County	Agricultural Transfer (AFY)	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	New Transbasin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	Total IPPs at 100% Success Rate (AFY)
Mesa County	400 – 500	0	1,100 – 1,700	0	0	0	0	1,500 – 2,200
Mesa County IPPs • Existing water rights • Agricultural transfers								
Montrose County	0	0	0	6,700 – 8,600	0	0	0	6,700 – 8,600
Montrose County IPP • Project 7								
Ouray County	0	0	0	20 – 500	0	0	0	20 – 500
Ouray County IPP • Project 7								
Total[1]	**400 – 500**	**0**	**1,100 – 1,700**	**11,000 – 15,000**	**0**	**900**	**0**	**14,000 – 18,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.

5.3 M&I Gap Analysis

The IPPs being pursued by local water providers represent significant quantities of water and the implementation of these local projects and plans is critical to meeting Colorado's future water supply needs. However, even with the implementation of the IPPs, there are still remaining M&I and SSI consumptive water supply gaps that will need to be satisfied. As stated previously, the calculated gaps do not necessarily represent a future water supply shortage, but the gaps do demonstrate where additional work is needed to identify projects and methods to meet those future needs. The following sections summarize the calculations and results of the 2050 M&I and SSI gap analysis. As described previously, this analysis includes 2050 low, medium, and high gap values to account for the inherent uncertainty in long-range population, demand, and water supply forecasting. Future M&I and SSI demands were assessed in Section 4 of this report.

Section 5.3.1 presents the M&I and SSI gap calculation methodology generally, followed by details on the variations that occur within the calculations for each basin. The calculations as described in Section 5.3.1 are based on the assumption of 100 percent success rate for the development of IPP yield. Section 5.3.2 describes alternate (i.e., less than 100 percent) IPP yield success rates for each basin as they are applied to estimate the 2050 medium and high gaps. Section 5.3.3 summarizes the results of the gap analysis at the statewide level and for the Gunnison Basin.

The results of the gap analysis presented in this report are based on the estimated firm yield of IPPs. Furthermore, the demand values that are integral to the gap calculations are based on water providers' treated water deliveries and do not account for losses during raw water collection, treatment, and distribution, which are highly variable depending on, among other things, water source, types of treatment processes, and age and condition of distribution system. Additionally, there are many future uncertainties such as the potential for climate change, drought, infrastructure failure, and other factors. Therefore, raw water needs are very likely to be greater than the gap values presented in this report.

Note that current and future agricultural consumptive demands and shortages were assessed in Section 4 of this report. Calculated irrigation shortages are based on available water supply being less than the ideal

amount required for meeting the consumptive use requirements of a particular crop. Changes in these calculated results for 2050 relative to 2008 are generally driven by the anticipated loss of irrigated land to development and other factors. The discussions that follow apply only to the M&I and SSI consumptive gap analysis.

5.3.1 M&I Gap Analysis Methodology

For the purpose of this study, the M&I and SSI water supply gap is defined as follows:

M&I and SSI Water Supply Gap = 2050 Net New Water Needs – 2050 IPPs

where:

2050 Net New Water Needs = (2050 low/medium/high M&I baseline demands – high passive conservation - current M&I use) + (2050 low/medium/high SSI demands – current SSI use)

2050 IPPs = Water Provider Anticipated Yield from: Agricultural Transfers + Reuse + Growth into Exiting Supplies + Regional In-basin Projects + New Transbasin Projects + Firming In-basin Water Rights + Firming Transbasin Water Rights

If the available IPPs exceeded the 2050 water needs for a particular county, the IPPs were reset equal to the 2050 water needs. As stated previously herein, this calculation effectively scales back the yield of each IPP in a pro-rata fashion in order to present only the amount of yield necessary to meet water supply needs at the 2050 planning horizon. Sometimes this occurs for all three growth scenarios, sometimes for only low or low and medium. It is generally assumed that one county's surplus IPPs would not be reallocated to another county and that one provider's surplus would not be specifically allocated to meet another provider's gap. This approach was applied in all basins, unless specified otherwise.

The 2050 M&I and SSI gap is referred to in the results tables (see Section 5.3.3) as the "information/real" gap. The "real" gap is based on known numerical data from the *Demands to 2050 Report*, water provider interviews and data, SWSI 1, and other sources. Based on this information, 2050 M&I and SSI demand forecasts exceed the anticipated yields of water providers' IPPs and the result is a real, defined gap. An "information" gap arises due to a lack of numerical data to support more detailed gap quantification for some water providers or even counties and subbasins.

The preceding description represents the general approach to the M&I gap analyses, with the yields of IPPs based on the 100 percent success rate. However, the process was modified as necessary for each county and basin based on the available source data. The following sections outline variations to the methodology in each basin. These are general descriptions and do not necessarily capture every variation for every county; however, additional details about the calculations for each county or region are provided in Appendix J of the SWSI 2010 Report.

5.3.1.1 Gunnison Basin

Following are the assumptions used to revise the Gunnison Basin's gap calculations:

- The 2050 net new water needs were calculated based on the M&I *Demands to 2050 Report* as described for the general approach.
- IPPs for the Gunnison Basin were summarized in Section 5.2.2.2.
- Delta County included provider-specified gaps based on CWCB interview data. Delta County and Ouray County included additional gaps for specific providers identified in SWSI 1. Delta, Mesa, Montrose, and Ouray Counties included an M&I gap for unincorporated areas equal to 5 percent of

2050 M&I water needs, also based on SWSI 1. For these four counties, the information/real gap was calculated as the sum of known gaps.

- Based on the IPPs exceeding 2050 net new water needs, Hinsdale County has no 2050 water supply gaps.
- After applying the Hinsdale County surplus IPPs to Gunnison County and calculating the gap as 2050 net new water needs minus IPPs, Gunnison County has 2050 gaps for the low, medium, and high growth scenarios.

5.3.2 Gap Analysis with Alternate IPP Yield Scenarios

The assumptions and calculations described in Section 5.3.1 above evaluate the gap based on a 100 percent success rate for IPP yield development. To assess the full range of the 2050 M&I and SSI Gap, CWCB developed three potential scenarios to bracket the range of the M&I and SSI gap for low to high scenarios. Each scenario has a variable IPP yield success rate applied as a percentage of total IPP yield. For the low gap scenario, it was assumed that 100 percent of the IPPs (see Section 5.2.1) could be applied to the 2050 net new water needs.

For the medium and high gap estimates, the yield of the IPPs was assumed to be varied based on discussions from the IBCC, CWCB, and basin roundtables. For the medium gap scenario, it was assumed that the IPP yield would be reduced based on percent success rates discussed by IBCC in their scenario discussions for the alternative portfolio (see Section 7). IPP yield for the high gap scenario is assumed to be reduced based on the percent success rates as defined in the status quo portfolio that has been discussed by the IBCC. The percentage success rates for IPP yields for the medium and high scenarios are presented in **Table 5-3**.

Table 5-3 IPP Success Rates for the Medium and High Gap Scenarios

Basin	IBCC Alternative Portfolio IPP Yield Success Rates	IBCC Status Quo Portfolio IPP Yield Success Rates
Arkansas	90%	75%
Colorado	90%	90%
Gunnison	**90%**	**90%**
Metro	60%	50%
North Platte	90%	90%
Rio Grande	90%	90%
South Platte	60%	40%
Southwest	75%	75%
Yampa-White	90%	90%

The gap calculations based on alternate IPP yield success rates are best demonstrated by example. The Colorado Basin has an existing (2008) demand of 68,000 AFY and a 2050 low growth demand of about 132,000 AFY, representing an increase of nearly 65,000 AFY. IPPs associated with the Colorado Basin low growth scenario are 42,000 AFY (at 100 percent implementation), leaving a 2050 supply gap of 22,000 AFY under the low gap scenario. The Colorado Basin has a 2050 medium growth demand of 150,000 AFY, representing an increase of 82,000 AFY over the existing demand. Medium growth IPPs total 54,000 AFY at 100 percent yield, but based on Table 5-3, only 90 percent (49,000 AFY) of the yield is assumed to be successfully developed under the medium gap scenario. The result is a gap of about 33,000 AFY in 2050. High growth scenario demands are approximately 180,000 AFY, which is an increase of about 110,000 AFY over the existing scenario. High growth IPPs total 70,000 AFY at 100 percent yield, but under the high gap scenario, again only 90 percent (63,000 AFY) success is achieved. Thus, the Colorado Basin high gap is about 48,000 AFY.

