INITIAL DRAFT Chapter 7

Scenario Planning and Adaptive Management

NOTE: This in an initial draft of the Statewide Water Supply Initiative Chapter 7 – Scenario Planning and Adaptive Management. In some instances, the chapter is still in annotated outline form and text is displayed in *italics*.

Executive Summary

The process of developing plausible scenarios of the future, matching portfolios to the scenarios, identifying no/low regrets actions, and using signposts to determine when additional actions are needed beyond the implementation of no/low regrets actions has the following benefits:

- It captures a range of uncertainties and risks that can affect the ability to meet water demands in the future
- It selects appropriate and representative supply portfolios to match future scenarios, which gives broad guidance on what types or categories of conservation and supply projects should be implemented
- It identifies near-term, no/low regrets actions that will provide benefits under a range of uncertainties as a foundation to longer term planning
- It provides a framework for incremental implementation beyond no/low regrets actions that uses signposts to determine when such additional actions are needed

This process also underscores the critical importance of implementing the no/low regrets actions within the next 10 to 15 years. Without the full implementation of these foundational actions, the gap between demands and water supplies will be much greater than originally projected. This means that even under a weak economy scenario, new water supplies would be needed. Under the scenarios in which demands for water are greater and/or supplies lower, even more new supplies would be needed beyond what was envisioned by the roundtables.

This chapter summarizes five representative portfolios out of the ten identified by the basin roundtables and the Interbasin Compact Committee (IBCC). These portfolios were selected for each of the five scenarios. Taking the minimum elements from each of these, the following no/low regrets emerged:

- **Identified Projects and Processes:** Implement Identified Projects and Processes (IPPs) to yield percent, equivalent to 70,000 acre-feet/year (AFY) for the West Slope and 280,000 AFY for the East Slope.

  Adaptive Capacity: Track the yield of the IPPs in meeting the gap. If IPPs are not implemented to planned levels, additional emphasis on other portfolio elements will be required.

- **Conservation:** Implement strategies to meet medium levels of conservation and apply half of that to meet the Municipal and Industrial (M&I) Gap.

Adaptive Capacities: Track the reliability of these conservation savings in meeting the gap. If conservation does not prove to be reliable, additional emphasis on other portfolio elements will be required.

- **Agricultural Transfers:** Limit traditional "buy and dry" to the IPPs and urbanization. Initiate alternative agricultural transfer project or projects on the East Slope to yield 50,000 AFY plus an additional 25,000 AFY from reuse of that water.

  Adaptive Capacity: Preserve and plan for additional alternative agricultural transfers, should a future scenario require it. If the 50,000 AFY alternative agricultural transfer project or projects is not implemented to planned levels, additional "buy and dry" will result.

- **New Supply:** Develop 35,000 AFY of new supplies in the Colorado River system for the West Slope.

  Adaptive Capacity: Preserve and plan for transbasin new supply options, should a future scenario require it.

- **Nonconsumptive:** Implement nonconsumptive projects.

- **Infrastructure:** Implement storage and other infrastructure to maximize flexibility and reliability.

If demands remain low, then no additional actions will be needed. If demands increase or supplies decrease, additional conservation, new supply, alternative transfers, and redundancies in Colorado's water infrastructure will be needed and should be phased in as appropriate, which is described in the adaptive management section of Chapter 7.

7.1 Introduction

Colorado, states across the country, and most water providers have utilized traditional predictive water planning processes. These processes have relied on the past as the key to extrapolate the most likely future water planning scenario. Due to the very long timeframe that it takes to build water supply projects, the planning horizon for the Statewide Water Supply Initiative (SWSI) is 2050. A wide range of uncertainties may present themselves between now and then; therefore, scenario planning was deemed as the best choice for addressing Colorado's water supply future. Uncertainties such as Colroado's future economy and how that will impact population growth, to climate change and how that mayaffect water supply levels are important to consider. Scenario planning helps explore a broader range of future possibilities and acknowledges that uncertainties can redirect current trends. Furthermore, this section also includes an adaptive management framework, which can be used to determine what actions may need to be implemented over time, depending on several "signposts." This adaptive framework will allow for Colorado to

- Be flexible so that it can address critical planning issues in a strategic fashion;
- Identify and prioritize key planning uncertainties; and
- Develop a consensus vision for how Colorado can meet the challenges and opportunities of the future.

The basin roundtables and IBCC developed the portfolios and scenarios in 2011 and 2012. This chapter summarizes that work, and organizes it into an adaptive management framework. Scenario planning and adaptive management are important additions to SWSI. Specifically, this chapter:

1. Reflects uncertainty of future conditions through development of plausible scenarios;
2. Includes a representative portfolio of water supply strategies for each scenario to address M&I water demands;
3. Identifies a set of no/low regrets actions that would benefit all or most scenarios of the future, and should be implemented within the next 10 years; and
4. Integrates the above work into an adaptive management framework that includes signposts to help determine which portfolio will need to be implemented in the future in addition to no/low regrets strategy.

Figure 7-1 depicts the "cone of uncertainty," which indicates that from today's vantage point, the future is unknown, and increasingly so as planners try to look further and further into the future. When exploring uncertainty, it is important to look at the edges of the cone to ensure that a full range of futures is being considered. Scenario planning and adaptive management is the process where these scenarios are developed, near-term actions are defined as no/low regrets that need to be implemented no matter what future Colorado faces, and additional actions are identified that may need to be implemented in the future for one or more particular scenarios.

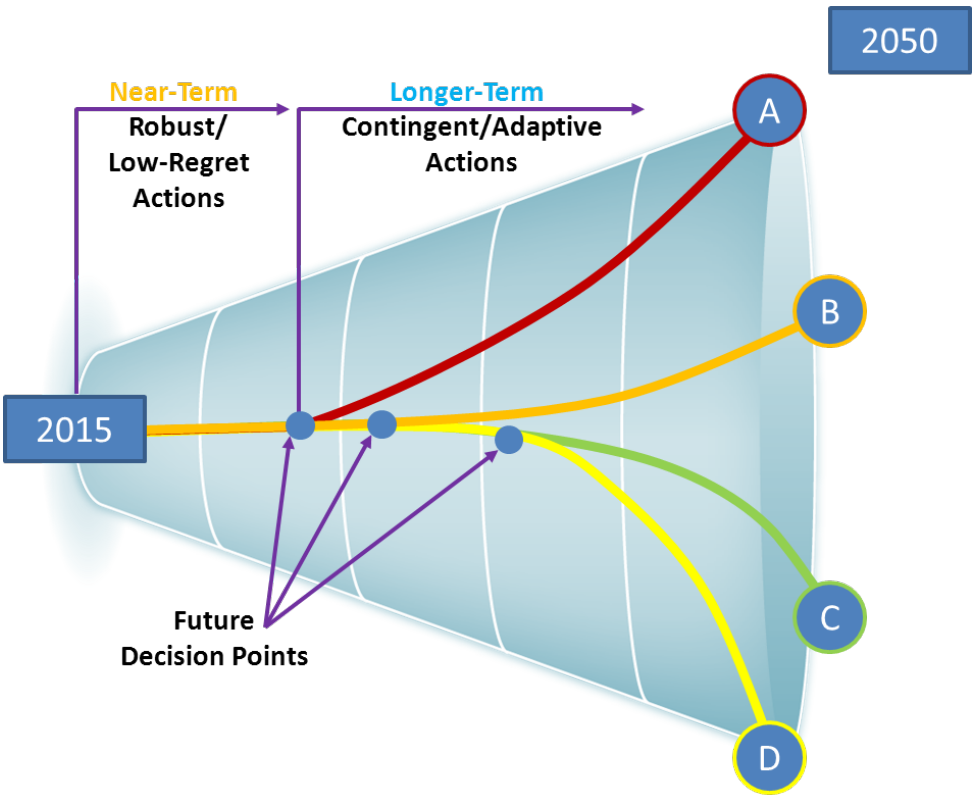

Figure 7-1. The cone of uncertainty helps define the range of water supply futures
(Source: Modified from Denver Water/Tucson Water; Copyright © 2012 Southwest Water Resources Consulting, LLC)

Colorado's water future is complex. Making wise choices will require a great deal of collaboration among stakeholders across all the basins in the state. State, federal, regional, and local entities throughout Colorado will have to make many decisions to implement the adaptive management framework outlined in SWSI and the Colorado Water Plan. SWSI and the Colorado Water Plan goals, actions, and strategies are central to ensuring that Colorado has a secure water future through 2050 and beyond.

Our decisions must balance a wide range of risks, given the uncertainties that may occur in the future. Some of the risks associated with potential changes in Colorado's future run quite high and require our consideration. Fortunately, the potential rewards are equally compelling, and a broader understanding of these opportunities can help Coloradans work together for a secure water future. The following definitions are used to describe the planning concepts used in this overall framework to incorporate risk and uncertainties:

- *Scenario Planning* – A planning process that defines complete, plausible scenarios of the future. This concept differs from traditional planning, in which one future is defined without taking into account uncertainties. Scenarios are formulated by assessing key drivers of uncertainty (e.g., economic/demographic growth, climate, environmental regulations, and social values and perspectives) and combining the outcomes of these drivers into a complete picture of what the future might look like.

- *Strategies* – Groupings of similar projects and methods that represent the "four legs of the stool" (e.g., IPPs, Conservation, Agricultural Transfers, and New Supply).

- *Portfolios* – Combinations of different strategies to meet M&I water demands. Portfolios were matched to future scenarios considering cost, reliability, the environment and recreation, agriculture, and the feasibility of implementing the portfolio.

- *No/Low Regret Actions* – Either 1) a set of strategies that are common to all of the portfolios matched to scenarios or 2) strategies that need to be planned for or preserved in order to provide adaptive capacity for one or more scenarios, while not undergoing the risks of fully developing the strategy in question. These actions have benefit under a wide range of uncertainties, and hence should be prioritized for near-term implementation.

- *Adaptive Management* – A process that develops alternative paths to each one of the future scenarios. Adaptive management reduces the risk of underperforming or over investing as it provides a framework for incremental monitoring of future trends and phased implementation of strategies over time.

- *Signposts* – Represent decision points by which future drivers of the scenarios will be assessed and actions taken to determine which path of strategies should be implemented. The signposts are directly related to the drivers used to develop the scenarios, but are fewer in number and may represent an aggregate of multiple drivers.

7.2 Challenges and Uncertainty

This section will explore the concept that planning for the future is uncertain and that change is continuous, requiring a thoughtful consideration of uncertainty and risk. These uncertainties will be examined to allow for better tracking and enable adaptive management. This discussion will help frame the need for an adaptive management planning framework and the potential benefits it can provide. Some of the factors that will be considered are:

- *Risk and Uncertainty*
- *Demand Uncertainty*
- *Supply Uncertainty*
- *Natural Disasters (Flood, Drought, Wildfire, etc.)*
- *Climate Variability*
- *Political Drivers*

7.3 Portfolios

On May 1, 2012, a Colorado Water for the 21st Century Updated Roadmap was provided to the basin roundtables, Colorado Water Conservation Board (CWCB), and IBCC Members. This roadmap was updated based on feedback received at the Basin Roundtable Summit in March 2012. The Updated Roadmap noted that the portfolio exercise resulted in general agreement on the following points:

- We must plan for a variety of possible futures and thus we should continue with scenario planning
- There are no easy or straightforward solutions, and we need to pursue all types of projects and methods concurrently in order to balance the trade-offs
- A high success rate for the IPPs statewide is critical to meet our municipal needs
- Conservation measures should be implemented and monitored to quantify their impact
- Nonconsumptive needs should be addressed
- Agricultural shortages should be addressed and agriculture should be preserved
- Specific solutions need to be identified to address the 2050 water supply gap

7.3.1 Portfolio Development Overview

The basin roundtables worked with the Portfolio and Trade-off Tool to develop 34 different portfolios for meeting the state's long-term water supply needs. Basin roundtable members have developed a broad range of portfolios to address many possible future scenarios. Some of these portfolios explore different potential futures, while others represent a basin roundtable's values in how they would meet such a future. These portfolios will be used by the IBCC as a basis for scenario planning.

As discussed above, the basin roundtables developed one or more statewide portfolios (see **Figure 7-2**). As part of this effort each basin roundtable developed at least one portfolio focusing on mid-level demands and most also developed portfolios for other demand scenarios. In developing portfolios, the basin roundtables have explored IPP yield success, the level of active conservation and whether these savings can be used to address the M&I gap, new supply development in the Colorado River System, and agricultural transfers. When developing portfolios, the basin roundtables also explored trade-offs associated with each portfolio.

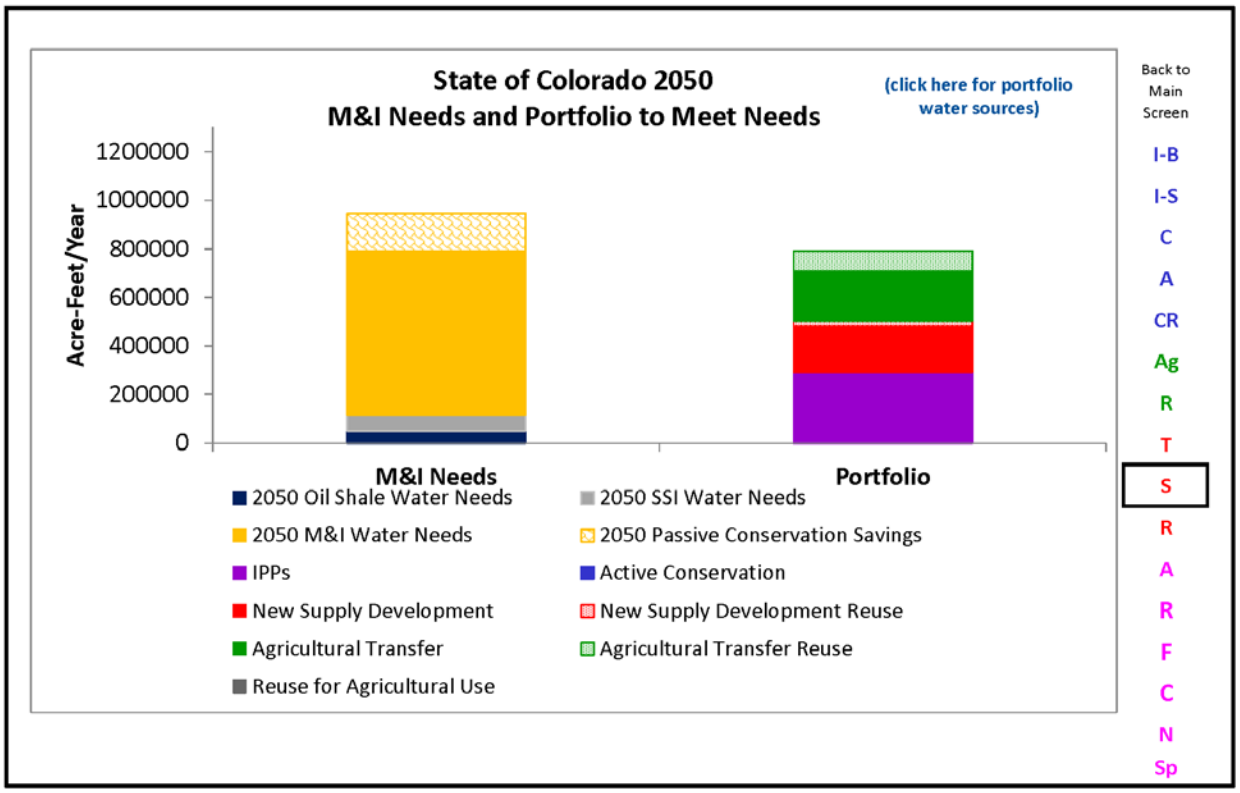

Figure 7-2. State of Colorado 2050 M&I Needs and Portfolio to Meet Needs

The IBCC summarized the basin roundtables' portfolios into a set of 10 representative portfolios as shown in **Figure 7-3**. Each of the roundtables reviewed these portfolios and they were determined to represent each of the 34 portfolios developed across the state. From this smaller set of portfolios, the IBCC was able to identify a set of no/low regrets implementation strategies that will be useful in meeting Colorado's water supply needs no matter what future emerges in the year 2050. These will be explored in Section 7.6.

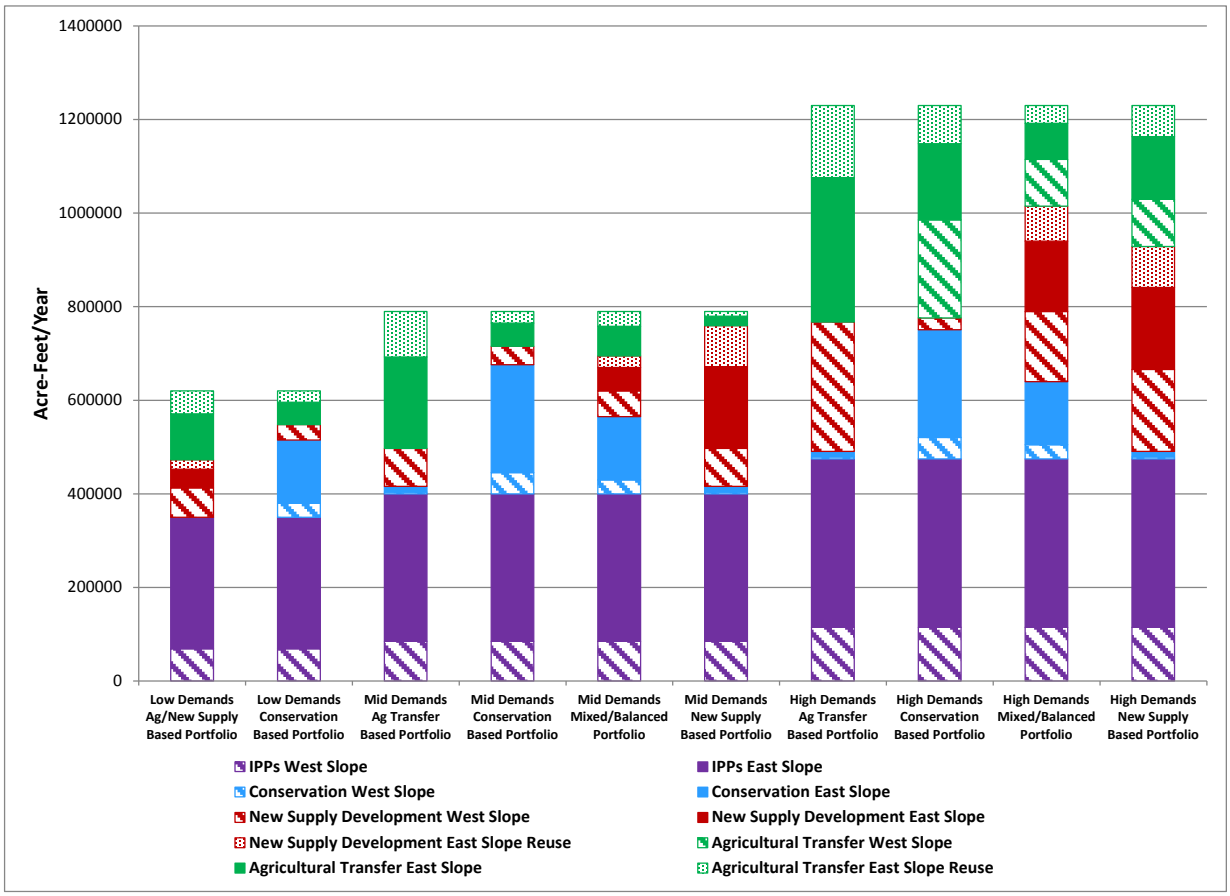

Figure 7-3. Representative portfolios based on basin roundtable's efforts

7.3.2 Basin Roundtable Portfolios Commonalities and Differences

The discussion below includes a summary of the commonalities and differences for each portfolio element based on the work of the nine basin roundtables.

7.3.2.1 Municipal and Industrial Demands

Of the 34 portfolios developed by the roundtables and the nonconsumptive committee, 5 portfolios were developed using the low demand scenario, 17 using the mid demand scenario, and 12 using the high demand scenario. The major difference between portfolios on the demand side was inclusion of oil shale demands. One-third of the portfolios do not include oil shale demands. The main reasons stated by basin roundtables that chose not to include oil shale are: (1) that it is not feasible that oil shale will be developed due to current economic conditions, and (2) that other oil development through the Niobrara and Bakken formations may preclude development of oil shale in Northwest Colorado.

The major commonality among the portfolios is that replacement of Front Range nontributary groundwater should occur in the future. Thirty-three of the 34 portfolios included this in the M&I demands to be met in the future. The one portfolio that did not include replacing Front Range nontributary groundwater was a high supply portfolio and it was assumed that under the high supply scenario this demand would not have to be replaced as there would be sufficient water supply that nontributary groundwater use would not be needed.

7.3.2.2 Identified Projects and Processes

The statewide IPP yield success rate used by the basin roundtables was relatively consistent at about 80 percent yield for all 34 portfolios. The exception was the North Platte Basin Roundtable that used an IPP success rate of about 70 percent statewide due to minimizing the amount of IPPs associated with agricultural transfers. All of the basin roundtables set their IPP success rate and held it constant for all of the portfolios they examined. **Table 7-1** summarizes the IPP success by IPP type as set by each basin roundtable. There has been agreement statewide from the basin roundtables, CWCB, and IBCC that an 80 percent success rate for the IPPs is important to achieve and the implications of this are explored in Section 7.5.

Table 7-1. IPP Success Rate by Basin and IPP Type

Basin	Agricultural Transfer	Reuse	Existing Supplies	In-Basin Project	Transbasin	In-Basin Firming	Total Success Rate
Arkansas	75%	75%	100%	100%	75%	80%	86%
Colorado	90%	90%	100%	85%	90%	85%	91%
Gunnison	90%	90%	100%	90%	90%	90%	88%
Metro	75%	75%	100%	75%	75%	75%	88%
North Platte	0%	90%	100%	90%	90%	90%	100%
Rio Grande	90%	90%	100%	90%	90%	85%	93%
South Platte	50%	80%	100%	50%	85%	50%	65%
Southwest	100%	100%	100%	80%	100%	100%	88%
Yampa-White	100%	100%	100%	50%	100%	100%	67%

7.3.2.3 Conservation and Reuse

The basin roundtables used all three levels of active conservation (Low = 160,000 AFY, Medium = 330,000 AFY, and High = 460,000 AFY) in their portfolio development. **Figure 7-4** shows the distribution by conservation strategy and the average amount of conservation savings from each strategy that the basin roundtables assigned to meet the M&I gap. For the low conservation strategy, a lower quantity of water was set aside to meet the M&I gap (13,000 AFY statewide). Most of the portfolios using the medium and high conservation strategies had a higher amount of savings used to meet the M&I gap (68,000 AFY and 268,000 AFY, respectively). The major difference among the portfolios is the amount of conservation savings that could be applied to the M&I gap. Those roundtables that applied a smaller percentage of conservation savings to the M&I gap have concerns regarding the reliability of using conserved water for new growth and that using conserved water to meet new demands will impact their drought reserve and system flexibility.

The portfolios developed by the basin roundtables also include reuse of any future transbasin supplies and the consumptive use portion of future agricultural transfers. This is included in the portfolio tool as a ratio of reuse that could be achieved by reusing either a transbasin supply or the consumptive use portion of an agricultural transfer. The range of reuse ratios used by the basin roundtables is 1.4 to 1.7 with most between 1.5 and 1.6. The initial draft nonconsumptive portfolio used a reuse ratio of 1.9.

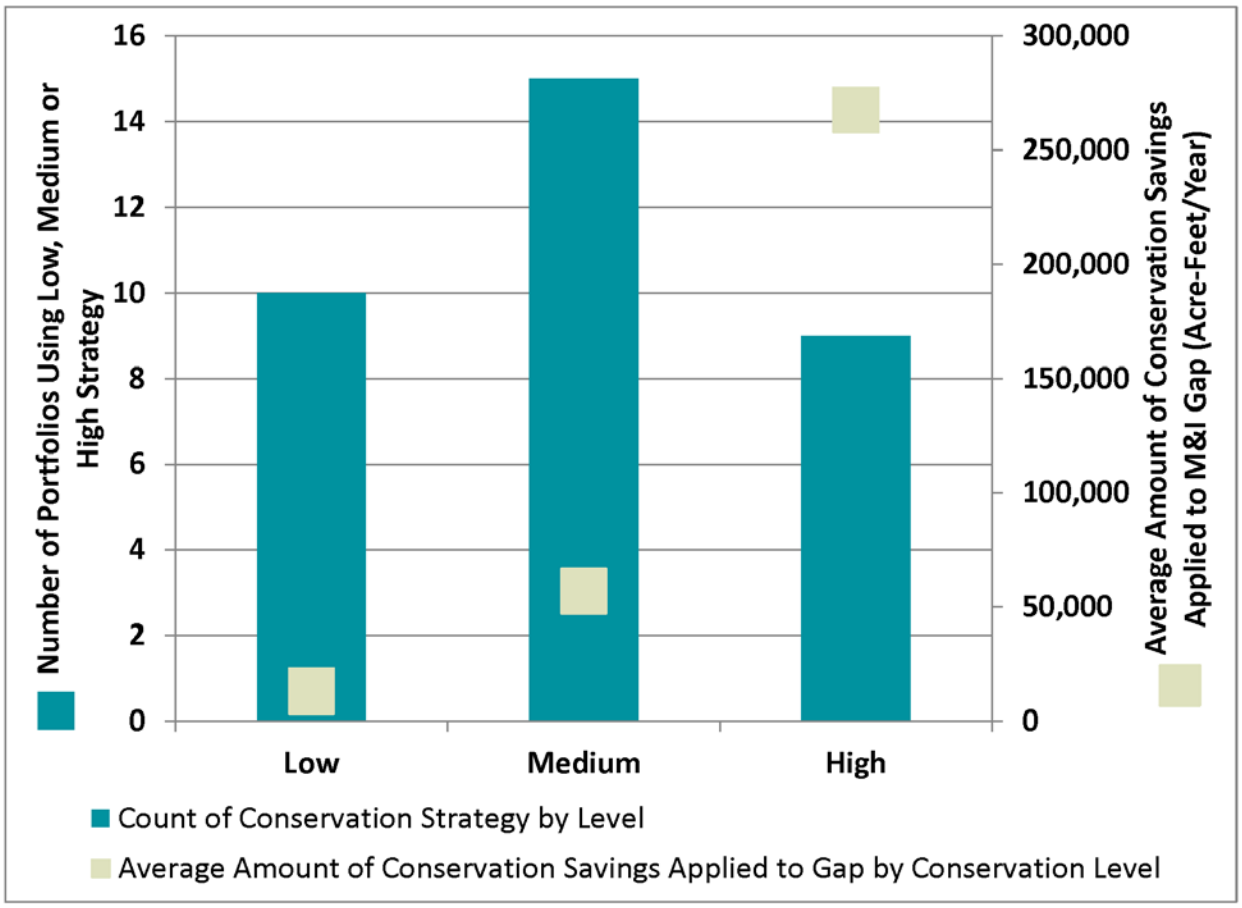

Figure 7-4. Number of portfolios by conservation strategy and savings applied to the M&I Gap

7.3.2.4 Colorado River System

The amount of Colorado River System water developed in the portfolios ranges from zero to 431,000 AFY. All of the basin roundtables developed at least one portfolio that identified Colorado River System development for West and East Slope use. Overall, more than 60 percent of the portfolios developed by the basin roundtables include Colorado River System water development and use by both the West and East Slope as shown in **Figure 7-5**.

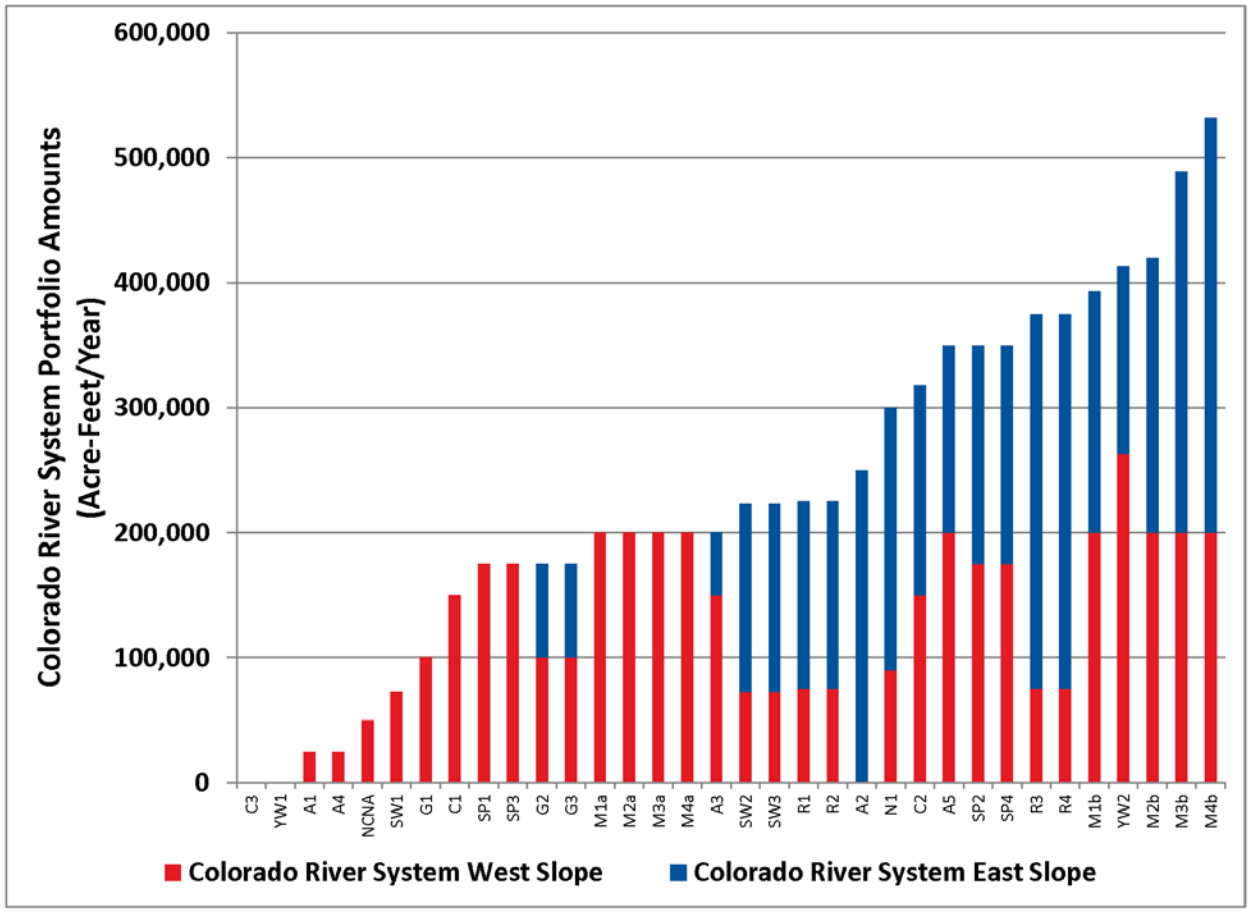

Figure 7-5. Colorado River system development included in basin roundtable portfolios

7.3.2.5 Agricultural Transfers

As shown in **Figure 7-6**, a little over half of the portfolios developed by the basin roundtables attempted to minimize additional agricultural transfers in the future. Based on results of IPPs analyses and population growth estimates presented in SWSI 2010, approximately 260,000 acres statewide will be lost due to transfers to M&I use or urbanization. Based on the portfolios developed to date, the South Platte could lose from 5 to 30 percent of additional irrigated acres above the 20 percent that is expected to be lost to IPPs and urbanization. The West Slope could lose from 5 to 25 percent of additional irrigated acres more than the 10 percent that is expected to be lost due to IPPs and urbanization. Reducing the impacts to agriculture as a result of meeting Colorado's future M&I water demands was discussed in detail by all of the basin roundtables when completing the portfolios exercise.

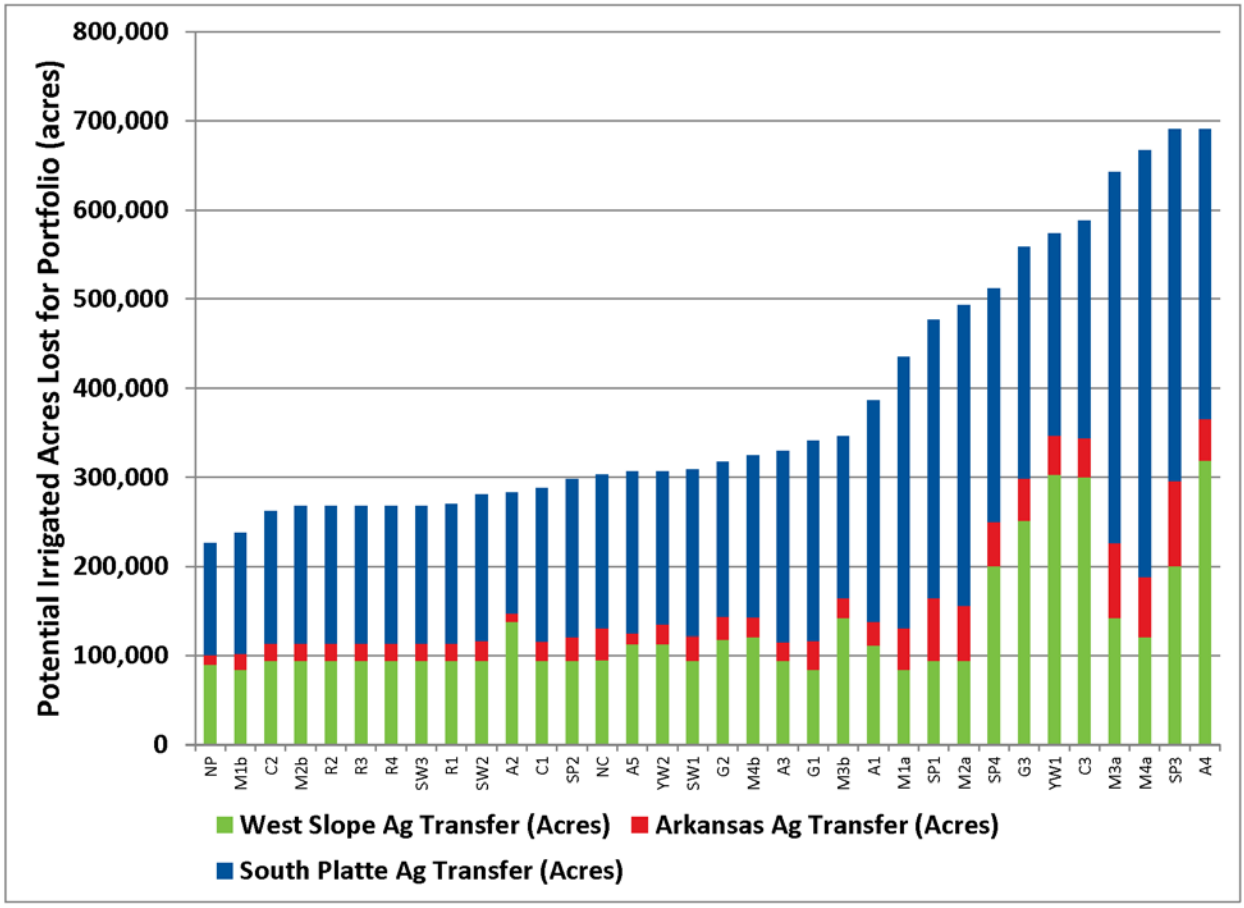

Figure 7-6. Potential irrigated acres lost by portfolio

7.3.2.6 Trade-Offs

The basin roundtables examined all of the trade-offs in the Portfolio and Trade-off Tool when developing their portfolios. Trade-offs included:

- Amount of irrigated acres that could be lost based on the agricultural transfer portion of the portfolio
- The size in acres of a rotational fallowing program that would be needed based on the agricultural transfer portion of the portfolio
- The cost of the portfolio
- A consideration of depletions related to environmental flow metrics at four locations on the West Slope
- A depletions analysis in the South Platte Basin at three key locations

Examination of the trade-offs help roundtables understand that Colorado is interconnected statewide. Colorado's West Slope ranching community relies on Front Range infrastructure to finish, process, and distribute their cattle. If agriculture in the South Platte no longer supports the agricultural infrastructure, primarily in Weld County, then it will negatively affect the West Slope's agriculture. Similarly, many people on the East Slope enjoy the environmental and recreational opportunities on the West Slope. The Portfolio and Trade-Off Tool helped roundtable members carefully consider Colorado's statewide interdependence, and most roundtable portfolios aimed at reducing trade-offs from a statewide perspective.

7.4 Scenarios and Major Drivers

As basin roundtables developed their portfolios, they did so for a number of different scenarios. Primarily, the roundtables were concerned about changes in M&I water demands and water supply availability. However, some roundtables discussed social values and other drivers, which the water community has no control over. Scenarios represent complete, plausible futures that are defined by major drivers that can impact M&I water demands and water supply availability, and are designed to capture a full range of uncertainty. In developing the final recommendation for the scenarios, the IBCC considered the basin roundtable discussions, the scenarios developed by the Bureau of Reclamation's Colorado River Supply and Demand Study, and the economic and demographic work done as part of SWSI 2010.