A similar process is utilized for the other basins. For the medium and high statewide analyses, the success rates in Table 5-3 are applied to each basin prior to calculating the overall gaps on an aggregate basis.

5.3.3 2050 M&I and SSI Gap Analysis Results

The water supply gaps resulting from the assumptions and calculations defined in Section 5.3.1 and Section 5.3.2 are summarized in the following sections, first statewide, then for each basin by subbasin (region) or county. The full set of gap results implies nine total gap scenarios based on low, medium, and high M&I demands and three IPP yield scenarios (100 percent success rate, an alternative success rate, and a status quo success rate). For the purpose of discussion, however, the results are reduced to three scenarios in the tables presented in the following sections. These three scenarios encapsulate the full range of anticipated M&I and SSI water supply gaps in 2050, from the lowest low gap scenario (lowest demands with 100 percent IPP success rate) to the highest high gap scenario (high demands with status quo IPP success rates).

5.3.3.1 Statewide

Colorado faces a significant M&I water supply gap in 2050. Under the low gap scenario (low demands and 100 percent IPP success rate), the statewide gap is 190,000 AFY. Under the medium gap scenario (medium demands and an alternative IPP success rate), the statewide gap is about 390,000 AFY. Under the high gap scenario (high demands and status quo IPP success rate), the statewide gap is about 630,000 AFY. By 2050, Colorado's M&I gap could be between 32 percent and 66 percent of new M&I demands.

Table 5-4 provides a summary of each basin's increased M&I and SSI demands relative to current conditions (defined for this study as 2008), the amount of that increase met by the IPPs, and the results of the gap calculations. In general, the low IPPs plus the low remaining M&I and SSI gap equal the low increase in M&I and SSI demand, with some minor variability due to rounding at the county or regional level. The same is true for the medium and high values. The Arkansas and Metro Basins are exceptions to this rule due to the inclusion of additional gap volumes associated with the replacement of existing nonrenewable groundwater sources.

Table 5-4 Statewide M&I and SSI Gaps in 2050[1]

Basin	Increase in M&I and SSI Demand (AFY)			Estimated Yield of Identified Projects and Processes (AFY)			Estimated Remaining M&I and SSI Gap after Identified Projects and Processes (AFY)		
				100% IPP Success Rate	Alternative IPP Success Rates	Status Quo IPP Success Rates	Gap at 100% IPP Success Rate	Gap at Alternative IPP Success Rates	Gap at Status Quo IPP Success Rates
	Low	Med	High	Low	Med	High	Low	Med	High
Arkansas[2]	110,000	140,000	170,000	88,000	85,000	76,000	36,000	64,000	110,000
Colorado	65,000	82,000	110,000	42,000	49,000	63,000	22,000	33,000	48,000
Gunnison	**16,000**	**19,000**	**23,000**	**14,000**	**14,000**	**16,000**	**2,800**	**5,100**	**6,500**
Metro[3]	180,000	210,000	280,000	140,000	97,000	100,000	63,000	130,000	190,000
North Platte	100	200	300	100	200	300	0	20	30
Rio Grande	7,700	9,900	13,000	5,900	6,400	7,700	1,800	3,600	5,100
South Platte	160,000	180,000	230,000	120,000	78,000	58,000	36,000	110,000	170,000
Southwest	20,000	25,000	31,000	14,000	13,000	15,000	5,100	12,000	16,000
Yampa-White	34,000	48,000	95,000	10,000	11,000	13,000	23,000	37,000	83,000
Total	**590,000**	**710,000**	**950,000**	**430,000**	**350,000**	**350,000**	**190,000**	**390,000**	**630,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.
[2] Arkansas gaps include additional 13,500 AFY for Urban Counties replacement of nonrenewable groundwater supplies.
[3] Metro gaps include additional 20,850 AFY for South Metro replacement of nonrenewable groundwater supplies.

Colorado faces immediate M&I water supply needs. **Figure 5-3** illustrates the timing of the statewide M&I and SSI gap for the medium gap scenario. Figures 5-3 through 5-5 show similar information for the Gunnison Basin. For the Gunnison Basin, the M&I gap ranges from 2,800 to 6,500 by 2050. The statewide existing supply is 1,161,000 AFY and is assumed to remain constant through 2050, except for the replacement of nontributary groundwater in Douglas and El Paso counties. Under the medium gap scenario Colorado's immediate M&I water supply needs are met with the successful implementation of the IPPs. The associated yield of the IPPs increases steadily from 2010 through 2020, then at a higher rate of growth through 2030. Under the medium gap scenario, the IPPs are fully implemented by 2030 and yield about 350,000 AFY. Without the successful implementation of additional IPPs, increases in demand after 2030 are assumed to be gap, leading to a 2050 M&I gap of approximately 390,000 AFY for the medium gap scenario.

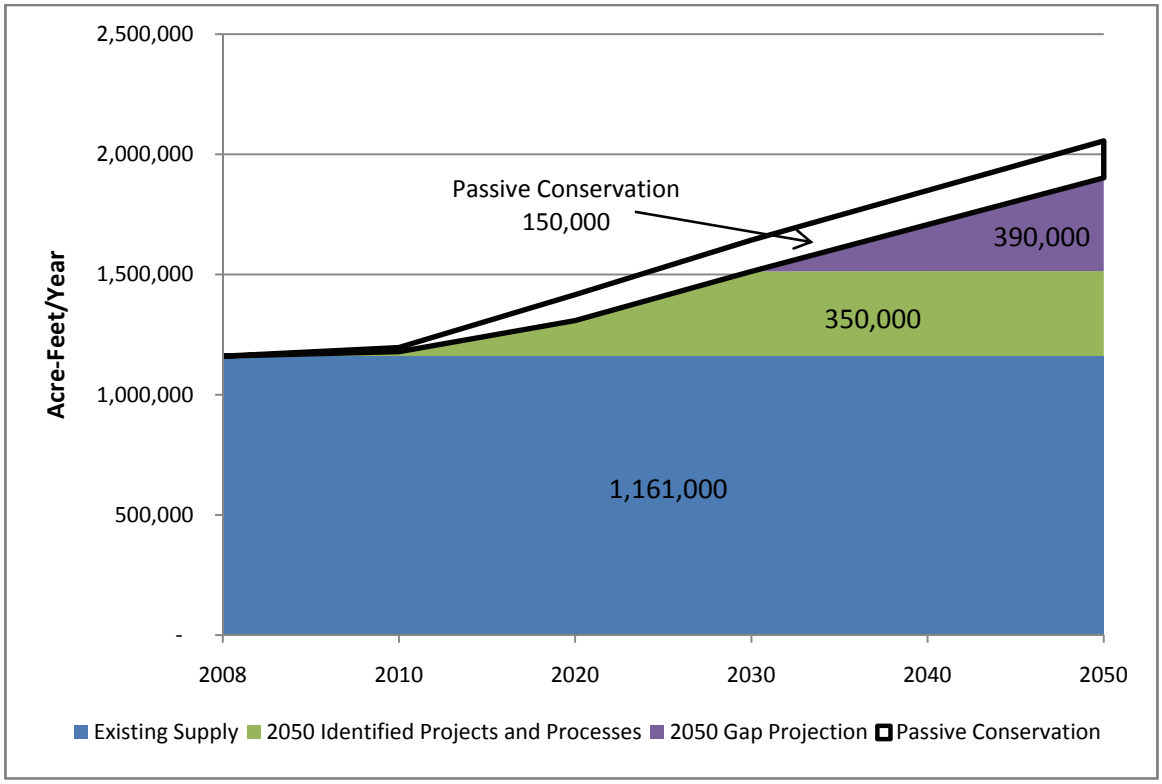

Figure 5-3 Statewide M&I and SSI Gap Summary Medium Scenario (IPPs at 70% Success Rate)

Note that while this plot does illustrate the temporal evolution of existing supplies, IPPs, and the gap, it is not intended to serve as a definitive timeline for the development of these parameters. A level of uncertainty remains for most components of this analysis; demand increases may come sooner or later than projected and IPPs may have more or less success than anticipated in these calculations. Thus, the figure functions as a representation of the interrelated nature of IPPs and the gap. At any given point in time, the sum of existing supplies, IPPs, and gap are equal to demands. The figure illustrates that the need for successful implementation of the IPPs is immediate. As long as the development of IPPs keeps pace with demands, the gap will be minimal. However, if demands continue to increase beyond the development of presently identified IPPs or if successful IPP yield development occurs at a lower rate, the gap will continue to grow in magnitude and will appear at an earlier point in time. It is also important to note the spatial variability of the M&I gap. Some areas of the state will have an M&I gap sooner than others. Plots

illustrating the low and high gap scenario statewide and the low, medium, and high gap scenarios for all basins are included in Appendix J.