Based on these past efforts, the following drivers were determined by the IBCC to indicate what type of future Colorado will face:

A. Population Growth / Economic Growth
B. Climate Status / Water Supply
C. Energy Water Needs
D. Agricultural Demand and Agricultural Water Demand
E. Availability of Water Efficiency Technology
F. Social / Environmental Values
G. Urban Land Use
H. Regulatory Constraints
I. M&I Water Demands (Includes A, C, E, and G)

Once these drivers were determined, the IBCC developed five scenarios for 2050. These scenarios represent plausible futures that depend on many assumptions. They are not predictions by CWCB or IBCC. Having multiple future scenarios helps to identify management responses that perform well when compared across a wide array of baseline conditions that could occur in the future. The scenarios developed are represented below and in **Figure 7-7** and described below:

1) Business as Usual – Recent trends continue into the future. Few unanticipated events occur. The economy goes through regular economic cycles but grows over time. By 2050 Colorado's population is close to 9 million people. Single-family homes dominate, but there is a slow increase in compact development in large urban areas. Social values and regulations hold steady, but stream flows and water supplies show increased stress. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation of new water development slowly increases. Municipal water conservation efforts slowly increase. Oil shale continues to be researched as an option. Large portions of agricultural land around cities are developed by 2050. Transfer of water from agricultural to urban uses continues. Efforts to mitigate the impacts of the transfers slowly increase. Agricultural economics continue to be viable but agricultural water use continues to decline. The climate is similar to the 20th century.

2) Weak Economy – The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected, slowing the conversion of agricultural land to housing. Maintaining infrastructure, including water facilities, becomes difficult. Many sectors of the state's economy begin to struggle financially, including most users of water and water-dependent businesses. There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation decreases due to economic concerns. Greenhouse gas emissions do not grow as much as currently projected.

3) Cooperative Growth – Environmental stewardship becomes the norm. Broad alliances form to provide for more integrated and efficient planning and development. Population growth occurs consistent with current forecasts. Mass transportation planning concentrates more development into urban centers and mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development. Coloradans embrace water and energy conservation. New water saving technologies emerge. Eco-tourism thrives. Water development regulations are more restrictive and require high water-use efficiency along with environmental and recreational benefits. Environmental regulations are more protective and include efforts to re-operate water supply projects to reduce impacts. Demand for more water-efficient foods reduces water use. There is a moderate warming of the climate, which results in increased water use in all sectors, threatening stream flows and supplies. This dynamic reinforces the social value of wide-spread water efficiency and increased environmental protection.

Drivers	Weak Economy	Business as Usual	Cooperative Growth	Adaptive Innovation	Hot Growth
A. Population Growth / Economic Growth	• 8.6 Million	• 9.1 Million	• 9.1 Million	• 10.0 Million	• 10.0 Million
B. Climate Status / Water Supply	Hottest / Hotter • Same as 20th Century Observed	Hottest / Hotter • Same as 20th Century Observed	Hottest / Hotter • Between Hot and Dry and 20th Century Observed	Hottest / Hotter • Hot and Dry	Hottest / Hotter • Hot and Dry
C. Energy Water Needs	• Low (no oil shale)	• Moderate (no oil shale)	• Low (no oil shale)	• Low (no oil shale)	• High (oil shale)
D. Agricultural Demand and Agricultural Water Demand	Total ag water demands slightly higher • Decrease in irrigated acres due to urbanization • Ag exports and demands lower • Ag is less able to compete with urban areas for water	Total ag water demands decrease • Decrease in irrigated acres due to urbanization • Ag exports and demands constant • Ag is less able to compete with urban areas for water	Total ag water demands slightly higher • Slight decrease in irrigated acres due to urbanization • Ag exports down and local demands up • Ag is better able to compete with urban areas for water • Increased ET due to climate change	Total ag water demands slightly higher • Slight decrease in irrigated acres due to urbanization • Ag exports down and local demands up • Ag is better able to compete with urban areas for water • Increased ET due to climate change	Total ag water demands higher • Significant decrease in irrigated acres due to urbanization • Ag exports and demands high • Ag is better able to compete with urban areas for water • Increased ET due to climate change
E. Availability of Water Efficiency Technology	• M&I: Moderate/Passive • Ag: same as today	• M&I: Moderate/Passive • Ag: same as today	• M&I: High • Ag: Efficiencies are implemented	• M&I: High • Ag: Efficiencies are implemented	• M&I: Moderate/Passive • Ag: same as today
F. Social / Environmental Values	• No Change	• No Change	• Increased Awareness • Increased willingness to protect environment and stream recreation	• Increased Awareness • Increased willingness to protect environment and stream recreation	• Full Use of Resources • Low willingness to protect environment and stream recreation
G. Urban Land Use	• No Change	• No Change	• Higher Density	• Higher Density	• Lower Density
H. Regulatory Constraints	Regulation / Deregulation • No Change	Regulation / Deregulation • No Change	Regulation / Deregulation • Increased	Regulation / Deregulation • Increased but expedited	Regulation / Deregulation • Reduced
I. M&I Water Demands*	• Lowest of the five scenarios	• Middle of the five scenarios	• Second lowest of the five scenarios	• Second highest of the five scenarios	• Highest of the five scenarios

Figure 7-7. State of Colorado Future Water Supply Scenarios

4) Adaptive Innovation – A hotter climate causes major environmental problems globally and locally. Social attitudes shift to a shared responsibility to address problems. Technological innovation becomes the dominant solution. Strong investments in research lead to breakthrough efficiencies in the use of natural resources including water. Renewable and clean energy become dominant. Colorado is a research hub and has a strong economy. The relatively cooler weather in Colorado (due to its higher elevation) and high tech job market causes population to grow faster than currently projected. The warmer climate increases demand for irrigation water in agricultural and municipal uses, but innovative technology mitigates the increased demand. Higher water efficiency helps maintain stream flows even as water supplies decline. The regulations are well defined and permitting outcomes are predictable and expedited. More food is bought locally increasing local food prices and reducing the loss of agricultural land to urban development. The environment declines and shifts to warmer weather species. Droughts and floods become more extreme. More compact urban development occurs through innovation in mass transit. The warmer climate reduces global food production increasing the market for local agriculture and increasing food imports to the state.

5) Hot Growth – A vibrant economy fuels population growth and development throughout the state. Regulations are relaxed in favor of flexibility to promote and pursue business development. A much warmer climate also brings more people to Colorado with its relatively cooler climate. Families prefer low-density housing and many seek rural properties, ranchettes, and mountain living. Agricultural and other open lands are rapidly developed. A hotter climate decreases global food production. Worldwide demand for agricultural products rises, greatly increasing food prices. Stream flows and water supplies decline. The environment degrades and shifts to warmer weather species. Droughts and floods become more extreme. Communities struggle unilaterally to provide the services needed for the rapid business and population growth. Fossil fuel is the dominate energy source, and there is large production of shale oil, coal, natural gas, and oil in the state.

7.5 Matching Portfolios to Scenarios

As discussed above, the basin roundtables identified 34 future portfolios as part of their portfolio development exercise. There were many commonalities among the portfolios, and 10 representative portfolios were developed by the IBCC and reviewed by the basin roundtables (see Figure 7-3). Based on a qualitative assessment of these 10 representative portfolios, five portfolios were best matched to the five future scenarios described in Section 7.4. The qualitative assessment incorporated the trade-offs and metrics discussions had at the IBCC and basin roundtables. The considerations include:

- Cost
- Reliability
- Environmental and recreational health
- Agricultural health
- The feasibility of permitting and building the portfolio for the given scenario

For each scenario, a representative portfolio was identified based on the five factors above. These are shown in **Table 7-2** and **Figure 7-8**. These portfolios are dependent up on achieving the no/low regrets, as described below. If the no/low regrets are not actualized, then modified versions of the other five portfolios will be necessary to meet future needs.

Table 7-2. Matched Scenarios and Portfolios

Scenario	Portfolio
Weak Economy	Conservation Based Low Demands Portfolio
Cooperative Growth	Conservation Based Mid Demands Portfolio
Business as Usual	Mixed/Balanced Mid Demands Portfolio
Adaptive Innovation	Conservation Based High Demands Portfolio
Hot Growth	Mixed/Balanced High Demands Portfolio

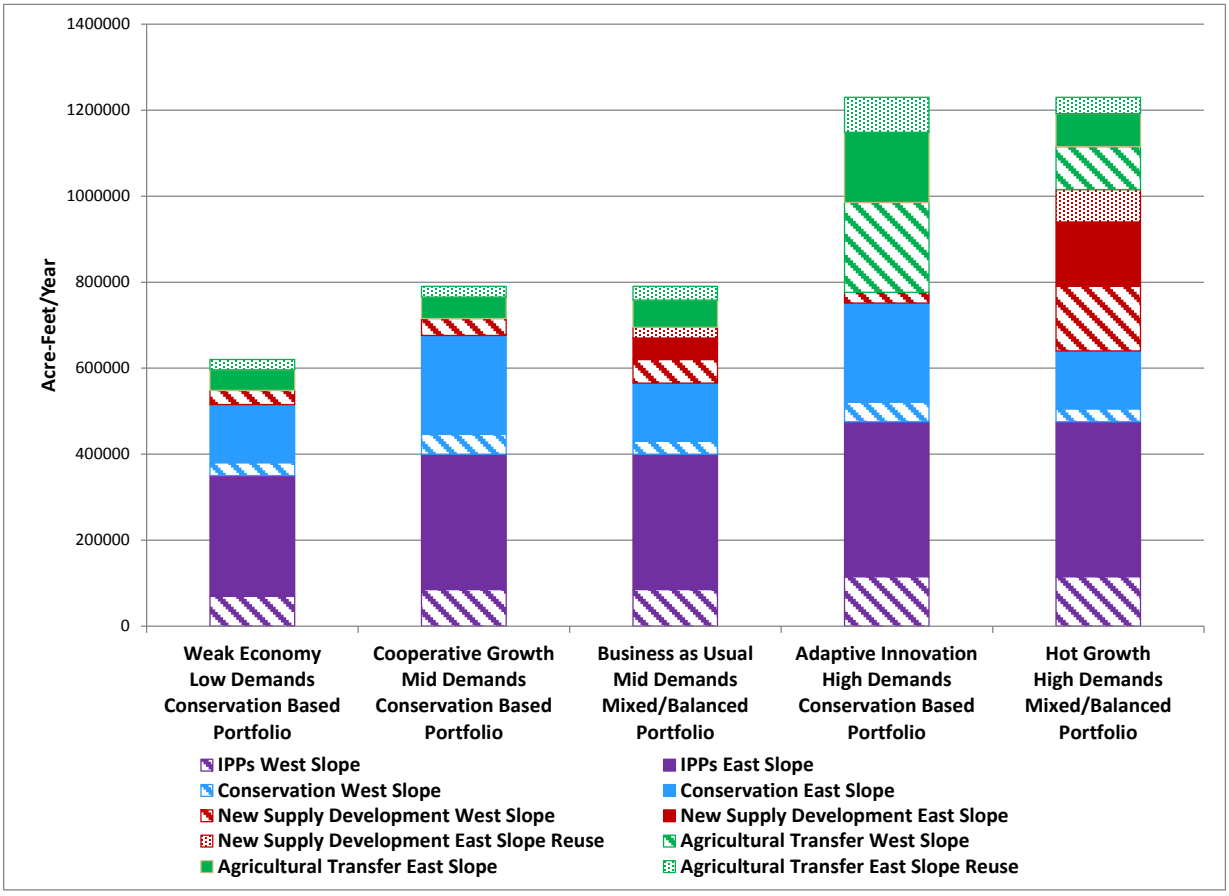

Figure 7-8. Summary portfolios matched with associated scenario

7.6 No and Low Regrets

The IBCC discussed no/low regrets at its November 2012 and March 2013 meetings and has concluded that the no/low regrets actions should meet the following criteria:

- Actions that are needed to meet future water needs, regardless of which 2050 scenario Colorado faces
- Actions that are needed to preserve the water supply options described in the portfolios, which may be needed for one or more scenarios
- Actions that should move forward in the near-term, and can serve as the initial implementation components of adaptive management, as well as the first phase of the Colorado Water Plan and implementation of SWSI
- Actions that can begin immediately
- Actions that have few or no disadvantages in terms of costs and benefits, regardless of the future

The IBCC identified the following No/Low Regret Goals:

- Minimize Statewide Acres Transferred (per Basin Goals)
- Implement Agricultural Sharing Projects
- Planning and Preserving Options for Existing and New Supply
- Low / Medium Conservation Strategies
- Implement Nonconsumptive Projects
- High Success Rate for IPPs
- Storage

After examining the five portfolios in detail as discussed in Section 7.5, several commonalities were revealed along with the need to plan for and preserve options for other portfolios that may be needed in the future. Implementing the common strategies would provide benefits under all of the five scenarios of the future. Because they provide a foundation of benefits, they are referred to as no/low regrets as defined above. Because they often represent a starting point for other possible actions down the road, the no/low regrets actions should be prioritized and implemented within the next 10 to 15 years.

The following is a summary of the no/low regrets:

- **Identified Projects and Processes:** Implement IPPs to yield 80 percent, equivalent to 70,000 AFY for the West Slope and 280,000 AFY for the East Slope (see **Figure 7-9**).

  Adaptive Capacity: Track the yield of the IPPs in meeting the gap. If IPPs are not implemented to planned levels, additional emphasis on other portfolio elements will be required.

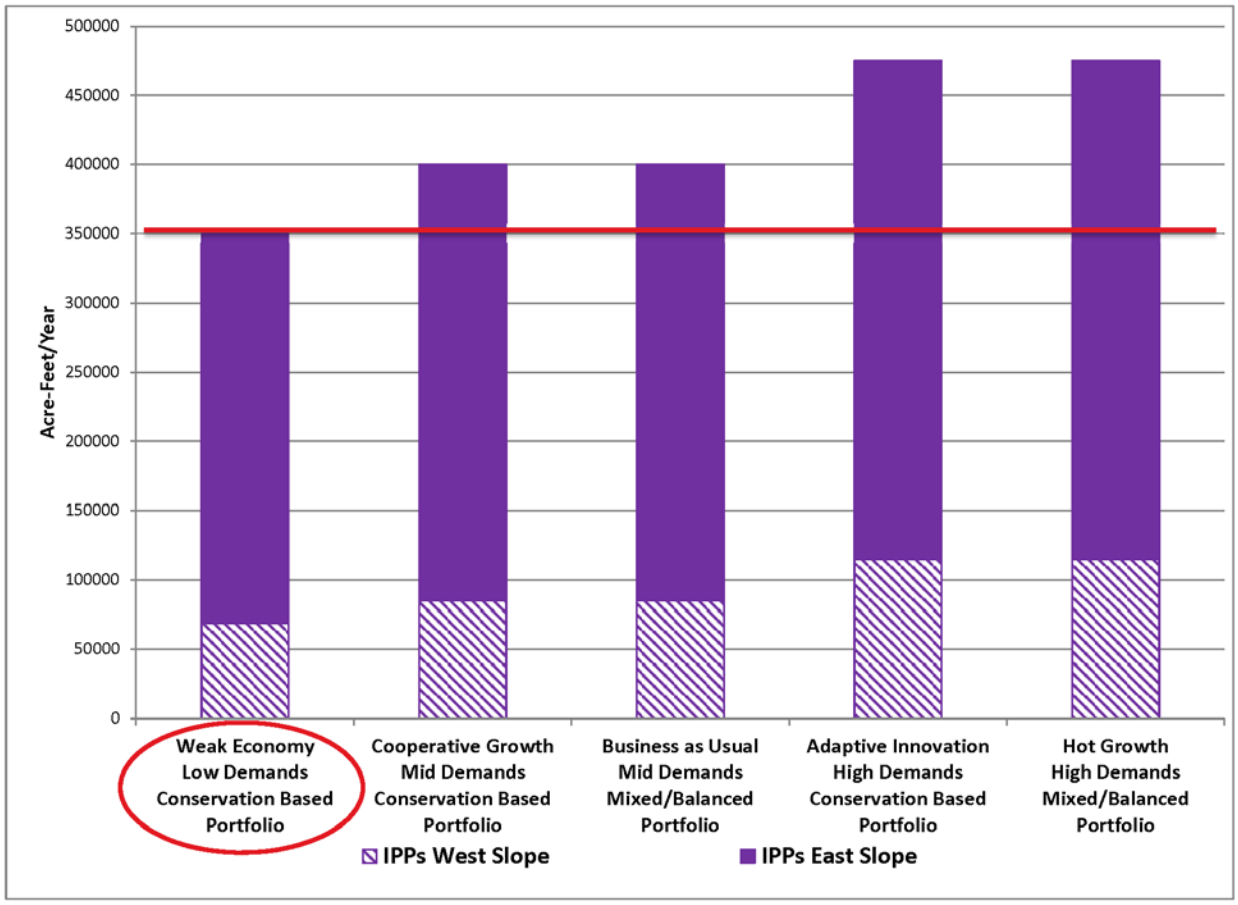

Figure 7-9. Common element is 80 percent of IPP yield (70,000 AFY on West Slope and 280,000 AFY on East Slope)

- **Conservation:** Implement strategies to meet medium levels of conservation and apply half of that to meet the M&I Gap (see **Figure 7-10**).

  Adaptive Capacities: Track the reliability of these conservation savings in meeting the gap. If conservation does not prove to be reliable, additional emphasis on other portfolio elements will be required.

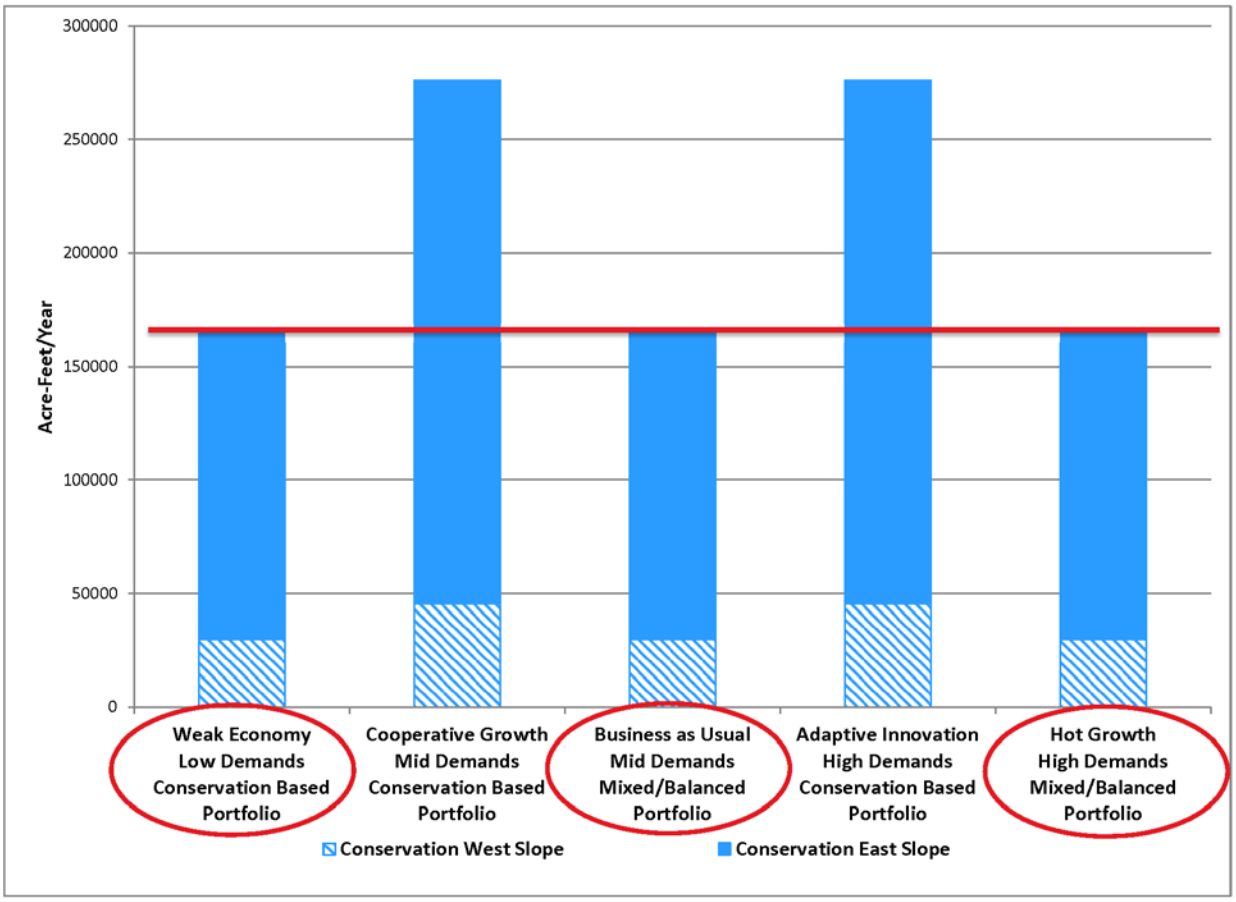

Figure 7-10. Common element is implement medium conservation measures and track demands to determine reliability

- **Agricultural Transfers:** Limit traditional "buy and dry" to the IPPs and urbanization. Initiate alternative agricultural transfer project or projects on the East Slope to yield 50,000 AFY plus an additional 25,000 AFY from reuse of that water (see **Figure 7-11**).

  Adaptive Capacity: Preserve and plan for additional alternative agricultural transfers, should a future scenario require it. If the 50,000 AFY alternative agricultural transfer project or projects is not implemented to planned levels, additional "buy and dry" will result.

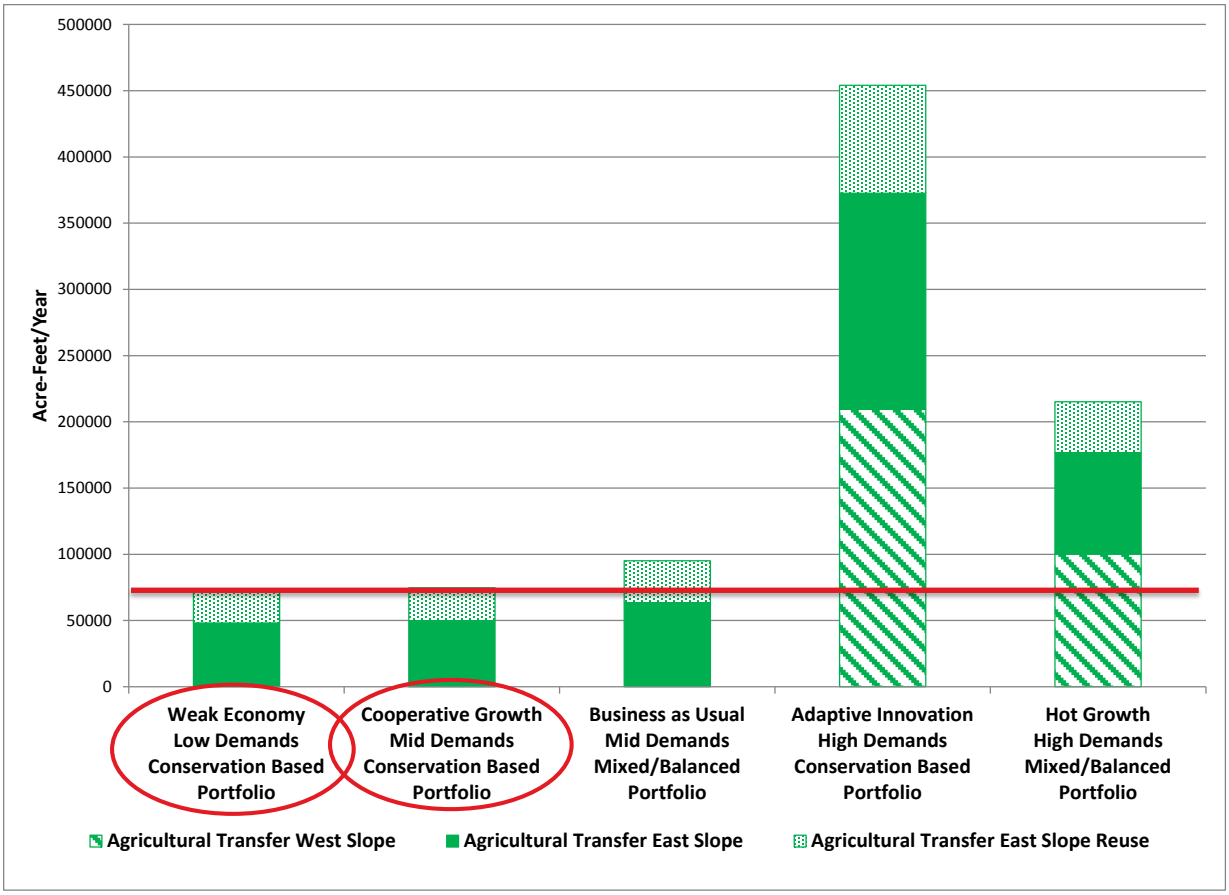

Figure 7-11. Common element is a 50,000 AFY alternative transfer method project on the East Slope, 25,000 AFY of reuse of this alternative supply, and preserving options for additional alternative transfers

- **New Supply:** Develop 25,000 AFY of new supplies in the Colorado River system for the West Slope (see **Figure 7-12**).

  Adaptive Capacity: Preserve and plan for transbasin new supply options, should a future scenario require it.

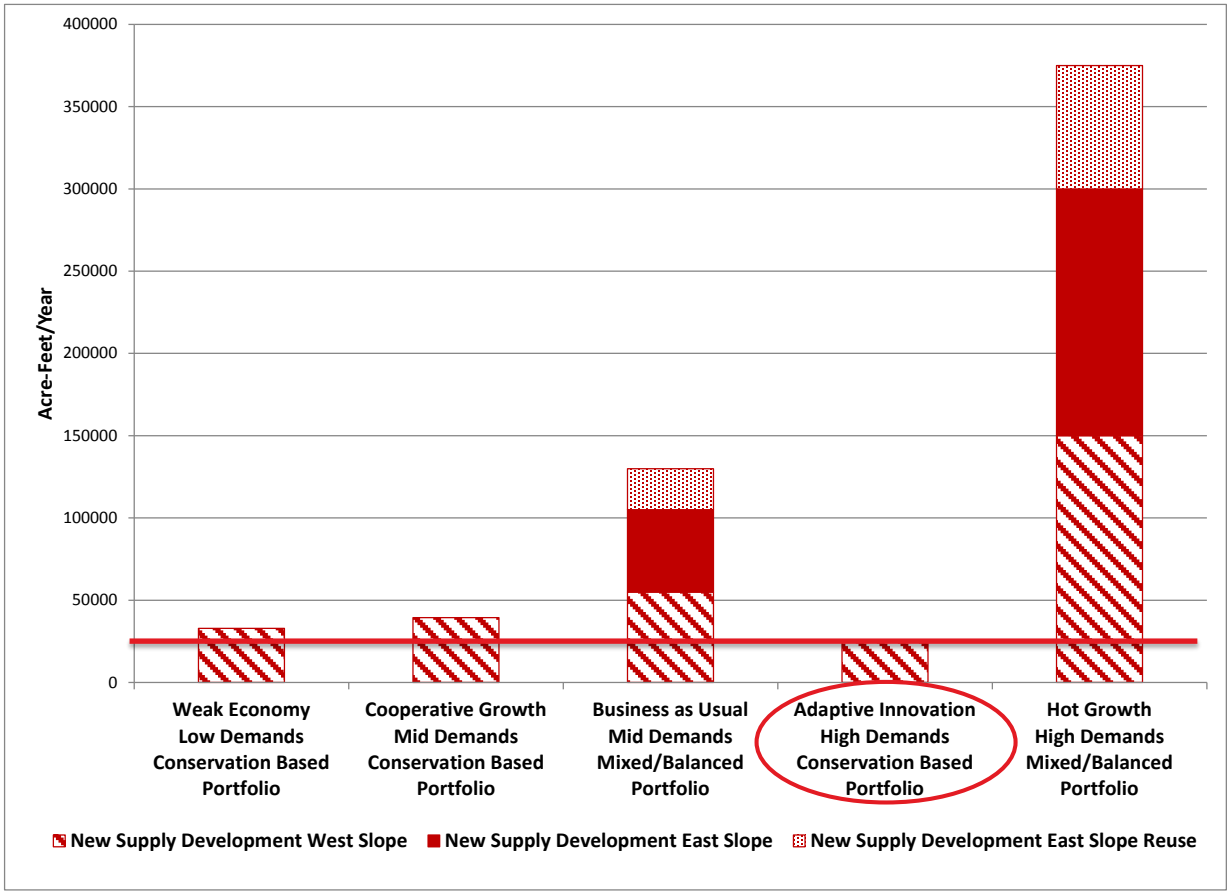

Figure 7-12. Common element is 25,000 AFY of new supply projects on the West Slope and preserving transbasin options

The no/low regrets can be combined into a no/low regrets portfolio. This can be compared to the "status quo" portfolio developed as part of the portfolio exercise (**Figure 7-13**). The no/low regrets portfolio better meets Colorado's values, as they were developed by the roundtables. Compared to the status quo portfolio, it minimizes impacts to the agricultural economy and supports environmental and recreational attributes. However, it only meets the Weak Economy scenario. If medium or high M&I demands are realized in the future, additional portfolio elements will be required, as described in Section 7.7 below.

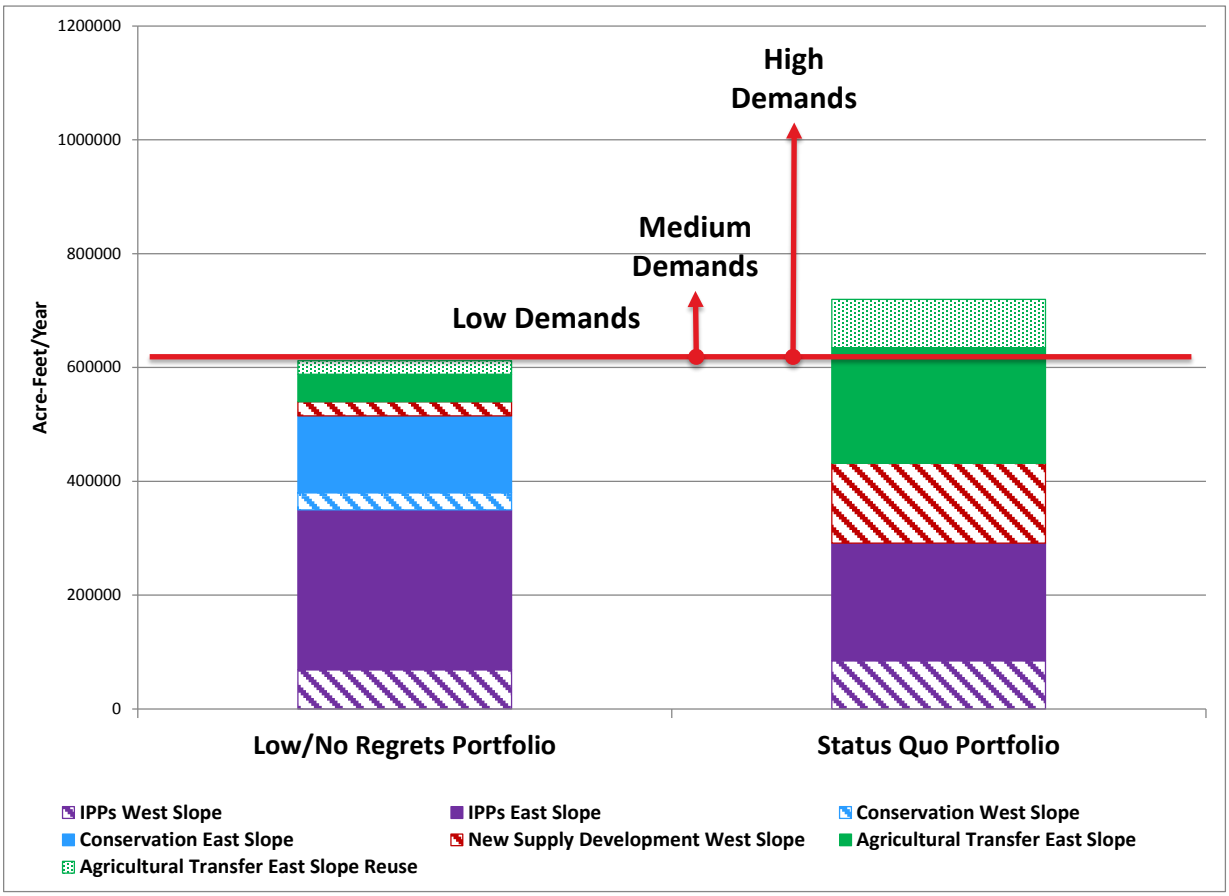

Figure 7-13. No/Low Regrets Portfolio vs. Status Quo Portfolio

7.7 Adaptive Management Framework

An adaptive management framework was used to determine if and when additional strategies beyond the no/low regret actions should be implemented. Adaptive management has three main elements: (1) signposts, (2) outcomes, and (3) actions.

7.7.1 Signposts

Signposts are decision points based on the most critical drivers that were used in the development of the future scenarios. The recommended signposts used in SWSI represent an aggregation of multiple drivers, and are defined as follows:

- *M&I Water Demands* – Based primarily on the tracking of economic and demographic growth, but also account for energy water demands, effectiveness of water efficiency, and urban land use. Water demands will be assessed as being lower or higher than the mid-level water demand forecast used in previous SWSI efforts.
- *Water Supply Availability* – Based on a tracking of climate, hydrology, legal constraints associated with Colorado's interstate compacts, and environmental regulations affecting availability of water. Water supplies will be assessed as being lower or higher than the mid-level water supply availability used in previous SWSI efforts.
- *Social Values* – Based on the tracking of values towards land-use development, energy use, water use efficiency, agriculture, environment, and recreation, an overall assessment will be made to define social values as being more "green" or more "resource utilization." Green values will dictate more dense, low-impact development; higher reliance on water use efficiency; greater protection of the environment and recreational resources; more energy efficiency; and preservation of agriculture and open space. Resource utilization values will dictate a full use of water supply resources, including new supplies and agricultural transfers, to meet M&I demands.

7.7.2 Outcomes

Outcomes represent alternative paths for the *signposts*. For example, the outcome of the M&I Water Demand signpost may be that demands are greater than mid-level forecasts because economic and demographic growth is tracking higher than expected.

7.7.3 Actions

Actions represent the strategies to be implemented based on the *outcomes* of the *signposts*. Actions may include: stay the course (after implementation of no/low regrets actions), acceleration of a previous strategy, or implementation of a new strategy (e.g., new water supply).

7.7.4 Adaptive Management Framework

Figure 7-14 depicts the way signposts are used to determine which path forward strategies should be implemented in order to arrive at the ultimate portfolio tied to a specific scenario of the future. In this example, M&I water demands will be assessed as being higher or lower than mid-level projections; then water supply availability will be assessed as being lower or higher than mid-level projections; and finally social values will be assessed as being more "resource utilization" or "green".

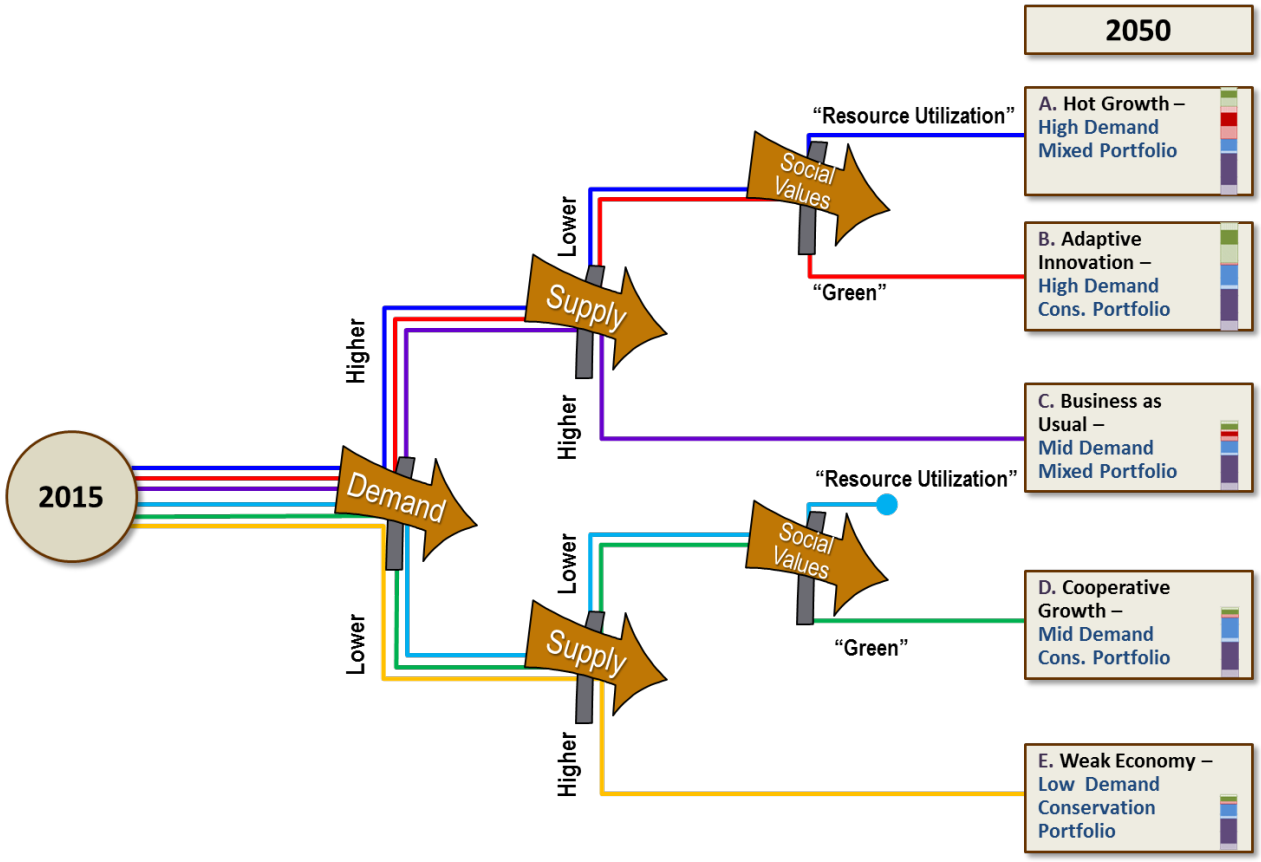

Figure 7-14. Example signposts and how they relate to Colorado's Water Supply Future Scenarios

This example represents one possible pathway to the scenarios. There are many other pathways and also other possible futures than those defined as part of the Roundtable and IBCC's work. Future updates to SWSI will consider whether or not the major drivers continue to be the most critical uncertainties for determining Colorado's future. With that in mind, a few key points are important to recognize in order for the adaptive management framework to best meet Colorado's future needs:

- Not every emerging critical driver is known at this point, but the adaptive management plan is a living document. As future drivers emerge or indicators change in the future, the scenarios and portfolios will adjust.
- Each of the major driver signposts will be assessed multiple times in future SWSI updates. Actions are phased so that "off-ramps" from a particular path is possible.