Figure 5-4 illustrates the relative percentages of 2050 net new water needs occupied by IPPs and the gap for each basin for the medium gap scenario. The pie chart shown on the map for each basin is scaled to represent the magnitude of the 2050 medium demand. IPP success rates are defined as shown for the "Alternative Portfolio" in Table 5-3; at the statewide level, the overall IPP success rate is approximately 70 percent for the medium gap scenario.

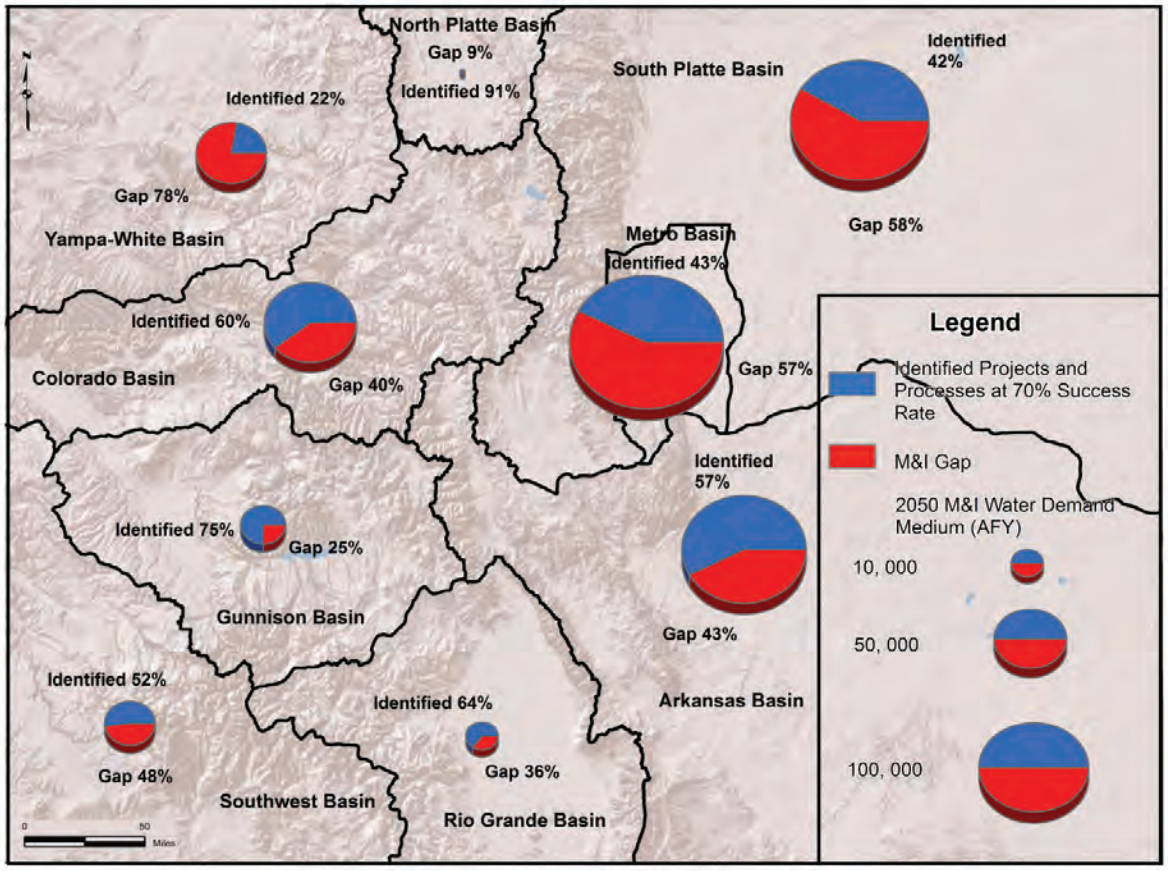

Figure 5-4 2050 M&I and SSI Gap Analysis – Medium Gap Scenario

For the Arkansas, Colorado, Gunnison, North Platte, and Rio Grande Basins, IPPs (illustrated as the blue part of the pie charts) meet 50 percent or more of the 2050 medium demand as a result of 90 percent IPP yield success rate in these basins. Southwest Basin IPPs also exceed 50 percent of 2050 medium demand despite a success rate of only 75 percent. The Yampa-White Basin has a 90 percent IPP yield success rate for the medium gap scenario, but the high yet uncertain demands associated with future SSI uses result in a very large water supply gap (78 percent, illustrated in red) in 2050. Future M&I and SSI water supply gaps for the South Platte and Metro Basins exceed 50 percent due to significantly reduced IPP yield success rates, at 60 percent. For these basins in particular, and also in the Arkansas Basin, a significant reduction in the success of yield development from planned projects and processes identified by Front Range water providers will likely lead to much greater increases in agricultural transfers as a means to meet future demands (see Section 4).

It must be clearly understood that the low, medium, and high gap scenarios evaluated in this study are based on assumptions about the implementation of IPPs made for the purposes of conducting the analyses. In reality, both demand growth and the development of IPPs will be impacted by various factors that will likely cause them to fall somewhere between the low and high values highlighted above. However, it remains highly probable that there will be some level of gap regardless of the level of IPPs development, and a portfolio of solutions will be needed to meet Colorado's future M&I water needs.

5.3.3.2 Gunnison Basin

Table 5-5 provides a summary of increased M&I and SSI demands, the estimated yield of IPPs, and the results of the gap calculations for each county in the Gunnison Basin.

Table 5-5 Gunnison Basin M&I and SSI Gaps in 2050

Region or County	Increase in M&I and SSI Demand (AFY)			Estimated Yield of Identified Projects and Processes (AFY)			Estimated Remaining M&I and SSI Gap after Identified Projects and Processes (AFY)		
				100% IPP Success Rate	Alternative IPP Success Rate (90%)	Status Quo IPP Success Rate (90%)	Gap at 100% IPP Success Rate	Gap at Alternative IPP Success Rate (90%)	Gap at Status Quo IPP Success Rate (90%)
	Low	Med	High	Low	Med	High	Low	Med	High
Delta County	5,300	5,900	6,700	3,700	3,800	4,400	1,700	2,100	2,200
Gunnison County	1,900	2,700	3,800	1,600	1,400	1,400	300	1,300	2,400
Hinsdale County	200	300	300	200	300	300	0	30	30
Mesa County	1,600	1,800	2,300	1,500	1,600	2,000	80	300	300
Montrose County	7,000	7,900	9,100	6,700	6,700	7,700	400	1,100	1,300
Ouray County	300	500	800	20	200	500	300	300	300
Total[1]	**16,000**	**19,000**	**23,000**	**14,000**	**14,000**	**16,000**	**2,800**	**5,100**	**6,500**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.

The existing supply is estimated to be 21,000 AFY and remains constant through 2050. After accounting for IPPs to meet some or all of the net new water needs in each county, the estimated 2050 water supply gaps are as follows:

- Low gap (100 percent IPP success) = 2,800 AFY
- Medium gap (90 percent IPP success) = 5,100 AFY
- High gap (90 percent IPP success) = 6,500 AFY

The temporal development of IPPs and the gap for the Gunnison Basin is represented in figures included in Appendix J of the SWSI 2010 Report.

Section 6
Gunnison Basin Water Availability

6.1 Water Availability Overview

Justice Gregory J. Hobbs of the Colorado Supreme Court has stated "The 21st Century is the era of limits made applicable to water decisionmaking. Due to natural western water scarcity, we are no longer developing a resource. Instead, we are learning how to share a developed resource." These words of wisdom should serve as guidance for all parties interested in Colorado water. The amount of water available for use within the state is finite.

The Statewide Water Supply Initiative (SWSI) 2010 analyzes Colorado's water availability based on recent work by the Colorado Water Conservation Board (CWCB) and the basin roundtables. SWSI 2010 finds that unappropriated water in the South Platte, Arkansas, and Rio Grande Basins is extremely limited, and reliance on nonrenewable, nontributary groundwater as a permanent water supply creates reliability and sustainability concerns, particularly along the Front Range. It also finds that Colorado River compact entitlements are not fully utilized and that water in the Colorado River system may be available to meet future needs. However, in order to develop new water supplies in the Colorado River system, projects and methods will be needed to manage the risks of additional development.