- Additional identified drivers will be monitored in SWSI and will impact whether a portfolio is able to be implemented or not, such as the state of the recovery programs for endangered species, the agricultural economy and the M&I reliability of conservation.

Using the recommended signposts and the framework presented, an adaptive management plan was developed for SWSI, which is shown in **Figure 7-15**.

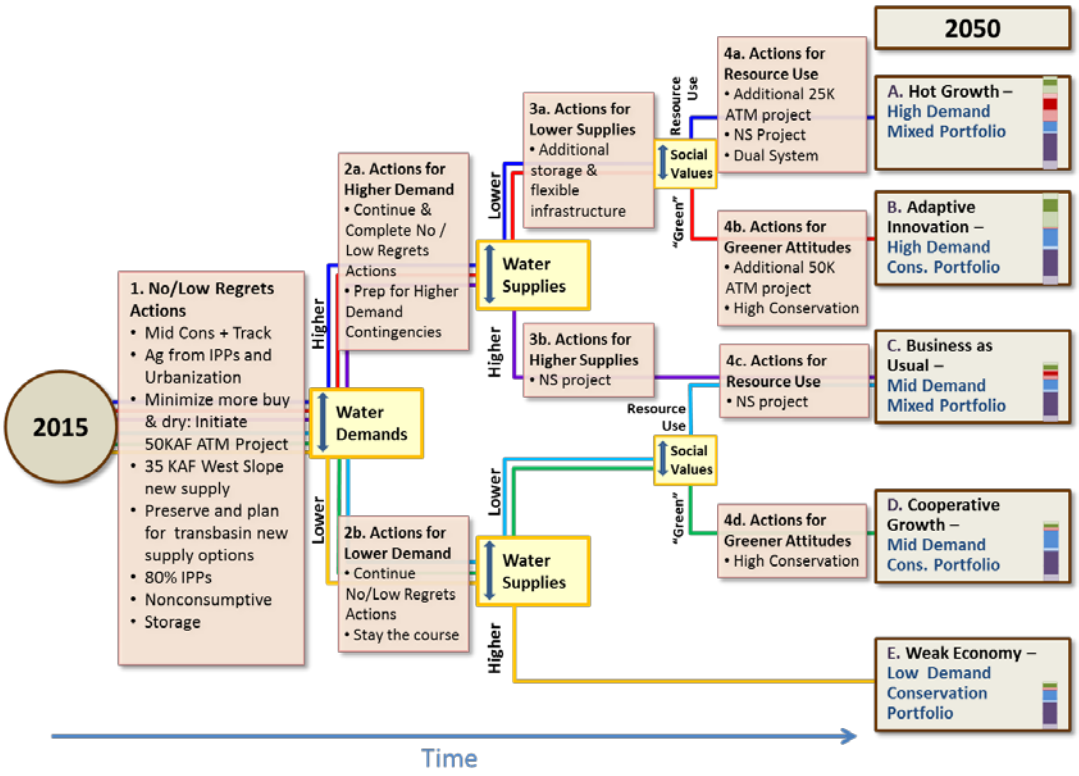

Figure 7-15. Adaptive management framework for SWSI

Future SWSI updates will need to track these signposts so that we can come to understand which future scenario Colorado will face. Also, existing signpost actions may need to be modified depending on how successful strategies are implemented and new signposts may also be needed in future SWSI updates to account for emerging uncertainties.

The importance of successful implementation of the no/low regrets actions cannot be overstated. If these foundational actions are not fully implemented, the paths to the five existing scenarios and associated portfolios would be accelerated in the best cases (any of the low or mid water demands, coupled with high water supply availability). However, if this situation of unsuccessful implementation of no/low regrets actions is packaged with high demands and low water supply availability, then the gap between demands and supplies would be greater than any of the portfolios envisioned by the roundtables—resulting in water shortages or the need to develop additional new supplies that have yet to be identified.

7.8 Conclusions

This process of developing plausible scenarios of the future, matching portfolios to the scenarios, identifying no/low regrets actions, and using signposts to determine when additional actions are needed beyond the implementation of no/low regrets actions has the following benefits:

- It captures a range of uncertainties and risks that can affect the ability to meet water demands in the future
- It selects appropriate and representative supply portfolios to match future scenarios, which gives broad guidance on what types or categories of conservation and supply projects should be implemented
- It identifies near-term, no/low regrets actions that will provide benefits under a range of uncertainties as a foundation to longer term planning
- It provides a framework for incremental implementation beyond no/low regrets actions that uses signposts to determine when such additional actions are needed

This process also underscores the critical importance of implementing the no/low regrets actions within the next 10 to 15 years. Without the full implementation of these foundational actions, the gap between demands and water supplies will be much greater than originally projected. This means that even under a weak economy scenario, new water supplies would be needed. Under the scenarios in which demands for water are greater and/or supplies lower, even more new supplies would be needed beyond what was envisioned by the roundtables.

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No.	Individual and/or Organization	Comment	Response
1	Barbara Vasquez, North Platte Basin Roundtable	I would like to add some projects to the North Platte NCN project map for completeness. Information of CPW stream restoration and reservoir improvement is provided below (list) and attached (map of locations).	Toolbox was updated to include this information.
2		In addition, I would like to suggest that CWCB ensure that all WSRA-funded projects for in-stream diversion structures be reviewed internally by CWCB staff to ensure that they include necessary design/construction elements to make them fish-friendly.	Comment noted for CWCB consideration.
3	Theresa M. Conley, Water Advocate, Conservation Colorado Jennifer Bock, Water Director, High Country Citizens' Alliance Nathan Fey, Director, Colorado River Stewardship Program, American Whitewater Bart Miller, Water Program Director, Western Resource Advocates Dan Randolph Executive , Director San Juan Citizens Alliance	Our organizations' primary motivation in submitting this comment letter is applaud the work that the CWCB, IBCC, and Basin Roundtables have done in studying, evaluating, and prioritizing nonconsumptive water uses and needs and to provide feedback to guide this process. We strongly support the creation of this Toolbox as it an important and necessary tool stemming from the previous nonconsumptive needs assessment ("NCNA") to be used in the implementation of basin-wide water plans. Further, we want to press upon the CWCB the critical need to ensure that nonconsumptive needs are incorporated into all the water planning efforts and the State Water Plan ("SWP"). Governor Hickenlooper stated that all conversations about water must start with conservation. We agree. But all conversations must also include a discussion of our nonconsumptive needs.	Comment noted for CWCB consideration. The Colorado Water Plan will include nonconsumptive needs.

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No.	Individual and/or Organization	Comment	Response
4	Theresa M. Conley, Water Advocate, Conservation Colorado Jennifer Bock, Water Director, High Country Citizens' Alliance Nathan Fey, Director, Colorado River Stewardship Program, American Whitewater	Despite driving this multibillion dollar industry, nonconsumptive water needs and uses — have historically been left out of the equation, or only considered after other uses are fulfilled. As the demands on our limited water supply increase, so does public concern. As reported by the State of the Rockies poll, one year ago, 33% of Colorado voters viewed water supply as an extremely or very serious problem3, but in just one year that number has increased to 51%. Further, the overwhelming majority of Coloradans say that low levels of water in rivers a serious problem. We believe this creates an imperative that the SWP should prioritize and allocate resources for nonconsumptive water needs.	Comment noted for CWCB consideration.
5	Bart Miller, Water Program Director, Western Resource Advocates Dan Randolph Executive , Director San Juan Citizens Alliance	We would recommend that lengthier Introduction and Overview sections include: • A brief but more thorough background of the IBCC and the Basin Roundtables, including Colorado Water for the 21st Century Act, responsibilities and goals of the IBCC and the Basin Roundtables, and the IBCC's directives to the Basin Roundtables. • A roadmap overview of the consumptive and nonconsumptive needs assessment that has been completed to date: SWSI – Nonconsumptive Needs Assessment (NCNA); the extensive inventory, analysis, and synthesized mapping efforts performed by the basins to establish baseline data; utilization of environmental and recreational mapping to identify focus areas; Phase I of the nonconsumptive needs assessment process; Phase II of the nonconsumptive needs assessment process; etc. Much this information is already included in the Toolbox; however, it is not readily available. To best serve as a guide to Basin Roundtables regarding nonconsumptive implementation plans, please add an overview background as to what work has been done and where the Toolbox falls in the state planning process.	Toolbox was updated to address this comment. A more complete background and roadmap was added to the introduction.

Comment Summary Nonconsumptive Toolbox Draft March 2013

No.	Individual and/or Organization	Comment	Response
6	Theresa M. Conley, Water Advocate, Conservation Colorado Jennifer Bock, Water Director, High Country Citizens' Alliance Nathan Fey, Director, Colorado River Stewardship Program, American Whitewater Bart Miller, Water Program Director, Western Resource Advocates Dan Randolph Executive , Director San Juan Citizens Alliance	The second objective of the Toolbox is to be a clearinghouse of data and information in Phases I and II of the NCNA process. But there is no list of the tools or resources that have already been created through this process, such as the focus area maps. Rather, these important resources are referenced throughout the various sections. Therefore, it would be helpful to have an overview of the "data" that has been collected and the "tools" that have been generated in one location in the beginning of the Toolbox. These include but are not limited to: SWSI 2010 Final Report, Statewide Nonconsumptive Needs Assessment Focus Area Map, statewide and individual basin maps, January 2010 CWCB nonconsumptive survey and the resulting database, GIS database, and the Basin Needs Decision Support System (BNDSS). Finally, the Toolbox outlines four implementation actions, referred to as "Step A", "Step B" and so on. These steps, however, are not intended to be followed in a strict order. Some users may start with Step B and move around in a non-linear way. Therefore, including an Introduction and Overview with a background on the planning process and the resources that have been created (and not listed within various steps) would allow users to jump around and reference the Toolbox in a piecemeal fashion in creating comprehensive basin roundtable implementation plans.	Toolbox was updated to address this comment.

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No.	Individual and/or Organization	Comment	Response
7	Nathan Fey, Director, Colorado River Program, American Whitewater Chris Menges, Gunnison Basin Stewardship Fellow American Whitewater	Despite driving this multi-billion dollar industry, nonconsumptive water needs and uses have historically been left out of the water-demand equation, or only considered after other uses are fulfilled. As the demands on our limited water supply increase, so does public concern. As reported by the State of the Rockies poll, one year ago, 33% of Colorado voters viewed water supply as an extremely or very serious problem, but in just one year that number has increased to 51%. Further, the overwhelming majority of Coloradans say that low levels of water in rivers a serious problem. We believe this creates an imperative for the State-wide Water Planning efforts to prioritize and allocate resources for nonconsumptive water needs.	Comment noted for CWCB consideration.
8		On p. 6. In the section describing Step B. Measurable Outcomes, the document provides three examples of what a measurable outcome might be, each one relating to an environmental attribute. We suggest adding one example of a measurable outcome relating to a nonconsumptive recreational attribute such as 'maintain adequate flows to support an acceptable through optimal paddling experience…'. Also on this page, we suggest that the fourth sentence of the second paragraph of the same section be modified to include recreation, reading "…and emphasize adaptive management around clear, measurable environmental and recreational goals." We contend that since environmental and recreational attributes are both important and often mutually compatible, consistent language applying to both aspects could helping readers realize that these approaches apply to both needs.	Toolbox was updated to address this comment. An example outcome was added for recreational boating days in a basin and for a wetland restoration project in the South Platte.

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No.	Individual and/or Organization	Comment	Response
9	Nathan Fey, Director, Colorado River Program, American Whitewater Chris Menges, Gunnison Basin Stewardship Fellow American Whitewater	On p. 7, in the third paragraph, we recommend adding language to include recreation. We ask that the third sentence be adjusted to "…data such as streamflow, water quality, fish survey, the extent and condition of riparian habitat and recreational flow needs are often not available to establish baseline conditions or allow the measurement of outcomes". Given our experience that defined recreational flow needs facilitate better, more inclusive management, and instances of some Basin Roundtables opting to forgo quantification of recreational attributes (during phase 2 of the Non Consumptive Needs Assessment process), we believe that it is important to highlight recreation in this context.	Toolbox was updated to address this comment. Recreational needs were added under Step B.
10		American Whitewater encourages the revision team to devise and include a recreational flow example in the Example Challenge statements section that begins on p. 13. While example 6 in this section considers significant changes in management or designation for outstanding river segments, major policy changes will not often be an option on the many sections of river where recreational attributes are threatened by changes in flow. More often, we anticipate situations where roundtable members must work collaboratively to attach nonconsumptive protections to consumptive practices and allocations. Figuring out how to do so, be it through conservation or otherwise, will be useful, timely, and relevant, and as such, an example of how to approach such a common yet complex situation is warranted.	Toolbox was updated to address this comment.

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No.	Individual and/or Organization	Comment	Response
11	Nathan Fey, Director, Colorado River Program, American Whitewater Chris Menges, Gunnison Basin Stewardship Fellow American Whitewater	Appendix B, Examples of Measurable Outcomes contains a short two paragraph section mentioning American Whitewater's flow studies as a way to assess acceptable through optimal recreational flow needs. Given a range of past applications, including those in Colorado, we contend that the study method we have been using is the best available tool for defining the relationship between streamflows and recreation-quality. As such, we suggest adding language to this section that highlights some of the merits of this approach, including: American Whitewater has used several flow study methods to inform the Colorado Basin Supply and Demand Study, over 80 Federal Energy Regulatory Commission Hydropower relicensing proceedings, and that is serves as one of the listed bases for assessment on the National Park Service's Hydropower Relicensing Program v. We believe that the final Toolbox report should include this depth of past usage in federal proceedings as it provides necessary context of the application and usefulness of recreational flow-evaluations. We would also suggest adding similar strengthening language to the second paragraph of the Recreational Tools section on p. C-3.	These studies were incorporated into Appendix B and C.

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No.	Individual and/or Organization	Comment	Response
12	Greg Kernohan, Manager, Conservation Programs (CO/WY), Ducks Unlimited, Inc.	… the document significantly ignores eastern plains concerns related to nonconsumptive needs. If this guide and the examples provided were used to develop statewide priorities for nonconsumptive water resources, I could see west slope and eastern mountain area species and in-stream flows trumping eastern plains nonconsumptive needs. Setting a priority that adds to consumptive needs on the west slope and the demand to protect more west slope water from east slope development. All of which would be fine, except that we do not understand the impact of such decisions on eastern plains nonconsumptive needs. If agricultural water is removed to meet Front Range M&I demands, which would be escalated if no new west slope water is developed, there is no telling how many now common species would then be threatened. We need to determine that impact. Eastern slope nonconsumptive needs are also highly tied to human population growth along the Front Range of Colorado. The document does not mention recreational value of hunting or fishing on these areas or the value that water assets tied to open space provide to this population. I think it is very important for the document to identify these issues and try to insert those considerations as examples throughout the document. At this time, I read the document as a decision tree for west slope interests and in fact, I learned a lot about west slope nonconsumptive considerations through the examples and case studies. An equal share of similar examples must be included from the eastern plains as well.	The toolbox has been updated to include this information. Several eastern Plains and wetland resources and examples have been added, including: • An example measurable outcome for wetlands. • A case study from a constructed recharge wetland along the South Platte. • The Playa Lakes Joint Venture Area Implementation Plan for the Colorado portion of Bird Conservation Region 18. • North American Waterfowl Management Plan and US Shorebird Conservation Plan • North American Wetland Conservation Act (under funding sources) • The CNHP/CPW/RMBO wetland mapping resources. • Dolores River tamarisk plan (which is comparable to the eastern phreatophyte work)
13		The document mentions that there were 57 meetings held in developing this tool since 2010. I can remember one or two, but who was represented at these meetings? Was it CDM and their contractors and CWCB? How many were truly well publicized public meetings? How many were on the west slope vs. the eastern plains?	As noted in the text, the 57 meetings were for developing the Phase II database. We added clarifying language that most of these 57 meetings were one-on-one or small group. Staff from Colorado Water Trust and The Nature Conservancy conducted most of these meetings by reaching out the BRTs and conservation groups throughout the state.

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No.	Individual and/or Organization	Comment	Response
14	Greg Kernohan, Manager, Conservation Programs (CO/WY), Ducks Unlimited, Inc.	The case studies need to include at least one from the South Platte that highlights CWCB investment in wetland projects. Additionally, a case study from the Rio Grande and the easements paid for in part by CWCB should be included to give a more complete picture of CWCB investment in nonconsumptive projects and the structure of different projects that are lending to meeting nonconsumptive needs than just fish and environmental flows.	The South Platte projects are great examples of consumptive/nonconsumptive users working together. We have now included the Haren constructed recharge wetland as a case study.
15		Appendix C – Most of the resources are very well laid out and acceptable. I was put off by seeing the first suggested resource tool being the WFET, which is then described as very local to the Yampa-White. There is no discussion about how to access or use the tool or how applicable it is to other basins. I felt like suggesting this tool would be like me suggesting that the Wetland Recharge Location Model would be appropriate for the rest of the state at this time, which it is not.	We have added language to clarify that the WFET requires models and data that are not currently available on the East Slope, and to develop it on the West Slope in Gunnison and Southwest basin roundtables would require investment of additional resources. The tool is not directly transferrable without additional effort.
16		There is a lot of discussion of programs in Appendix E, but there needs to be an appendix for plans that drive much of the programs. I searched for the North American Waterfowl Management Plan, North American Wetlands Conservation Act, Playa Lakes Joint Venture and did not find any reference. These plans drive bird conservation on the eastern plains many of which have goals for riparian and wetland habitat. I know that NAWCA is prolific in other basins around the state as well. I am sure it is the same for fish.	Appendix E has been updated to include NAWCA. The NAWMP and PLJV (as well as US Shorebird Conservation Plan) are also referenced in Appendix B.
17	John Ely, Pitkin County Attorney	The Act speaks specifically to consumptive and nonconsumptive water supply needs. Too often nonconsumptive needs are translated with limitation to environmental and recreational attributes. The activities of fishing and floating are not the beginning and end of nonconsumptive water supply needs. The processes identified by the CWCB should recognize the economic benefits associated with real property valuation and sales tax generation that are the result of nonconsumptive use of water resources.	The NC Toolbox purpose is to help basin roundtables and other stakeholders implement NC projects. Other documents produced by the CWCB, IBCC, and BRTs speak to economic value of conservation and recreation, including for direct expenditures, job creation, and property values. These references will be incorporated into the next SWSI update.

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No.	Individual and/or Organization	Comment	Response
18	John Ely, Pitkin County Attorney	The draft report processes concerning goals, measured outcomes and needs and opportunities would be greatly assisted with a coordinated approach to methodologies recommended to evaluate these issues and instream flow needs to preserve healthy riparian environments. The debate concerning how much water should be left in natural stream channels and at what times of year can become quite heated. A recommended approach as to methodology and variable analysis would assist local communities and statewide water planners In evaluating nonconsumptive needs.	Comment noted. The Basin Roundtable process is intended to address these issues through collaborative discussion among roundtable members and between roundtables. The intent of the toolbox document is to provide examples of tools that can aid in the discussion regarding instream flows. The toolbox is not intended as policy document that would provide a prescriptive methodology to conduct these types of evaluations as they are highly site-specific in nature.
19		Interwoven into the final report should be a discussion and if possible, a recommendation on processes to evaluate competing interests. Consumptive and nonconsumptive uses both have a place in water management but as the supply is reduced over time with increased drought periods, the resolution of balance between the demands on our limited water resource is a topic that cannot be ignored. The processes concerning the administration, change, loan or other options available to meet demands during times of short supply, should be incorporated into these analyses.	The Basin Roundtables and IBCC are designed to address competing interests. However, In Appendix C we added a tool/resource that is specifically designed to address competing interests. This tool is called Collaborative Modeling for Decision Support (CMDS). CMDS is specifically designed to resolve complex, data-intensive water resource problems. This approach was tested with Shared Vision Planning on the Cache la Poudre River, as now referenced in the document.
20	Frank Kugel General Manager, UGRWCD	I have an update to the toolbox regarding the Gunnison RICD. In appendix F, page 9, please update your narrative to reflect that this water right was made absolute in 2012.	Toolbox was updated to address this comment.

Comment Summary Nonconsumptive Toolbox Draft March 2013

No.	Individual and/or Organization	Comment	Response
21	Eric Hecox, Executive Director, South Metro Water Supply Authority	I suggest working through the document to make sure that non-flow related solutions are at least as much a focus as flow related solutions. Figure 6 identifies a path for meeting non consumptive needs with non-flow related solutions. However, the document focuses more on flow related solutions. It would be helpful to focus equally on non-flow related benefits and mitigation. For example, under "Example Challenge Statements" the example provided sets up an either/or. It asks is the problem habitat related which includes a solution of river channel reconfiguration. Or it asks if the problem is flow related. Often if there is a problem that is flow related, reconfiguring the channel to the available flow is most appropriate. But that solution does not come through in this example. This is just one instance in the document. The Appendices are also light on non-flow related solutions. There is a case study (Lower Blanco), some mention in Funding Opportunities, and Existing Programs. But the other Appendices, especially in Tools and Resources, Scientific Information, and Measurable Outcomes, have little focus on non-flow related issues and solution. Recent experience from the Upper Colorado and the mitigation and enhancements Denver and Northern are agreeing to, shows that channel reconfiguration to available flow is going to be a large part of meeting non-consumptive needs. So non-flow related solutions should get at least as much focus, if not more, than flow related solutions throughout the toolbox.	We have added multiple tools and case studies that include non-flow solutions, in addition to those already present in the draft document.

Comment Summary Nonconsumptive Toolbox Draft March 2013

No.	Individual and/or Organization	Comment	Response
22	Eric Hecox, Executive Director, South Metro Water Supply Authority	Because of its geographic boundaries, the Metro Roundtable has more limited non-consumptive needs than other roundtables. However, the few that we have we have taken very seriously. A Metro Roundtable non-consumptive priority is the South Platte River through Denver. We have put significant resources into implementing solutions to meet this non-consumptive priority by funding a variety of actives through the Greenway Foundation. I think this is a great case study of a roundtable using the non-consumptive mapping process to identify a non consumptive priority and then using the WSRA program to implement on-the-river solutions. I suggest including this as one of the case studies to highlight a BRT implementing non-consumptive projects and methods and to highlight the value of non-flow related solutions.	See response to comment no. 14. Also, the Greenway Foundation case study has been added.
23	Bob Street, South Platte Basin Roundtable	I find the Tool Box to be a useful framework to complete a NCN Plan for the SP as one can pick and choose parts to be used. The references are useful, although as Greg K. pointed out, some additional ones exist. I do not have any suggestions for modifying the draft, but I do have a suggestion for how we in the SPRT might proceed to complete our "plan." First of all, the work that would be entailed to complete the goals and the quantified outcomes would be enormous and would likely be an exercise in futility. All the water in the SP Basin if fully appropriated to ag, municipal ,industrial and specific natural resource uses. Any environ-rec benefits that might included as mitigation in current proposed projects (Windy Gap, NISP, and Greeley/Ft. Collins reservoirs) will be done without regard to a SP NCN plan. Our only "hope" is if "new" water projects brought west slope water to the Front Range. If this would to occur, then we could tailor our NCN Plan to take advantage of opportunities that would then unfold. What we need is a dedicated, knowledgeable staff person to work on our plan full-time. Our NCN committee volunteers can provide input, guidance, coordination but we simply cannot effect the NCN plan using the Tool Box by ourselves.	Comment noted for CWCB consideration. As part of the Basin Roundtable Implementation Plan activities that the Basin Roundtables will complete, the CWCB will provide further technical assistance to the roundtables in completing these activities. In addition, the framework presented in the toolbox should not be a barrier to doing good projects, nor should it be followed just for the sake of the work. Language to this effect has been included in the document. The framework should be used only to create a vision and long-term implementation plan for feasible (if ambitious) solutions. If implementing the full framework is not appropriate for a BRT, the BRT can proceed with whichever portions of the toolbox are helpful.

Comment Summary Nonconsumptive Toolbox Draft March 2013

No.	Individual and/or Organization	Comment	Response
24	Nonconsumptive Committee of the Colorado Basin Roundtable (Jim Pokrandt, Stan Cazier, Lane Wyatt, Ken Neubecker, Karn Stiegelmeier)	The report suggests using the statewide nonconsumptive needs assessment focus area maps to help establish goals. The Colorado River Basin focus map outlines stream reaches with certain attributes at risk, or in some cases already impaired. Therefore, this would be a good tool to target areas either in need of help or likely to become a problem. Note that our Colorado River Basin Watershed Evaluation Tool identified most of these segments and provided estimates of how much water would be needed to protect or restore the attribute at risk, if flow shortages were a cause of the problem. The link to this spreadsheet in the Toolbox report takes one to an older draft version that did not contain these estimates of flow needs.	The link to the Colorado Basin Roundtable's WFET Report has been updated to the most recent version.
25		The Toolbox reports that SWSI 2010 also provides maps of certain nonconsumptive needs that could also be used for setting basin wide goals. These include such things as boreal toad and other threatened species habitat, State impaired waters for water quality, RICDs, Gold Medal fisheries, significant wetlands and riparian areas, etc.	Comment noted.
26		In describing the “Needs and Opportunities” portion of the Toolbox process the report describes a CWCB product that depicts the number of projects or stream miles that currently have some level of protection for nonconsumptive uses. This may be a bit misleading in that all instream flow miles are included. Although these water rights do afford some protection, there is some concern on the CBRT that it is not adequate to truly protect the fishery in some cases.	This is a valid point that applies to more than instream flows. In many cases, the presence of a project does not ensure protection of the resource. BRT implementation plans may want to address this point, as suggested in the decision tree including in the toolbox.
27		Appendix B provides some good examples of a “measurable outcomes” as used in the Toolbox process.	Comment noted.
28		Appendix D is missing from the report.	Toolbox has been updated to address this comment.

Comment Summary Nonconsumptive Toolbox Draft March 2013

No.	Individual and/or Organization	Comment	Response
29	Nonconsumptive Committee of the Colorado Basin Roundtable (Jim Pokrandt, Stan Cazier, Lane Wyatt, Ken Neubecker, Karn Stiegelmeier)	Appendix E describes funding opportunities for nonconsumptive projects. The tables in this appendix are great! They describe the purpose of the funding source and provide direct links to more information on the funding source.	Comment noted.
30		Appendix F is some case studies laid out it in the format of the decision making process prescribed by the Toolbox. In the case of the Colorado River Basin, the case study is on the Wild and Scenic Alternative Management Plan.	Comment noted.
31		Water Quality: we do not get the sense that water quality is emphasized in the sense of state requirements. In other words, are impaired waters and other concepts (303d and such) covered somewhere else? A reduction in flows can equal a major problem for an in-basin user because it lowers the critical flow and increases treatment costs.	Comment noted. Water quality is touched on briefly in the decision tree diagram. The CWCB does not have statuatory authority over water quality. The 303(d) list and associated total maximum daily loads are addressed by the Colorado Department of Health and Environment's Water Quality Control Division.
32		We do not see a comment about in-basin water storage helping with existing problems.	In basin storage as a solution is implicit in the multiple references to multi-purpose projects as a preferred solution.
33		There is not much of a discussion regarding changes in water management, including modification of Exchange Agreements.	As with previous comment, changes in water management as a solution is implicit in the multiple references to multi-purpose projects as a preferred solution.
34		The emphasis appears to be on nonconsumptive use within the basin, but in the Colorado River Basin, many of the impacts have already occurred and we cannot do anything without the participation of the transbasin diverter.	BRT and IBCC are intended to address this type of issue. The toolbox encourages multi-purpose and collaborative solutions.

FINAL DRAFT
REPORT

Nonconsumptive Toolbox

Colorado Water
Conservation Board

July 2013

Toolbox Objective

The objective of the Nonconsumptive Needs Toolbox is to be a guidance and resource document to assist with the development of the Basin Implementation Plans. This is not a policy document of the Colorado Water Conservation Board. The intent of the document is to provide a compilation of information for use by the basin roundtables and others as they address nonconsumptive needs and implementation of nonconsumptive projects and methods. As the basin roundtables or project proponents consider use of the tools described in this document they will need to consider the applicability and limitations of the tool that may apply to the issue they are addressing.

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Acronyms

BCR	Bird Conservation Region
BLM	U.S. Bureau of Land Management
cfs	cubic feet per second
CMDS	Collaborative Modeling for Decision Support
CNHP	Colorado Natural Heritage Program
CPUE	Catch/Unit Effort
CPW	Colorado Parks and Wildlife
CWCB	Colorado Water Conservation Board
CWCS	Comprehensive Wildlife Conservation Strategy
CWT	Colorado Water Trust
DPR	Denver Parks and Recreation
DPW	Denver Public Works
DU	Ducks Unlimited
DW	Denver Water
EDU	Ecological Drainage Unit
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
GIS	geographic information system
GMP	Guaranteed Maximum Price
HB	House Bill
IBCC	Interbasin Compact Committee
IFIM	Instream Flow Incremental Methodology
IPPs	identified projects and processes
ISF	instream flow

ISF Rules	CWCB Rules Concerning the Colorado Instream Flow and Natural Lake Level Program
ISFP	Instream Flow Program
JAWRA	Journal of the American Water Resources Association
LBPOA	Lower Blanco Property Owners Association
NAWCA	North American Wetlands Conservation Act
NEPA	National Environmental Policy Act
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
ORVs	Outstandingly Remarkable Values
PCAs	Potential Conservation Areas
PHABSIM	Physical Habitat Simulation
RICDs	Recreational In-Channel Diversions
RINO	River North
RISO	River South
RMBO	Rocky Mountains Bird Observatory
RVIP	River Vision Implementation Plan
SG	stakeholder group
SG Plan	Upper Colorado River Wild & Scenic Stakeholder Group Management Plan
SJRRIP	San Juan River Endangered Fish Recovery Implementation Program
SJWCD	San Juan Water Conservancy District
SVP	Shared Vision Planning
SWCD	Southwestern Water Conservation District
SWSI	Statewide Water Supply Initiative
TFE	Total Fishing Effort
TNC	The Nature Conservancy
Toolbox	Nonconsumptive Needs Toolbox
UCRRIP	Upper Colorado River Endangered Fish Recovery Implementation Program
UDFCD	Urban Drainage and Flood Control District
UGRWCD	Upper Gunnison River Water Conservancy District
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWSD	United Water and Sanitation District
WARSSS	Watershed Assessment of River Stability and Sediment Supply
WFET	Watershed Flow Evaluation Tool
WHIP	Wildlife Habitat Improvement Program
WRP	Wetland Reserve Program
WSRA	Water Supply Reserve Account

Colorado Water Conservation Board

Nonconsumptive Needs Toolbox

Introduction

In 2005, the Colorado General Assembly passed the Colorado Water for the 21st Century Act (House Bill [HB] 05-1177) (**Figure 1**). The Act established a framework to provide a permanent forum for broad-based water discussions. The process created a voluntary, collaborative process to help the State of Colorado address its water challenges. The Act also created nine basin roundtables and an Interbasin Compact Committee (IBCC). Because environmental and recreational attributes are important to the State of Colorado and to the quality of life for Colorado's citizens, the Water for the 21st Century Act explicitly called out the need to plan for future environmental and recreational uses in water supply planning. Environmental and recreational uses of water are referred to as nonconsumptive uses in the Water for the 21st Century Act.

The Colorado Water Conservation Board (CWCB) continues to work closely with the basin roundtables to better understand Colorado's nonconsumptive needs. Below is a brief description of some of the resources that have been developed so far.

- *Phase 1. Nonconsumptive Mapping (2010):* As part of the nonconsumptive needs assessments, each roundtable mapped where important nonconsumptive attributes exist. These reaches or watersheds are known as "focus areas." Each focus area is associated with one or more attributes such as imperiled fish species, important boating and fishing areas, important water fowl hunting areas, etc. The maps are available as part of the Statewide Water Supply Initiative (SWSI) 2010 report Section 2 and in more detail in Appendix C. Geo PDFs, which include information about which attributes exist in each stream reach, are available for each basin here:
  - Arkansas Basin
  - Colorado Basin
  - Gunnison Basin
  - Metro Basin
  - North Platte Basin
  - Rio Grande Basin

37-75-104 (2)(c) … develop a basinwide consumptive and nonconsumptive water supply needs assessment, conduct an analysis of available unappropriated waters within the basin, and propose projects or methods, both structural and nonstructural, for meeting those needs and utilizing those unappropriated waters where appropriate. Basin roundtables shall actively seek the input and advice of affected local governments, water providers, and other interested stakeholders in establishing its needs assessment, and shall propose projects or methods for meeting those needs.

37-75-102 … this article is not intended to restrict the ability of the holder of a water right to use or dispose of that water right in any manner permitted under Colorado law.

Figure 1. Excerpts from HB 05-1177, Colorado Water for the 21st Century Act

  - South Platte Basin
  - Southwest Basin
  - Yampa/White/Green Basins
  - Statewide

- *Phase 2. Nonconsumptive Projects and Methods (2010):* The purpose of Phase 2 was to determine where planned and existing nonconsumptive projects and methods, also known as nonconsumptive identified projects and processes (IPPs), are in relation to the focus areas developed in Phase 1. This information can be used to determine where known nonconsumptive IPPs offer direct or indirect protection for a specific attribute, and equally as important where there are no known protections for a given focus area. The survey information was organized in a database along with Phase 1 information and was summarized by creating mapping using geographic information system (GIS). The information is summarized in SWSI 2010 Section 3 – Nonconsumptive Projects and Methods and the maps are also summarized in that section. In addition there is more detail in SWSI Appendix F – Nonconsumptive Needs Assessment Survey Interview Projects and SWSI 2010 Appendix G – Nonconsumptive Needs Assessment Project Analysis. This information is used in this Nonconsumptive Needs Toolbox (Toolbox) as part of the Needs and Opportunities section and in the Toolbox's Appendix D, which includes the most recent set of maps. These maps include a list of planned nonconsumptive projects and methods. They show where planned and existing projects and methods overlap with the nonconsumptive focus areas and where there are no known projects that support those reaches.

- *Watershed Flow Evaluation Tool:* CWCB partnered with The Nature Conservancy (TNC) and CDM Smith to pilot a tool known as the Watershed Flow Evaluation Tool (WFET). The WFET assesses the risk flows have to specific attributes, such as cold water fish, warm water fish, and riparian areas. The report is available here and summarized here. In addition, the Colorado and Yampa-White basin roundtables further improved this work and applied it to their basins. The Colorado report is available here and the Yampa-White report here.

Together, this body of work represents a significant increase in the understanding of Colorado's nonconsumptive needs. In addition, basin roundtables continue to take this information and support nonconsumptive Water Supply Reserve Account (WSRA) applications that meet described needs or seek to further understand them. However, the IBCC recognized that additional support was needed to help the roundtables propose projects or methods for meeting nonconsumptive needs.

Based on the recommendations of its Nonconsumptive Subcommittee, the IBCC recommended the following nonconsumptive implementation activities on November 30, 2011:

1. Action request for the basin roundtables:

   a. Develop Nonconsumptive Implementation Plan: Building on information previously compiled for SWSI 2010, identify nonconsumptive geographic and/or seasonal gaps and then suggest and prioritize projects and methods that can fill those gaps in a strategic manner. Using the Toolbox described below, the projects should identify initial cost estimates, potential partners, and whether any entity has agreed to take the lead.

b. Initiate three to five nonconsumptive projects: Using the basin's Nonconsumptive IPPs list, determine how to implement three to five projects or methods that meet identified nonconsumptive needs.

c. Identify one or more pilot projects that integrate nonconsumptive projects/needs with consumptive projects/needs. The pilot project can count as one of the three to five nonconsumptive projects as long as it clearly meets a nonconsumptive needs gap.

d. Define technical questions related to nonconsumptive needs that need to be answered in your basin. These are questions that can be queried in the nonconsumptive database, such as how many projects are supporting a particular attribute, or additional technical questions such as those concerning how a portfolio may affect flows in a given reach, etc.

2. The CWCB will develop a Toolbox for nonconsumptive needs, starting with a list of what resources are already available to inform the above discussions and how to access those resources; this will include summaries of a mapping exercise in the Southwest Basin and a modeling exercise in the Yampa-White-Green Basin.