6.2 Methodology to Evaluate Surface Water Supply Availability

This section provides a summary of statewide surface water and groundwater availability. This update summarizes work to date completed by the CWCB and the basin roundtables through the development of their basinwide water needs assessments. A comprehensive analysis of water availability for each basin was completed in SWSI 1 and is only partially updated. Future SWSI updates will provide updated water availability analysis in each basin based on additional Colorado Decision Support System (CDSS) modeling tools.

In addition to the analysis of water availability in SWSI 1, the SWSI 2010 update specifically includes an updated analysis for the basins within the Colorado River system as part of the CWCB's Colorado River Water Availability Study (CRWAS), which is summarized here. Updated information is also included for the South Platte Basin based on results of analysis directly associated with the South Platte Basin Roundtable Task Order.

In another effort related to water availability, statewide drought planning has occurred through the preparation and implementation of the Colorado Drought Mitigation and Response Plan (DMRP). In 2010, the CWCB conducted a comprehensive revision of the DMRP. The updated plan provides a blueprint for how the state will monitor, mitigate, and respond to drought.

The potential effects of climate change are quantified in the CRWAS, and provided at various locations throughout the Colorado River basins. Reliable climate change analyses are not yet available for the other basins and are not included in this update.

6.3 Water Availability

The purpose of this section is to summarize the available data and studies indicating the level of water availability in each basin and the location of opportunities for further new water supply development.

Table 6-1 below summarizes the findings from SWSI 1 related to water supply development potential under interstate compacts and U.S. Supreme Court decrees. Colorado has entered into and is affected by nine interstate compacts, two equitable apportionment decrees, and one international treaty.

Table 6-1 Major Interstate Compacts, Decrees, and Endangered Species Programs by Basin

River Basin	Flows Legally Available under Compact or Decrees for Future Development	Interstate Compacts, Equitable Apportionment Decrees and Endangered Species Recovery Programs	Year of Compact or Decree
Arkansas		Arkansas River Compact	1948
		Kansas vs. Colorado	1995
Colorado	✓	Colorado River Compact	1922
		Upper Colorado River Basin Compact	1948
		Upper Colorado River Endangered Fish Recovery Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
Dolores/San Juan/ San Miguel (Southwest)	✓	Colorado River Compact	1922
		La Plata River Compact	1922
		Upper Colorado River Basin Compact	1948
		Animas-La Plata Project Compact	1969
		San Juan River Basin Recovery Implementation Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
Gunnison	✓	Colorado River Compact	1922
		Aspinall Unit Operations	—
		Upper Colorado River Basin Compact	1948
		Upper Colorado River Endangered Fish Recovery Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
North Platte/ Laramie	✓	Nebraska vs. Wyoming	1945
		Wyoming vs. Colorado	1957
		Platte River Recovery Implementation Program	—

Table 6-1 Major Interstate Compacts, Decrees, and Endangered Species Programs by Basin, continued

River Basin	Flows Legally Available under Compact or Decrees for Future Development	Interstate Compacts, Equitable Apportionment Decrees and Endangered Species Recovery Programs	Year of Compact or Decree
Rio Grande		Rio Grande River Compact	1938
		Costilla Creek Compact (amended)	1963
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
South Platte	✓	South Platte River Compact	1923
		Republican River Compact	1942
		Platte River Recovery Implementation Program	—
Yampa/White/Green	✓	Colorado River Compact	1922
		Upper Colorado River Basin Compact and Yampa River Portion	1948
		Upper Colorado River Endangered Fish Recovery Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945

These agreements establish how water is apportioned between Colorado and downstream states as well as between the United States and Mexico. Each agreement has a significant effect on the development of future water supplies in Colorado. Additional information about the compacts is provided in Section 1.4.

SWSI 1 found there are no reliable additional water supplies that can be developed in the Arkansas and Rio Grande Basins, except in very wet years. The North Platte Basin has the ability to increase both irrigated acres and some additional consumptive uses, consistent with the North Platte Decrees. The South Platte Basin has water that is legally and physically available for development in wet years, although unappropriated water is extremely limited.

Gunnison River

Compact entitlements in the Colorado River Basins are not fully utilized and those basins (Colorado, Gunnison, Southwest, and Yampa-White) have water supplies that are legally and physically available for development given current patterns of water use.

CWCB's CRWAS analyzed water availability in the Colorado River Basins (Colorado, Gunnison, Southwest, Yampa, and White River Basins). Upon completion of the CRWAS Phase 1 study, an addendum to the SWSI 2010 report will be developed summarizing the results of the study for these basins.

The CRWAS Phase 1 Study is comprised of four interrelated components or steps:

1. Update and expand the state's water availability computer simulation tools based on input solicited from water users (consumptive and nonconsumptive) through the basin roundtables, the Interbasin Compact Committee, and other public forums.

2. Assess potential water availability using records of historical water supplies.

3. Use scientific analyses and datasets previously developed by others to estimate streamflows over the past several hundred years, which was done using annual growth of trees (especially as an indicator of transitions between wet and dry years and as an indicator of the potential lengths of dry and wet

periods). This extended natural flow hydrology was used to assess remaining water availability as if today's water uses existed throughout the extended period.

4. Superimpose the effects of potential changes in precipitation and temperature from previously developed global climate models (GCMs, also known as General Circulation Models) to reflect hydrologic conditions that may exist in 2040 and 2070 if the greenhouse gas emissions occur as postulated in the various scenarios ("storylines") simulated by the GCMs.

CRWAS compared future supply and current demand to determine whether there is enough water to meet either current demands based on the "supply-and-demand equation:"

Future Supply – Current Demand = Water Available for Future Consumptive Use

CRWAS Phase 1 held the demand side of the water availability equation constant at current levels (adjusted for changes in irrigation water requirements) and considered three different conditions for the water supply side of the equation as follows.

6.3.1 Historical Hydrology

Traditionally, water supply agencies use recorded historical information on water supply as an indication of likely future conditions; the premise being that history tends to repeat itself. Many agencies in Colorado used streamflow records dating back to at least 1950 so they could consider the impacts of the 1950s multi-year drought on the reliability of their systems. CWCB developed natural flow hydrology back to 1909 in the Colorado River Basin in Colorado, but this required filling missing records or records for discontinued stream and weather gages with scientifically estimated values. For the purposes of CRWAS, a 56-year study period is used to represent historical hydrology (1950 through 2005). This period includes both very wet and very dry years, contains the most reliable historical data upon which to base comparisons of the effects of climate change, and uses information that Colorado River stakeholders can relate to through their own experiences. Historical hydrologic conditions are characterized by the record of natural flows at hundreds of points throughout the basin; basin-scale record of precipitation, temperature, and wind disaggregated to thousands of cells in a rectangular grid covering the entire Colorado River Basin; and a record of local weather recorded at 54 weather stations within Colorado.

6.3.2 Paleohydrology

This approach extends historical records using information from more than 1,200 years of previously published tree-ring records. The CRWAS reviews alternative methods for correlating annual tree growth with streamflow and concludes that a "re-sequencing" approach best serves the needs of the study. This approach focuses on the probabilities of transitioning back and forth between wet and dry years. The lengths of the wet periods and dry periods have significant effects on water availability for future use, especially when combined with the effects of climate change. Development of 100 equally-probable 56-year-long flow traces test the effects of more severe droughts on water supply and management in Colorado and on the state's amount of water available for future consumptive use (CU) as potentially constrained by the compacts under various assumptions.

6.3.3 Climate-Adjusted Hydrology

This approach assesses the magnitude of future water supply availability considering the effects of climate change scenarios. CRWAS reviews information from the climate projections that are available for the Colorado River Basin. Working with the Front Range Climate Change Vulnerability Study, CRWAS identified five projections for each of the 2040 and 2070 planning horizons (10 total). CWCB utilizes the state's Climate Change Technical Advisory Group, comprised of many federal, state, private scientists, water resource engineers, and managers to conduct a technical peer review of the approach and methods used in handling GCM data.

The Variable Infiltration Capacity model is used to translate changes in temperature and precipitation from the selected GCMs to changes in natural flows throughout the river basin. In Colorado, the potential climate-induced changes have been introduced into two models comprising the state's CDSS. First, "StateCU" is used to estimate CU of water by crops resulting from the generated higher temperatures and longer growing seasons. Second, "StateMod" is used to simulate the water management (for example, diversions, return flows, reservoir operations, and instream flows) that would result from changes in natural flows. Input of the basin roundtables during Phase I significantly enhanced the river operations of the models in the CDSS.