Overview of the Nonconsumptive Needs Toolbox

The Toolbox was created to support efforts of the basin roundtables and other stakeholders to develop projects and methods to meet nonconsumptive needs, and has two main objectives:

1. To serve as a guide for basin roundtables as they develop their basin roundtable implementation plans. The tools and resources can help roundtables and other stakeholders develop and execute the nonconsumptive portions of their basin roundtable implementation plans and specific projects in a strategic fashion to meet the nonconsumptive needs each roundtable identified.

2. To be a clearinghouse for data and information generated in Phases I and II of the nonconsumptive needs assessment process by compiling the work of the roundtables in one place.

The Toolbox framework is organized around four steps (**Figure 2**), which provide some of the resources and information to encourage comprehensive planning for nonconsumptive needs in each basin. The Toolbox also aids in identifying needs for project implementation, analyzing information, devising plans, and making decisions in light of existing water policies, laws, and regulations. It provides a framework to evaluate existing information and identify opportunities and challenges toward implementation of nonconsumptive projects. The Toolbox includes tools that can be applied during project planning and implementation, programs that can be used to meet nonconsumptive needs, and cost estimates for common project types.

The Toolbox is a guidance or resource document and contains some of the resources and procedures that may support the assessment of nonconsumptive needs and projects. Other current and future resources and evaluation tools that are not described herein may also provide valuable support in the assessment of nonconsumptive needs. Each tool may or may not be applicable, in its current form, to any site-specific set of facts in question.

This is not a policy document of the CWCB. The intent of the document is to provide a compilation of information for use by the basin roundtables and others as they address nonconsumptive needs and implementation of nonconsumptive projects and methods. As the basin roundtables or project proponents consider use of the tools described in this document they will need to consider the applicability and limitations of the tool that may apply to the issue they are addressing.

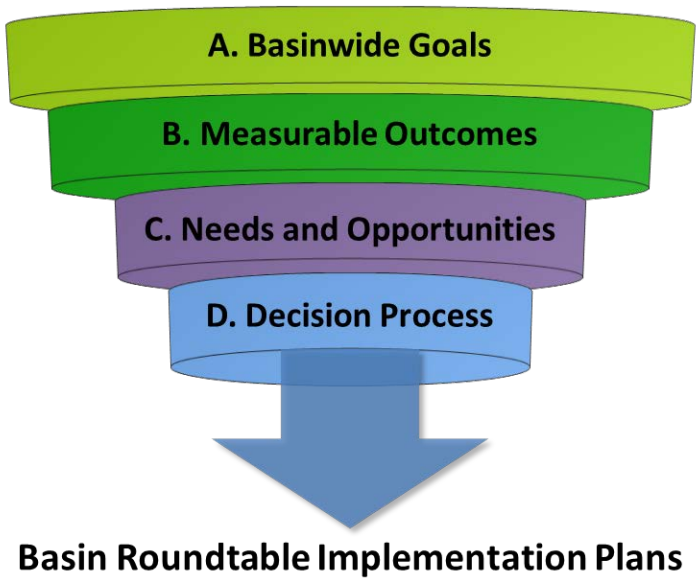


Figure 2. Overview of the Nonconsumptive Portion of the Basin Roundtable Implementation Plans

Using the Toolbox consists of the four fundamental actions. Each action outlines a step in producing a comprehensive basin roundtable implementation plan. These actions are discussed in more detail and serve as the organizing framework for the Toolbox.

Step A. **Basinwide Goals:** Develop basin-level goals for the mapped attributes identified in the Statewide Nonconsumptive Needs Assessment Focus Area Map.

Example: Maintain population of native fish species so that none are listed in our basin.

Step B. **Measurable Outcomes:** Establish quantifiable, measurable outcomes for nonconsumptive targets and attributes.

Example: Sustain 10 populations of bluehead sucker in 10 different river locations.

Step C. **Needs and Opportunities:** Using the project and methods database, identify needs and opportunities for protecting targets and attributes and strategically plan to meet those nonconsumptive needs.

Example: Based on analysis of existing levels of protection and where attributes occur, only five populations of bluehead sucker are protected. As a result, we need to protect an additional five populations to meet our established measurable outcomes.

Step D. **Decision Process:** Use the decision template to determine what actions need to be taken to meet nonconsumptive needs and implement projects.

Example: For one of the five locations where protection of bluehead sucker populations is limited, moving through the decision template may lead to the determination that reservoir reoperation could achieve desired outcomes.

While these actions are called "steps," not every roundtable will start at the top and work their way down the list sequentially. For some roundtables it may be appropriate to focus on one or two of the steps. Also, each of the steps may inform the other three and there may be interaction between the steps. This process is designed to serve as a guide, but is not prescriptive in its approach. Instead, as projects are assessed, this framework may offer consistency in determining needs, goals, and outcomes. If projects are already assessed or ongoing, then this framework may not need to be utilized.

The Toolbox can be utilized to help develop near-term and long-range plans for meeting goals and implementing projects on the ground. At the basin scale, the tools can be used to help develop a basinwide strategic approach for meeting nonconsumptive needs and developing specific measurable outcomes for environmental attributes and conservation targets. At the local level, water resource managers may be able to use the tools and other resources to directly address specific project needs.

Step A. Basinwide Goals

The first step toward devising a basin roundtable implementation plan is to develop basinwide goals that specify environmental and recreational targets. These goals will serve as the foundation for a strategic framework to guide current and future nonconsumptive project planning.

Examples of basin-scale goals and objectives include:

- Improve conditions in the basin for all fish species on the federal candidate species list to prevent additional threatened and endangered species listings
- Maintain all habitat for fish species on the state imperiled list in the basin
- Maintain important fishing and whitewater opportunities in the basin

To improve conditions usually entails a restoration project. These projects are often more expensive than projects that protect or maintain existing conditions, but may be needed for high priority attributes or locations. In areas with competing water needs, management actions or limited protection may be the only way to balance multiple uses of a river or stream.

In order to help determine the goals, roundtables may turn to the nonconsumptive needs maps, which indicate what species and attributes are in the basin and where they are. To date, basin roundtables have conducted an extensive inventory, analysis, and synthesized mapping effort to establish baseline data and catalog nonconsumptive attributes across the state (**Figure 3)**. The mapping information was summarized in the SWSI 2010 Final Report, Section 2, Figure 2-3; the complete Section 2 can be downloaded from the CWCB website. For this effort, the basin roundtables utilized environmental and recreational mapping to identify nonconsumptive focus areas in their basins. The focus area maps developed by each basin roundtable are based on a common set of environmental and recreational attributes and denote where Colorado's important water-based environmental and recreational

attributes are located. Additional scientific information that relates to the environmental attributes identified by the roundtables is detailed in **Appendix A**.

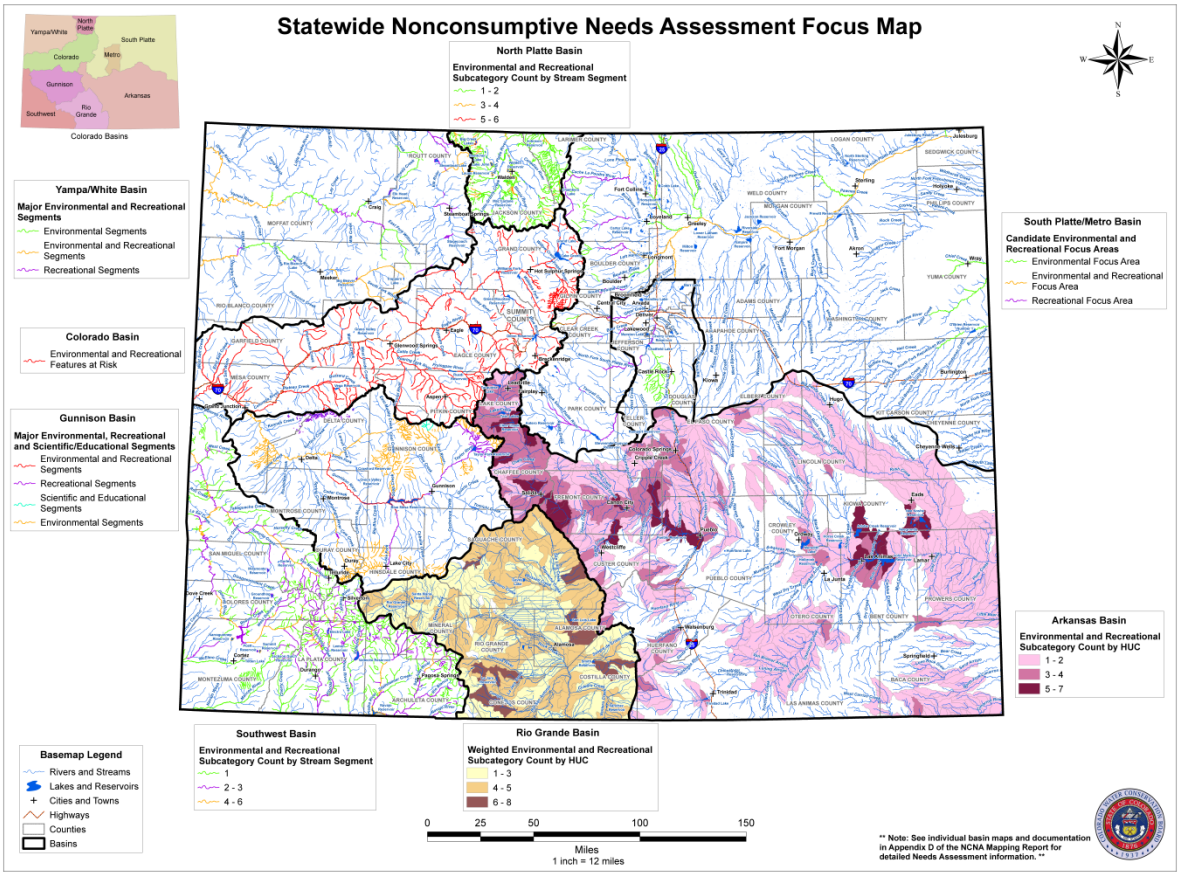


Figure 3. Statewide Nonconsumptive Needs Assessment Focus Area Map

The statewide map, the individual basin maps, and accompanying information can be found on the CWCB SWSI 2010 website, under SWSI 2010 Full Final Report, Appendix C. The basin maps are designed in such a way that users can select a stream reach or focus area and determine what species and other attributes are associated with it. Directions for how to use these "geo pdfs" are available in Section 2 – Nonconsumptive Needs Assessments.

This map information along with the Colorado Parks and Wildlife (CPW) species management plans and the Colorado Natural Heritage Program's (CNHP) goals, can serve as tools for developing goals and objectives at the basin scale for nonconsumptive attributes. After the basin roundtables develop goals and objectives, the next step is to identify measurable outcomes for their goals.

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 Nonconsumptive Needs Assessments 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 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 to enable coordination on future projects and to help avoid future conflicts between meeting consumptive, environmental, and recreational needs
- The maps can assist in identifying the status of environmental and recreational water needs, including reaches where needs are being met, where additional study is needed, and where proposed implementation projects in the basin have been identified
- 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 a basis for collaborative efforts for future multi-objective projects

Step B. Measurable Outcomes

Once environmental and recreational attributes have been identified and basinwide goals established, the next step for the nonconsumptive portion of the basin roundtable implementation plans is to formulate measurable outcomes for environmental and recreational attributes based on the basin roundtable goals. A measurable outcome is a statement that articulates—in measurable or quantifiable terms—the desired state of an attribute as a result from an action or decision, such as:

- Maintain 80 percent of cutthroat trout habitat or population levels in subbasin Y
- Increase habitat or population levels for candidate species by 15 percent in the basin
- Protect the two populations of northern redbelly dace in subbasin X
- Increase acres of wetlands for shorebirds and waterfowl by 500 acres by 2015
- Maintain 90 percent of boatable days at basin roundtable mapped whitewater recreation locations

Measurable outcomes should be identified at both the local scale (project level) and at the basin scale (regional strategy). The process of developing measurable outcomes should involve stakeholders with a diverse range of interests. Projects should be planned both proactively and strategically to address current and future issues. Basin roundtables should encourage a comprehensive suite of projects to meet basinwide goals, develop an approach to identifying the most important projects, and emphasize adaptive management around clear, measurable environmental goals. Actions should be based on sound science. The results of these actions should be monitored to measure results and inform future projects.

Listed below are some of the organizations and programs that can serve as resources and examples as each has identified specific measurable outcomes:

- Colorado Natural Heritage Program
- The Nature Conservancy
- Southern Rocky Mountains – An Ecoregional Assessment and Conservation Blueprint
- 2006 Central Shortgrass Prairie Ecoregional Assessment and Partnership Initiative
- American Whitewater Flow Surveys

- Colorado's Wildlife Action Plan
- Colorado Recovery and Conservation Plans
- Range-wide Conservation Agreement and Strategy
- Upper Colorado River Endangered Fish Recovery Implementation Program
- Routt County Livability Index

The specific measurable outcomes developed by these organizations and programs are detailed in **Appendix B**. Other programs and examples also exist and the examples above should not be interpreted as an endorsement by the CWCB of the specific goals, objectives, or processes of the above programs.

The examples of measurable outcomes described in **Appendix C** can assist the basin roundtables in developing goals and objectives for their attributes as well as developing measurable outcomes. Many methods to measure nonconsumptive outcomes have been developed and as the basin roundtables or project proponents consider use of the tools described in this document they will need to consider the applicability and limitations of the tool that may apply to the issue they are addressing.

To determine the outcomes of a project, baseline information is often required. Technical and scientific tools can be used to help define ecological baselines, such as current flow levels through a fishery or existing riparian habitat. The information used to identify scientific baselines can also be utilized in establishing metrics to evaluate whether a desired outcome is being achieved. Some commonly used tools for collecting scientific information for environmental and recreational attributes are detailed in **Appendix C**. Baseline environmental data such as streamflow, water quality, fish survey, the extent and condition of riparian habitat, and recreational needs are often not available to establish baseline conditions or allow the measurement of outcomes. In many instances, the collection of additional field information may be required to establish the baselines and outcomes described in **Appendix C**.

Step C. Needs and Opportunities

Once attributes have been assessed for the basin and measurable outcomes established, the next step is for basin roundtables to survey existing and planned projects and methods and identify needs and opportunities to meet measurable outcomes. This step in the planning process is focused on conducting analysis to identify gaps in nonconsumptive needs, determine protection statistics, and consider project funding sources to devise comprehensive basin roundtable implementation plans. Roundtables may want to explore the existing and planned projects and methods for a given attribute before determining measurable outcomes (Step B).

As a follow-up to the focus mapping, in January 2010 CWCB developed a survey to collect information on existing and planned nonconsumptive projects, methods, and studies for Phase II from nonconsumptive project proponents. The responses from this effort were put into a database and mapped. Roundtables can work with CWCB staff to ask questions about the locations of planned and existing projects and level of protection for a given attribute. This will help roundtables focus on locations that may be most strategic for executing nonconsumptive projects and methods.

This data gathering effort was parallel to a similar survey used to gather data from municipal project proponents, and is summarized below.

The nonconsumptive survey data was compiled into a nonconsumptive needs projects and methods database. Studies were included, as 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 list.

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. In addition, CWCB gathered information from additional individuals and organizations to follow up with the data collection effort. Since the February 2010 meeting, an additional 57 meetings were held to gather data on additional projects, methods, and studies, as shown in **Table 1**. CWCB and the technical team supplemented the survey data with information from CWCB's grant programs, instream flow (ISF) program, and levels of protection afforded by land management practices on public and private lands.

Table 1. Summary of Basin Roundtable Nonconsumptive Project and Methods

Basin Roundtable	No. Projects and Methods in Focus Areas	No. Projects and Methods Outside Focus Areas	Total No. Projects and Methods[1]
Arkansas	40	0	40
Colorado	168	35	203
Gunnison	44	15	59
Metro	See South Platte	See South Platte	See South Platte
North Platte	41	7	48
Rio Grande	59	0	59
South Platte	54	53	107
Southwest	84	10	94
Yampa-White	22	16	38
TOTAL	**512**	**136**	**648**

[1] Total does not include all CWCB-funded projects and ISFs

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 protect a specific attribute. For example, ISFs provide direct protection of fish attributes. Additionally, restoration of a stream channel would provide direct protection of aquatic species.
- **Indirect Protection** – Projects and methods with components that were not designed to directly protect the specific attribute but may still provide protection. For example, flow protection designed to benefit a fish species may also indirectly protect riparian vegetation that is located in the protected stream reach. Other examples include protective land stewardship or a wetland or bank stabilization effort that could indirectly protect aquatic species.

These direct and indirect protections can be analyzed by river, basin, or at the statewide level as they relate to environmental and recreational attributes. **Figure 4** shows an example of an analysis for cutthroat trout, state threatened and endangered warm water fish, and riparian and wetland areas. In this example, cutthroat trout have the highest percentage of direct protections (38 percent). Riparian and wetland areas have the highest percentage of stream miles with no known protections (73 percent) and very few miles with direct protections (4 percent). With this baseline information collected, the next step is for the basin roundtables to analyze those data to develop measurable outcomes to achieve their goals related to these attributes.

In combination, the Focus Maps and the projects and methods database provide a point from which roundtables and other stakeholders can devise a strategic, comprehensive plan that sets targets and measurable outcomes for protecting nonconsumptive attributes. To start, roundtables should ask what they want to achieve for each of the river segments on their Focus Maps. Is the measurable outcome to sustain all attributes in all focal segments? Are there some attributes or segments that are more important than others? Are there attributes that will be maintained or improved only on an opportunistic basis?

Next, maps of projects and methods for each basin can be superimposed on top of the Focus Maps. **Figure 5** provides an example map from overlaying the projects and methods database on the Focus Maps for a portion of the Southwest Basin. Segments shown in red are roundtable-identified focus segments that have no known protections on them. Roundtable members or other stakeholders may want to identify what types of projects or methods could be implemented on these segments to sustain the nonconsumptive values. **Appendix D** contains similar maps for all basins.