The CWCB is currently in the process of updating CRWAS based on comments received on the draft report. After Phase I of the study is completed, CWCB will issue an addendum to the SWSI 2010 report that summarizes the results of the study.

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Section 7
Gunnison Basin Roundtable's Strategies to Address Consumptive and Nonconsumptive Needs

7.1 Overview

The Gunnison Basin Roundtable has reviewed the Interbasin Compact Committee's (IBCC) Framework Document developed in December 2010. The content of this section is based on comments submitted to the IBCC Director. These comments were developed after careful review of the framework document, input from roundtable members at two formal Gunnison Basin Roundtable discussions, and from members of the public. In addition, 15 current members of the Gunnison Basin Roundtable attended the March 3, 2011 Statewide Roundtable Summit in Westminster to become further informed.

The discussion that has occurred thus far at the statewide level has centered upon the need for the State of Colorado to fill an anticipated gap between expected needs and the projected available water supplies by the year 2050. In Western Colorado, the driving force is not meeting the municipal and industrial (M&I) needs of the Front Range, but rather meeting the needs of our own growing and diverse communities and agriculture, while avoiding any curtailment in use resulting from our obligations under the Colorado River Compact of 1922 and the Upper Colorado River Basin Compact of 1948. Therefore, we place great importance on clearly understanding the amount of water being currently used in the Colorado River Basin, available in the Colorado River for future use in Colorado, and available to meet our compact obligations downstream. That is why our roundtable is anxiously awaiting the timely completion of the Colorado River Water Availability Study. We want to move forward meaningfully with assessing the real risk to existing water users of further large scale development of Colorado River water.

Moreover, in the Gunnison River Basin, agriculture is the foundation of our local economies. While tourism, recreation, education, and government services are growing segments, agriculture provides the basis upon which most of the communities are shaped culturally and economically. The needs assessment required by House Bill (HB) 1177 has resulted in a very detailed summary of current agricultural water shortages that total nearly 128,000 acre-feet per year (AFY) with an additional current 54, 000 acre foot (AF) shortage for M&I uses in the Gunnison Basin.

7.2 The Colorado River, the Colorado River Compact, and New Supply Development

During the March 3, 2011 Statewide Roundtable Summit in Westminster, representatives of the state announced from the podium that there was water available for development in the Colorado River..."up to potentially 900,000 acre-feet annually". To many in the Gunnison Roundtable, that statement was a significant and unfortunate overreach of the facts on the river. While it may be true that Colorado River Compact entitlements are not fully utilized, to plan on the possibility of that quantity remaining carries significant risk of eventual large-scale curtailment of existing users. Creating an expectation that water of that magnitude remains available in the Colorado River system to meet Colorado's needs is unrealistic and irresponsible. We think a more measured approach is merited – one that recognizes that the lower end of the projected range is closer to reality when the consequences of overdevelopment are considered.

Also, there is a presumption in the framework document that further development of the Colorado River: 1) should be used to address both East and West Slope needs, and 2) a goal is to allow for full development of Colorado's Colorado River Compact allocation.

As to the first point, we believe that a discussion should be had as to the importance of meeting needs on the Western Slope first before allowing further East Slope development of Colorado River water. There should not be an assumption that the basin of use will be treated equally with the basin of origin. Consumptive and nonconsumptive uses on the Western Slope should be carefully and promptly addressed as the most cost efficient means of utilizing the remaining compact entitlement before Front Range demand is addressed.

Secondly, the Gunnison Basin Roundtable recognizes that as a state we must plan to meet our downstream obligations under the Colorado River Compact, recognizing that there is a range as to what those ultimate legal and physical obligations might be. However, we are concerned that a blind rush to full development carries with it an unacceptable risk of over-appropriation with attendant consequences, especially to existing users, as has occurred on the South Platte, Republican, and Arkansas River systems.

7.3 The Five (Six) Part Framework

We fully support the general outlines of a five part framework proposed by the IBCC, with the following comments and observations, and the addition of a sixth part: "Demand." We understand the importance of aggressive pursuit of conservation, reuse, and IPPs to minimize risk and delay the need for new supplies and additional agricultural transfers.

7.3.1 Identified Projects and Processes

While the Gunnison Basin Roundtable supports much of the discussion developed by the IBCC Subcommittee on IPPs, there is substantial disagreement with the statement that "the State of Colorado become public advocates for a project" and that there be "Direction to publically advocate for a project from the Governor…shared with all State Agencies." As presented, this proposal represents a fundamental shift in the role of the several state agencies and processes and should be withdrawn. There is not support in the Gunnison Basin Roundtable for the state as an advocate of a particular project, except insofar as advocating for the federal government to expedite review of projects and for federal funding of projects with established statewide public support.

The Gunnison Basin Roundtable supports the role of the state as a facilitator bringing interested parties together. In particular, there is considerable experience in the Gunnison Basin with the Colorado Joint Review Process and its resurrection may be a useful model for how to proceed. There is support in our

roundtable for the development of a clear sequential process of internal and external actions to move a project forward through the regulatory process, complete with deadlines and responsible parties clearly identified.

We also believe that significant opportunities for greater reuse of existing water supplies should be aggressively pursued. The notion of using introduced waters to extinction has a valid place in Colorado law and may provide significant reductions in the gap. We sincerely appreciate the efforts on these issues to date and encourage broader application of the principles of reuse.

7.3.2 Conservation

The Gunnison Basin Roundtable supports the concept of large domestic water providers taking every meaningful step possible to conserve water. The steps being taken by the large metro providers to conserve water are necessary and acknowledged. In particular, their efforts to manage the irrigation component associated with lawn watering shows results.

Members of our roundtable expressed concern about the practicality of requiring high levels of water conservation by small and mid-sized rural domestic water providers. The cost of such requirements would not be offset by additional water yield, and the benefit would contribute very little in terms of new supplies. In our area, the Tri-County Water Conservancy District is implementing meaningful conservation steps, even though the actual water savings are relatively minimal.

As to increased agricultural efficiency, many of our roundtable members noted that increased efficiency had additive benefits to other nonconsumptive uses within the river systems. However, rather than first focusing on on-farm efficiency, instead prioritize rehabilitation, restoration, and improvements to existing major diversion structures, head gates, and major control and distribution facilities. We have an aging infrastructure in irrigated agriculture in many locations in the Gunnison Basin and improving and restoring those facilities would provide direct benefits. The challenge for these activities remains adequately funding those improvements and having all interests who benefit participate in bearing the cost. If the focus is solely on direct on-farm efficiency, there may be reductions in historical return flows to immediate downstream farms and neighbors, while not necessarily freeing up additional water that can be efficiently captured for new uses.

7.3.3 Agricultural Transfers

Dry-up of irrigated agriculture has considerable social, environmental, and economic impacts. The Gunnison Roundtable recognizes that large scale dry- up of land along the Platte, Arkansas, Colorado, or even Gunnison Rivers is not in the long term best interest of our state and its economic and food security interests. One only needs to travel in areas of Colorado where the water has been removed to see the impacts (e. g. South Park, Crowley County, and Rocky Ford) to whole communities. Furthermore, no segment of our agriculture production in Colorado is or should be considered expendable to benefit another region. There should be no presumption that wheat grown in Weld County or lambs fed in Larimer County are more valuable than peaches from Palisade, sweet corn from Olathe, or beef from Gunnison.

The Gunnison Basin Roundtable concurs that transfers of water out of agriculture to make municipal or industrial water available should not become the easiest or "default" option to achieve new supplies. However, some of the proposals put forth may have only limited applicability due to climatic or legal factors and the subcommittee has correctly outlined addition technical work that needs to be done.

We support the development of new methods of alternative water transfers as opposed to simply buying and drying the land. Further, we recognize that not all methods will have applicability in all areas, but the concepts of alternative or rotational fallowing or long term leasing deserves further exploration and

development. The challenge will be to provide essentially a firm new supply while maintaining a serious mode of long-term agricultural production. On irrigated hay meadows, orchards, and other long term crops, the concepts of fallowing will probably not work.

7.3.4 Demand

The Gunnison Roundtable suggests that the IBCC add "Demand" as an additional component of the framework. Changing the ultimate amount of water Colorado needs, or even the pace at which that demand is brought online could significantly affect the amount of water remaining in the river systems and provide for non-consumptive uses and drought protection. In our view, the IBCC process thus far has focused on finding new supplies to meet the anticipated increases in demand, and not enough on limiting or reducing what those water needs actually are.

On January 6, 2010, the Gunnison Basin Roundtable sent a letter to the IBCC requesting that the IBCC include in its deliberations in developing the framework discussions and ideas about affecting the demand for the M&I water that creates the tremendous M&I "gap." A copy of that correspondence is attached and we renew our request that this issue be further developed.

Is there a clear connection between the concepts outlined in the IBCC Framework and the early Vision that the IBCC laid out for the future of Colorado? We recognize that land use planning has historically and appropriately occurred at the local level, but feel that an important part of the framework should be state incentives that encourage land use strategies that minimize increases in demand for water, such as infill development and higher density that reduces thirsty landscaping. Another possibility is limiting those areas where growth can occur using conservation easements in the urban- rural interface or open land preservation like what has occurred in the Boulder Greenbelt. We need additional incentives that focus on what kind of Colorado we want in the future and on how much water we will need.

Passive conservation will contribute to reducing demand, but we would like the IBCC to examine state and local incentives for aggressive active conservation measures that permanently reduce demand. An example of such incentives is Las Vegas paying its residents to remove lawns or reuse to extinction of imported water. Another would be very aggressive graduated water rates that discourage unnecessary outdoor water use. We recognize that the current budget crisis makes it difficult to consider any additional expenditure of state or local funds for any purpose, but in the context of long term planning for the Colorado we want to see in 2050, we think that our economy will recover sufficiently to make these incentives a realistic possibility.

7.3.5 New Supply

There are three components to the new supply framework : 1) locally developed new supplies, 2) large transbasin new supplies, and 3) large permanent agricultural transfers. In the Gunnison Basin, locally developed new supplies are already being developed and improved. The roundtable is playing a leadership role in bringing about those local improvements in our basin.

As to the new supply tasks outlined in the subcommittee report (page 34), the Gunnison Roundtable acknowledges that the tasks are necessary. All the tasks, but particularly the risk management and the conceptual outline for benefits and trade-offs, need meaningful discussion and feedback that reaches the grass roots level to promote understanding and develop trust. Our roundtable is vitally interested in those topics.

We do agree wholeheartedly with the following recommendation in the framework documents:

> "that the IBCC, Colorado Water Conservation Board (CWCB), and the basin roundtables discuss the need for a detailed analysis of future risk and risk management strategies, taking into account information available under the Colorado River Water Availability Study, the Compact compliance Study, and other related work."

We strongly support the development of a risk management program for the Colorado River and the further commitment of time and resources to fully develop that concept. The Colorado River Water Conservation District has provided leadership on this issue and the concept has merit. This discussion must be meaningful, open, and transparent. No successful resolution of these issues will be achieved if the process is not built on trust and disclosure. The conclusions reached based on the results of the Compact Compliance Study will affect millions of Colorado water users.

We are interested in an approach that not only minimizes, but possibly avoids entirely a future Colorado River Compact curtailment on all Colorado River users. We are interested in how this might be accomplished. To that end, we are exploring various mechanisms, including the availability of storage space in the Aspinall Unit, and support the work of the Colorado River Water Conservation District, the Southwestern Water Conservation District, The Nature Conservancy, the Front Range Water Council, and others in developing a water bank concept.

Regarding a water transfer fee, one of the difficulties that will need to be addressed will be to not only value the fee fairly, but to also value the project's impacts at their true cost. We are learning more about the true value of existing uses, the actual cost of the risk of a Compact call, and the relative and usually undervalued benefits of nonconsumptive uses. The cost of new supply will be substantial.

7.3.6 Nonconsumptive Uses

The Gunnison Basin has a number of very important nonconsumptive uses across the basin. They are protected by a number of different strategies, some developed by hard fought legal battles while others were developed through collaborative, proactive stakeholder efforts. We recognize that there is an important link between sustainable agriculture and a whole range of nonconsumptive uses of water. Agriculture in our basin provides important return flows that sustain late season flows for fisheries and recreation.

The framework identifies funding as a critical component of protecting these uses. We concur. Developing sustainable funding options to help pay for protecting and restoring nonconsumptive values will have statewide public benefit. It will also ensure that those values have a seat at the table when multi-purpose project opportunities come forward.

In our roundtable, representatives of the U.S. Bureau of Reclamation, the Colorado Division of Wildlife, Natural Resources Conservation Service, and the U.S. Forest Service make important and significant contributions. While not supplanting the primary roles of the various Roundtable and IBCC members in this process, their input, cooperation, and assistance is important and should be encouraged as this dialogue moves forward.

7.4 WSRA Grants

Lake San Cristobal Controlled Outlet Structure

APPLICANT: Upper Gunnison Water Conservancy District and Hinsdale County

APPROVED: May 2007

STATUS: Complete

WSRA FUNDS: $35,000 (Basin Account)

MATCHING FUNDS: None

DESCRIPTION:
Hinsdale County and the Upper Gunnison River Water Conservancy District explored the feasibility of constructing a new permanent control structure at the outlet of Lake San Cristobal. The new structure allows for more controlled releases to regulate the lake level and prevent failure of the structure during flood events. The additional stored water resulting from the project will be used primarily as augmentation water within the Lake Fork of the Gunnison River. Other beneficial uses may include agriculture, recreation, and releases for instream flows. The feasibility study estimates the firm yield of the additional 960 AF of storage and develop an engineering report to support the water right application in the pending water rights case (case no. 03CW108). The study also analyzes the current and future market for water impounded by the structure. As upstream augmentation source, Lake San Cristobal could augment out of priority depletions caused by growth within the Lake Fork basin rather than utilizing downstream sources such as Blue Mesa Reservoir. A number of CWCB instream flow water rights could also benefit both directly and indirectly from this project.

Safety and Serviceability Needs Inventory for Reservoirs in the Leroux Creek Drainage Basin

APPLICANT: Leroux Creek Water Users Association

APPROVED: May 2007

STATUS: In Progress

WSRA FUNDS: $60,000 (Basin Account)

MATCHING FUNDS: $10,000

DESCRIPTION:
The Leroux Creek Water Users Association (LCWUA) is an irrigation company in Delta County with 29 small reservoirs in the Leroux Creek Drainage. Built in the early 1900s, the reservoirs serve as the primary water supply for over 4,500 acres of valuable orchard, vineyard, and hay land, which produces more than $3.5 million in direct economic benefits. The system's water storage also provides domestic water for the Towns of Hotchkiss, Rogers Mesa, and Hanson Mesa. The reservoirs range in size from 10 AF to 920 AF, with dam heights up to 52 feet. LCWUA has initiated a program of identifying and prioritizing rehabilitation/upgrade needs in order to enhance the safety and reliability of the dams within their system. The project involves conducting a preliminary inventory of the needs for 28 of the dams (one has been excluded due to its recent rehabilitation). Needs will be assessed and categorized as: outlet works, seepage, slope stability, spillway/flood hydrology, and general dam condition.

Orchard City Water Reservoir Project (Task 1 – 3)

APPLICANT: Town of Orchard City

APPROVED: May 2007

STATUS: Complete

WSRA FUNDS: $60,000 (Basin Account)

MATCHING FUNDS: $56,694

DESCRIPTION:
This project involves the design of an approximately 500 AF off-channel reservoir to serve the municipal/domestic needs of Orchard City. Prior to the completion of the final engineering design an alternative analysis for determining the most cost-effective structure was performed. The overall project includes: alternative analysis; geotechnical investigations; kick-off and progress meetings; final design work and documents per state requirements; engineer's construction cost estimate; bid process support. The final reservoir design will enable the subsequent construction of the reservoir in a timely, cost-effective, and safe manner. Following completion of reservoir design the applicants sought assistance with funding for project construction from the Water Supply Reserve Account (WSRA) statewide fund in September 2007.

Orchard City Water Reservoir Project (Remaining Tasks)

APPLICANT: Town of Orchard City

APPROVED: September 2007

STATUS: Complete

WSRA FUNDS: $480,000 (Statewide Account)

MATCHING FUNDS: $678,000

DESCRIPTION:
The recent drought has exposed several serious deficiencies in the water supply system of the Town of Orchard City. In response, the town has been forced to evaluate its water rights (both in quantity and type), storage, collection and delivery system, and treatment plant. Most of the town's supply comes from relatively junior direct flow agricultural rights. These rights are made even more vulnerable by a complicated exchange into the different drainage where the treatment plant is located. With no reservoirs or storage rights the town has no backup supply in the event of a drought, and no way to store excess flows when available. In addition to changing a key water right to include storage the town has completed design work on an off-channel reservoir of about 500 AF and has obtained the necessary land. The reservoir provides: 100 days of backup supply; a second supply source for redundancy and security; an emergency winter supply; wildfire protection; and flexibility to lease or trade existing agricultural supplies to local farmers.

Off-System Raw Water Storage Reservoir Study

APPLICANT: Project 7 Water Authority and Uncompahgre Valley Water Users Association

APPROVED: September 2007

STATUS: Complete

WSRA FUNDS: $56,700 (Basin Account)

MATCHING FUNDS: None

DESCRIPTION:
The Project 7 Water Authority (P7) and Uncompahgre Valley Water Users Association (UVWUA) examined the feasibility of constructing a new raw water storage reservoir to augment the existing Fairview Reservoir to provide a more reliable source of domestic water to the valley. Fairview Reservoir is owned and operated by P7, but the water rights are owned by UVWUA. Since system deliveries come from the Gunnison Tunnel and South Canal, the reservoir also provides backup supplies in the event of tunnel closures. The proposed new reservoir to be located on Bureau of Land Management and/or private land in the vicinity of Fairview Reservoir would have a capacity sufficient to supply P7 customers with domestic water for up to one full year. The feasibility study examines several potential sites for suitability and availability of a reservoir of up to 10,000 AF. A detailed evaluation and comparative analysis of the potential sites was performed to identify the best reservoir location.

Paonia – Feldman Diversion Reconstruction Project

APPLICANT: North Fork River Improvement Association

APPROVED: September 2007

STATUS: Complete

WSRA FUNDS: $110,700 ($48,000 - Basin Account; $62,700 - Statewide Account)

MATCHING FUNDS: $76,316

DESCRIPTION:
This project consists of a feasibility study and final construction of an efficient, low-maintenance concrete headgate and low-head rock weir for two ditches. The new structure is designed to deliver the ditches full decreed amount while conserving water, improving use efficiencies, reducing the need for bulldozers in the channel, and decreasing suspended sediment. In addition, the structure allows fish migration and boat passage across the diversion; both of which are now prevented by the existing diversion structure. The Paonia and Feldman diversions are on either side of the North Fork of the Gunnison River, adjacent to the Town of Paonia. The uncontrolled diversions formerly used a rock and debris structure created by bulldozing the river bed resulting in considerable erosion and sedimentation issues. The new structure reduces maintenance, ensures full diversion, and also greatly benefits the stream by enhancing the fishery, water quality, and riparian system.

Sedimentation Management Study for Paonia Reservoir

APPLICANT: North Fork Water Conservancy District and Fire Mountain Canal and Reservoir Company

APPROVED: September 2007

STATUS: In Progress

WSRA FUNDS: $309,000 ($79,000 - Basin Account; $230,000 - Statewide Account)

MATCHING FUNDS: $10,000

DESCRIPTION:

According to the most recent sediment survey in 2002, the 21,000 AF Paonia Reservoir had lost 24 percent of its capacity to sedimentation. There are no other irrigation options for the farms and ranches in this area, and without some action there will be a devastating impact on existing agricultural water users. Along with the significant reduction in storage capacity, the sedimentation delta is approaching the intake structure of the dam's outlet, which could result in serious operational and environmental problems. Therefore, there is a compelling need to evaluate a range of sedimentation mitigation options and identify the best and most cost-effective methods for ensuring reservoir sustainability and a continued full supply of water from the Paonia Reservoir project. The objective of this study is to investigate sediment management options for Paonia Reservoir to remove a portion of the historically accumulated sediment, reduce the rate of sedimentation, and identify operational and management practices to extend the life of the reservoir.

Overland Reservoir Dam Expansion and Restoration

APPLICANT: Overland Ditch and Reservoir Company

APPROVED: September 2007

STATUS: In Progress

WSRA FUNDS: $68,000 (Statewide Account)

MATCHING FUNDS: None

DESCRIPTION:

The Overland Ditch and Reservoir Company (Overland) seeks technical assistance for permitting, feasibility studies, and yield analysis of its reservoir dam expansion and restoration project. Overland needs to expand the dam and reservoir to store 971 AF of water under a 1902 conditional storage decree. Without expansion the conditional storage will eventually be lost to a more junior decree, which would likely be subject to 1922 Colorado River Pact. The current tasks involve the completion of engineering necessary for permit applications and approvals, including reservoir yield analysis, mitigation designs, and a U.S. Forest Service special use permit. The current proposed dam expansion and restoration project will increase the storage capacity to 7,171 AF and allow perfection of the 971 AF conditional right, thereby protecting the water for the State of Colorado.

Lake San Cristobal Outlet Modification Project – Phase II

APPLICANT: Upper Gunnison Water Conservancy District

APPROVED: July 2008

STATUS: In Progress

WSRA FUNDS: $75,265 (Basin Account)

MATCHING FUNDS: None

DESCRIPTION:
The Lake San Cristobal Outlet Modification Project is intended to replace an annually-placed rock wall with a permanent outlet structure. This structure would maintain the historical storage regime that has taken place for over 50 years. The proposed outlet would allow for more controlled releases while eliminating the need to annually place and remove rocks at the lake's outlet. In addition, the new outlet structure would allow development of a local plan of augmentation to benefit the environment via the Instream Flow Right along the Lake Fork of the Gunnison and reduce the reliance on Blue Mesa Reservoir as a downstream source of augmentation water. The current phase of the project includes the hazard classification report preparation, preliminary review, and approval by the Colorado State Engineer, all other permit requirements, and the geotechnical, design, and hydrology reports.

Lake San Cristobal Outlet Modification Project – Phase III

APPLICANT: Upper Gunnison Water Conservancy District

APPROVED: September 2008

STATUS: In Progress

WSRA FUNDS: $120,960 (Statewide Account)

MATCHING FUNDS: None

DESCRIPTION:
The Lake San Cristobal Outlet Modification Project is intended to replace an annually-placed rock wall with a permanent outlet structure. This structure would maintain the historical storage regime that has taken place for over 50 years. The proposed outlet would allow for more controlled releases while eliminating the need to annually place and remove rocks at the lake's outlet. In addition, the new outlet structure would allow development of a local plan of augmentation to benefit the environment via the Instream Flow Right along the Lake Fork of the Gunnison and reduce the reliance on Blue Mesa Reservoir as a downstream source of augmentation water. The current phase of the project includes the completion of final design documents and construction cost estimates. This work involves preparation of the technical specifications, design drawings and details, and applying for and obtaining construction approval of the outlet control structure from the Colorado State Engineer. The consultant shall see the application through to construction approval by the state.

Ridgway Ditch and Lake Otonawanda Improvement Project

APPLICANT: Town of Ridgway

APPROVED: March 2009

STATUS: In Progress

WSRA FUNDS: $109,500 (Basin Account)

MATCHING FUNDS: $27,380

DESCRIPTION:
The Town of Ridgeway is seeking technical assistance regarding design, cost estimates, and permitting associated with the enlargement of its municipal reservoir and rehabilitation of the associated diversion structure. The Ridgway Ditch and Lake Otonawanda Improvement Project will help meet the demands of projected growth in the Town of Ridgway. The project will also provide augmentation supplies necessary to meet calls by senior users that threaten the reliability of the town's water supply in dry years. The current phase of the project includes an engineering feasibility study on the expansion of storage in Lake Otonawanda via dredging and bentonite amendment. The study will include an analysis of outflow infrastructure necessary for direct releases to the town's water treatment plant. The study would identify permitting and environmental issues, preliminary concept design, and preliminary engineer's cost for project construction. The study also includes a redesign of the town's diversion and headgate structure above the reservoir. A previous study estimated seepage loss from the ditch to be approximately 35 to 40 percent, providing an opportunity for huge efficiency gains.

Juniata Reservoir Spillway Modification

APPLICANT: City of Grand Junction Water Enterprise Fund

APPROVED: March 2009

STATUS: Complete

WSRA FUNDS: $97,000 (Basin Account)

MATCHING FUNDS: $97,586

DESCRIPTION:
This project involves construction to raise the spillway on Juniata Reservoir. Design components, which are part of this project, have already been completed and were approved by the State Engineers Office (SEO), Colorado Water Resources Dam Safety Division. Design components included a geotechnical investigation and structural evaluation of the dam, hydrologic study of the tributary basin, and hydraulic evaluation of the emergency spillway. The resulting design report, supported by geotechnical and hydrologic evaluations, including construction plans and specifications, demonstrate that the proposed storage enlargement will have no adverse impacts on the continued safe operation of the reservoir and comply fully with Rule 5 of the Colorado "Rules and Regulations for Dam Safety and Dam Construction," dated 2007, as adopted by the Colorado SEO. Raising the spillway 3 feet will allow for the additional storage of 445 AF of water. This additional storage will serve many purposes. This first and most important will be drought protection. The 445 AF of additional storage represents 7.5 percent of annual water demands in the City of Grand Junction domestic water system.

Agricultural Water Needs Assessment and Water Supply Analysis

APPLICANT: Upper Gunnison River Water Conservancy District

APPROVED: March 2009

STATUS: Contracting

WSRA FUNDS: $120,560 (Basin Account)

MATCHING FUNDS: $12,400

DESCRIPTION:
This study will identify agricultural water needs and shortages in the Gunnison River Basin. The following objectives are to be accomplished: To interview, on a sub-basin level, water users and other sources of local information for agricultural physical and legal water supply issues during the most recent drought period, 2000 – 2007. Based on the results of those interviews, refine and update estimates of current agricultural water demands, supplies, and shortages for the Gunnison River Basin, including the State's Decision Support System models and updated data.

Hartland Diversion Dam Fish Passage Feasibility Study

APPLICANT: Painted Sky Resource Conservation and Development Council, Inc.

APPROVED: May 2009

STATUS: Complete

WSRA FUNDS: $22,100 (Basin Account)

MATCHING FUNDS: $1,000

DESCRIPTION:
This feasibility study of the Hartland Diversion Dam will include a conceptual design for fish and/or boater passage, an up-to-date cost estimate of construction and permitting costs, and analysis of any environmental compliance requirements pursuant to potential U.S. Army Corps of Engineers jurisdiction over the project. Requested funds will not be used to physically alter the diversion structure, but will only assess cost and methods for doing so. Painted Sky proposes to study and design a structure in conjunction with the existing Hartland Diversion Dam, which enables upstream fish passage while preserving the current volume of water diverted by the structure for private use. Pending successful completion of the study and design, Painted Sky has been informed that approximately $700,000 has been allocated to construct the fish passage structure; however, requested funds in this proposal are required to bring the project to a "Shovel-Ready" status, in order to access stimulus funds for project implementation.

Development of Augmentation Supplies

APPLICANT: City of Ouray

APPROVED: May 2009

STATUS: In Progress

WSRA FUNDS: $50,000 (Basin Account)

MATCHING FUNDS: $87,129

DESCRIPTION:
The City of Ouray is seeking technical assistance regarding the purchase of water rights from Red Mountain Ditch, a framework for interruptible water supply contracts with irrigators in the Uncompahgre River Basin, and the feasibility of enlarging the Ouray Hydropower Plan Reservoir to store these water rights. Although the City of Ouray has fairly senior water rights dating from 1881 and 1885 and adjudicated in 1904, in severe droughts such as 2002 and 2003, water calls were placed on those rights by senior agricultural producers in both the Upper and Lower Uncompahgre River. For this reason, the Division 4 Engineer requested the City of Ouray to procure augmentation supplies to protect the city's water rights during dry years. The city would like to minimize the impact to agriculture, and will only need augmentation supplies during very dry years, enabling interruptible supply agreements to be a viable solution. A small storage reservoir will allow the storage and redistribution of the historical consumptive use credits from the interruptible supply contracts to meet the city's depletion pattern. Representatives of the city have already met with owners of senior irrigation water rights in the Upper Uncompahgre Basin and have identified willing participants. The use of an existing hydropower facility provides a multi-use option that enables the generation of revenue during periods when augmentation supplies are not needed.

75 Ditch Diversion Improvements and Feature Enhancements

APPLICANT: Gunnison River Festival

APPROVED: May 2010

STATUS: Contracting

WSRA FUNDS: $46,100 (Basin Account)

MATCHING FUNDS: $110,584

DESCRIPTION:
This project involves the construction of a multi-purpose structure on the Gunnison River in Gunnison, Colorado at the location of the 75 Ditch diversion, which is the oldest water right in the Gunnison Basin. These water rights were adjudicated in 1906 and have an 1875 appropriation date. The holistic design of this structure will improve the year-round delivery of water to the 75 Ditch, eliminating the annual instream disturbances currently caused by the use of heavy machinery to manipulate river substrate to ensure water delivery during low flows. In 2009, the CWCB provided the initial funding (through a severance tax grant) to have Recreational Engineering and Planning of Boulder, Colorado create a preliminary design and cost estimate used to develop this proposal. Due to the channel width, stream gradient, and diversion characteristics, this is an ideal location for a multi-purpose structure. Additionally, this reach of the Gunnison Whitewater Park currently poses a safety risk to commercial and private boaters at low flow conditions.

Lake San Cristobal Outlet Structure

APPLICANT: Lake San Cristobal Water Activity Enterprise

APPROVED: May 2010

STATUS: Contracting

WSRA FUNDS: $150,000 (Basin Account)

MATCHING FUNDS: $432,660

DESCRIPTION:
This grant request funding will be used to install a structure at the outlet of Lake San Cristobal for water storage augmentation. This project will also allow the Lake San Cristobal Water Activity Enterprise to monitor and enhance river flow for fisheries and maintain wetlands. Lake San Cristobal is Colorado's second largest natural lake and is located on the Lake Fork of the Gunnison River in Hinsdale County, Colorado. It is located approximately 3.5 miles southeast of Lake City. The existing outlet structure consists of large boulders placed in the stream channel at the lake's outlet. The boulders are removed by Hinsdale County Road and Bridge staff during the spring runoff, approximately April to June, each year to allow runoff flow to enter the Lake Fork.

Hanson Reservoir Outlet Rehabilitation

APPLICANT: Leroux Creek Water Users Association

APPROVED: July 2010

STATUS: Contracting

WSRA FUNDS: $50,000 (Basin Account)

MATCHING FUNDS: Over $50,000

DESCRIPTION:
The Hanson Outlet Rehabilitation project involves replacing an existing downstream outlet valve with a new upstream valve on Hanson Reservoir, one of 28 reservoirs owned and operated by LCWUA. The Leroux Creek Dam Inventory study was funded by the Gunnison Basin Roundtable to identify and prioritize safety issues and maintenance needs on the reservoirs. This study identified problems with the Hanson outlet. After consulting with the State Dam Safety Engineer for Division 4, this outlet issue became the number one priority for LCWUA. Inspection of the outlet and original dam plans indicated the existence of an older abandoned valve buried in the embankment some 20 feet upstream of the current outlet valve. This buried valve has developed some leakage around the stem, which is producing a wet area on the dam face. The Dam Safety Engineer has indicated the need to repair this problem or face restrictions on dam operations.

The Rehabilitation of Blanche Park Reservoir

APPLICANT: Grand Mesa Water Conservancy District, Water Enterprise Fund

APPROVED: March 2011

STATUS: Contracting

WSRA FUNDS: $75,000

MATCHING FUNDS: $95,539

DESCRIPTION:
The project will rebuild a breeched reservoir site, placing it in full utilization for water storage. This will allow the district to put approximately 130 AF of its conditional water decree into use as irrigation, recreation, fish culture, municipal use by the Town of Orchard City or by the Town of Cedaredge, domestic use by contract with Upper Surface Creek Domestic Water Company or Coalby Domestic Water Company. This will restore the reservoir site to its historical use.

Valley View Irrigation Improvement Project

APPLICANT: Valley View Irrigation Association

APPROVED: March 2011

STATUS: Contracting

WSRA FUNDS: $11,817

MATCHING FUNDS: $1,600

DESCRIPTION:
This project seeks to continue improvements to the Valley View Irrigation system. The association pipes water through a distribution system for delivery to member lots. The association now needs to connect the delivery system to a bore under Marine Drive. Montrose County has requested that this bore replace an existing culvert that causes problems for the right-of-way. By completing the bore and connecting the irrigation system, the Valley View system will entirely avoid public easements. In addition, this project will contribute to the completion of piping the whole system to enable increased efficiency and pressure delivery. WSRA will fund the bore, casing, and pipe to connect to the existing system. The association will provide in-kind labor and equipment for the pipe work. This project is a two-part improvement to the existing delivery system for irrigation of subdivided land northwest of Montrose. Part one involves boring and piping under Marine Drive (a County Road). Part two includes piping from the bore and connecting to the existing system.

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