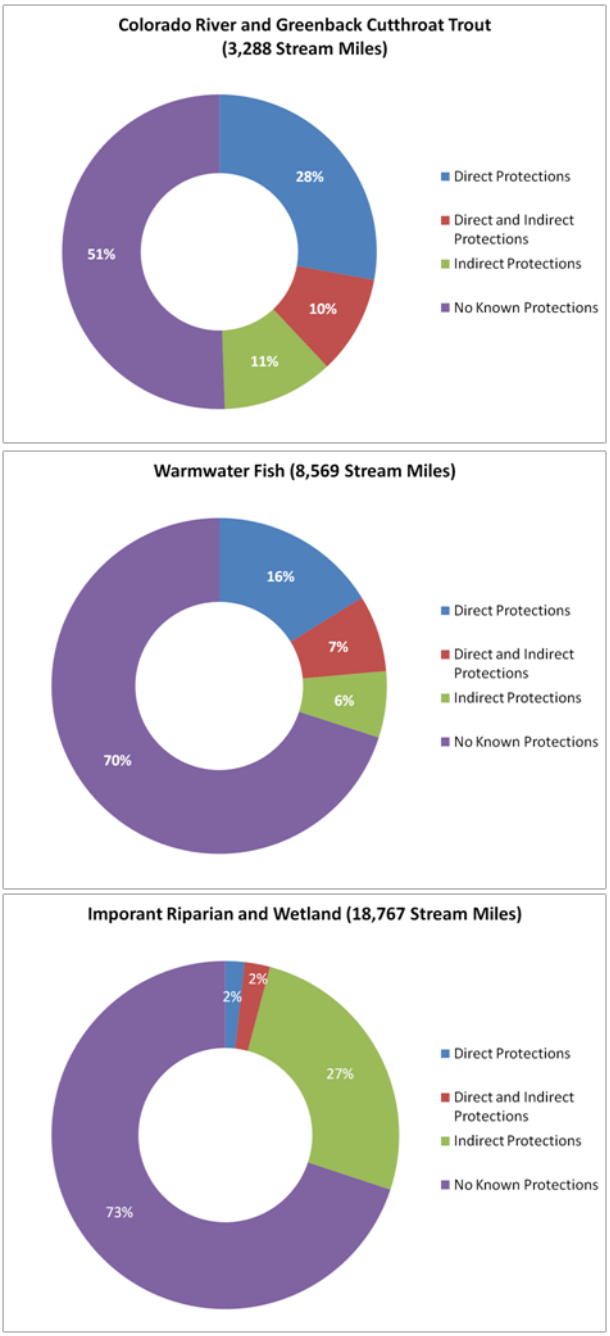


Figure 4. Statewide Direct and Indirect Protections

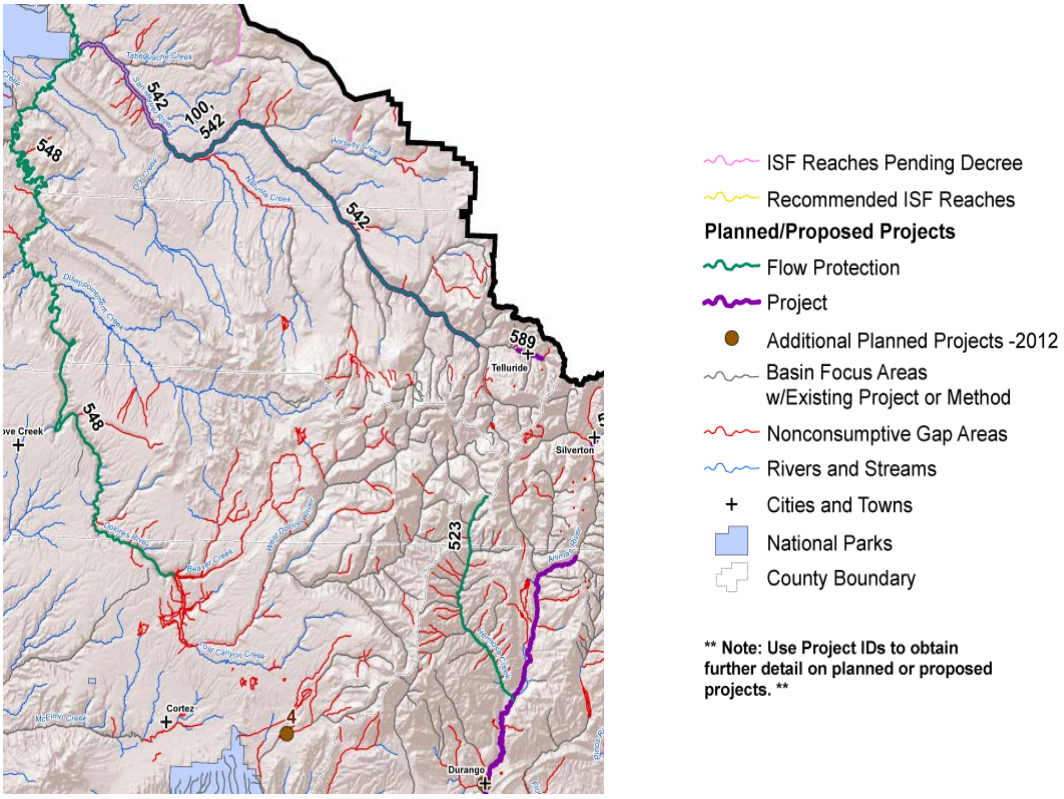


Figure 5. Close-up of Mapping Detail in the Southwest Basin

This overlay enables the users to ask a series of questions such as:

- For each focus segment, are there protections in place for the attributes?
- If protections are in place, are they sufficient to maintain/sustain the attributes?
- If protections are either insufficient or are not present, what additional action can be taken to maintain the attributes?

Step D. Decision Process

The decision tree in **Figure 6** can be used to identify what should be done to ensure the long-term maintenance of an environmental or recreational attribute on a specific stream reach, which may have been identified through Step C. These actions should support basinwide goals (Step A) and measurable outcomes (Step B). The decision tree was developed in partnership with the Colorado Basin Roundtable to assist in determining what types of projects or methods may be needed in a given reach. It emphasizes the types of protection or restoration that may be needed for a given water body. Examples of restoration activities include improving habitat, water quality, or flow conditions in a given reach. For water body protection, projects and methods could include policy mechanisms or voluntary agreements. The flow chart illustrates that there are many different options for developing the nonconsumptive portion of the basin roundtable implementation plans and completing projects and methods for nonconsumptive needs in the future.

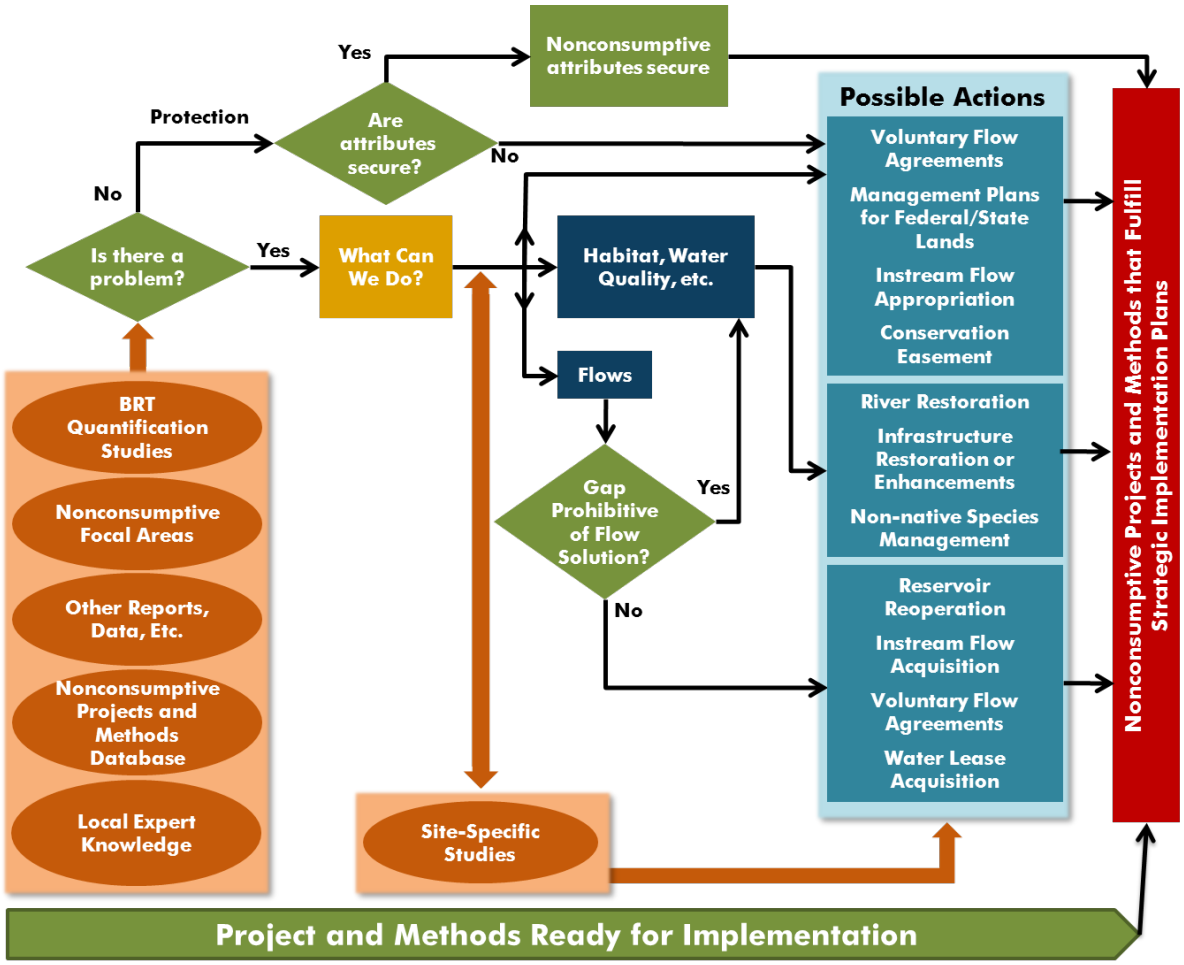


Figure 6. Decision Tree for Planning and Implementing Nonconsumptive Projects

If a roundtable chooses to develop its implementation plan, this decision tree might be applied to a mapped focus area where an environmental or recreational attribute is present. In this case, the decision tree could guide the practitioner to an understanding of what actions are needed in relevant focus segments or locations across the entire watershed. Alternatively, the decision tree can be used on an individual stream segment to identify what should be done in that segment.

Although significant information has been gathered, there may be segments or locations with environmental or recreational attributes where there remains insufficient information to answer the first question in the decision tree: Is there a problem? In this case, the science tools can be used to understand what attribute(s) may be at risk, but actual monitoring of ecological and recreational indicators may be required to identify the extent to which an attribute exists, if an attribute is of concern, and the actual factors impacting the attribute.

The template in the following section illustrates how to walk through the decision tree to make choices about possible actions to meet nonconsumptive needs. This template demonstrates the process by first isolating each node in the decision tree and describing its intention. At each node, one or more tools can help with understanding where and how one can proceed to meet nonconsumptive needs. The template indicates the level of information that should ideally be used in developing each project.

Immediately following the template is a series of example "challenge statements." These challenge statements enter the decision tree at the node labeled "Is there a problem?" The challenge statement itself provides the answer to that question, thereby assuming that much is already known about the attributes in the stream, river, wetland, or reservoir being considered.

There are various funding options to support implementation of nonconsumptive projects and methods. These funding sources are described in **Appendix E**. **Appendix F** contains case studies that utilize the template below to provide examples on implementing nonconsumptive projects and methods. **Appendix G** summarizes existing programs that are available to assist in the implementation of nonconsumptive projects and methods at the local, state, and federal level.

Example Decision-Making Template to Use in Basin Implementation Plans

Collect background on environmental and recreational attributes, protections, and gaps.

STEP 1: Challenge/Problem Statement: Identify the problem and create a challenge statement that identifies the attributes affected.

STEP 2: Decision-Making Process: Participation by a broad group of stakeholders is a vital component of assuring that the problem is adequately identified or that the attributes are secure. The stakeholder group would help determine whether additional work is needed to clarify the issue or contributing factors.

A. **Assembling Stakeholder Group:** Develop a plan to engage diverse stakeholders, including, but not limited to, watershed groups, agricultural water users, water suppliers, municipal entities, and conservation groups.

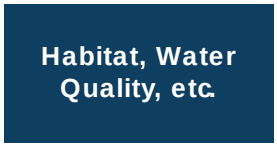
B. **Issue Clarification/Contributing Factors:** Refer to site-specific studies, pilot projects, stakeholder review processes, reliance on expert opinion, etc. to clarify the issues and identify contributing factors.

STEP 3: Identify Measurable Outcomes: What can we do? What are the local-scale measurable outcomes? How do these fit into basin- and state-level goals? What tools can we use? A measurable outcome is a statement that articulates—in measurable or quantifiable terms—the desired state of an attribute as a result from an action or decision.

C. **Identify Attributes:** What are the observed and measured ecological or recreational attributes of the reach? Is there adequate protection of those attributes?

D. **Choosing the right tool(s) to address the challenge:** After reviewing and evaluating available tools, seek stakeholder agreement on which tool is 1) most appropriate to address the challenge or problem, and 2) will achieve the best results.

- **Tool 1:** Describe the tool and why it was chosen, e.g., channel reconfiguration
- **Tool 2:** Describe the tool and why it was chosen, e.g., ISF



STEP 4: Categorize Information Needs.

E. Identify possible actions: Describe science and what types of ecosystem structure/function needs to be addressed.

STEP 5: Implementation Process: This may need to be repeated for each tool.

Implementation Plans

F. Planning/Assessment: Describe planning/assessment process, including any site-specific studies that are needed and the costs associated with it, including potential sources of funding.

G. Design: Describe the design process, including any site-specific studies that are needed and the costs associated with it, including the sources of funding. Design may include several steps, such as 30 percent, 60 percent, and final design.

H. Permitting: Permitting process, including the costs associated with it and the sources of funding. Include a list of the local, state, and federal permits that were needed.

I. Construction: Describe construction process, including the costs associated with it and the sources of funding.

Monitoring: Include the scope, final results, and the benefits of the project. Describe pre-, post-, and long-term project monitoring. Include pre- and post-project photos.

Nonconsumptive Projects and Methods

Example Challenge Statements

The following challenge statements are provided as examples for practitioners who are ready to determine what types of actions are most desirable to restore or maintain specific attributes. Each example serves as a type of "story problem" and then moves through the decision tree to determine what types of methods might serve to meet a measurable outcome. These challenge statements are based on the assumption that the practitioner already has some understanding of existing baseline conditions. The decision tree guides practitioners through project planning and the implementation process after baseline conditions have been inventoried and environmental and recreational attributes have been assessed.

1) There is a degraded population of an imperiled aquatic species (federal- or state-listed threatened or endangered species, candidate for federal listing, state-listed species of special concern) or recreational fishery:
    a. Include existing protections of these species in your implementation plan.
    b. Is the problem habitat-related? If so, what types of habitat improvements are needed? Some examples include:
        i. Riparian habitat improvements – bank restoration that affects temperature or water quality concerns, such as bank stabilization and vegetation plantings.
        ii. Instream habitat improvements – restoration, such as J hooks, pool rocks, assisting with rock embeddedness.
        iii. Reservoir reoperation – modify reservoir operations to address habitat needs; examples include re-timing of releases or adjusting the temperature of releases, as needed.

c. Is the problem flow-related? If so, what types of flow adjustments are needed? Some examples include:

   i. Infrastructure restoration/enhancement – install a more efficient headgate or ditch system so less water needs to be diverted.

   ii. Voluntary flow agreement/reservoir reoperation – Work with local water provider stakeholders to determine if there is an opportunity to re-time reservoir operations, modify exchange agreements, or create additional flows for the degraded aquatic species.

   iii. ISF acquisition – Work with a willing local water rights holder to donate, lease, and/or sell all or a portion of their water right. These water rights can only be held by the CWCB, so it is necessary to work with CWCB staff.
   NOTE: The Colorado Water Trust is a nonprofit whose mission is to help with flow-related restoration efforts and may be able to help.

d. Is a flow solution not feasible due to lack of available water or is a habitat improvement project a preferable option?

   i. Channel Reconfiguration – Modify the channel morphology to accommodate lower flows while still providing for a healthy stream.

2) There is a healthy population of an imperiled aquatic species or recreational fishery:

   a. Include existing protections of these species in your implementation plan.

   b. If additional protection is needed, consider:

      i. ISF or natural lake level appropriation – work with CWCB 1) to establish an ISF; 2) to increase an existing ISF water right to meet the needs of the imperiled aquatic species; or 3) to acquire water for ISF use. CPW or the U.S. Bureau of Land Management (BLM) may be partners who can help conduct site-specific flow studies necessary for an ISF appropriation or increase.

      ii. Land management protections – if the attribute is located on state- or federally-owned land that is not currently being managed to protect the attribute, consider working with the state or federal owner to incorporate protective measures into the land management plan. If the reach is on privately-owned land, contact the land owner to explore the possibility of establishing a conservation easement.

      iii. Wild & Scenic River Stakeholder Group process – if the reach containing the attribute is on the Wild & Scenic eligible or suitable list, consider working with an existing Wild & Scenic River Stakeholder Group to consider alternatives to a Wild & Scenic designation for protection of the attribute. If a stakeholder group is not currently in place, consider working to establish one.

      iv. Gold Medal stream designation – work with CPW to establish the reach as a Gold Medal fishery.

      v. Voluntary flow agreement – consider working with existing water rights owners to establish or modify voluntary flow or exchange agreements.

3) There is a degraded rare riparian or wetland plant community:

   a. Include existing protections of this plant community in your implementation plan.

b. Is the problem habitat-related?

   i. Riparian/wetland habitat improvements – bank restoration that affects temperature or water quality concerns, such as bank stabilization and vegetation plantings.

c. Is the problem flow-related?

   i. Infrastructure restoration/enhancement – see 1.b.i.

d. Is a flow solution not feasible due to lack of available water or is a habitat improvement project a preferable option?

   i. Channel reconfiguration – Modify the channel morphology to accommodate the new low-flow channel and still provide for a healthy stream.

4) There is an outstanding example of a riparian or wetland plant community:

   a. Include existing protections of these species in your implementation plan.

   b. If the plant community is not protected, consider:

      i. Management plan with government entity that owns the property – If the property is owned by CPW, the U.S. Forest Service (USFS), or the BLM, consider working with them to protect the area.

      ii. Conservation easement – If the property is privately owned and the owner is interested, a conservation easement could be considered. Conservation easements can even specify how the water is managed on the property.

      iii. ISF or natural lake level – See 1.c.iii.

5) There is a reach of river that is overused by anglers or boaters:

   a. Develop fee/license structure.

   b. Educate commercial outfitters and clients on best practice.

   c. Improve access point infrastructure (this could help with riparian habitat as well).

   d. Develop better access to neighboring streams that are currently underutilized.

6) There is an outstanding recreational (boating or fishing) river reach:

   a. Include existing protections of the recreational values in your implementation plan.

   b. If it is not protected, consider:

      i. Wild & Scenic alternatives.

      ii. Federal or state management plans.

      iii. Recreational In-Channel Diversions (RICDs).

      iv. Access easements.

      v. Improved access infrastructure.

      vi. Work with CPW to designate a recreational area (i.e., the Arkansas Headwaters Recreational Area through state parks).

      vii. Collaborative solutions are often the best solution, as they do not require major policy development or changes. Such local solutions may include developing a memorandum of

understanding between water users, developing a multipurpose project that includes nonconsumptive protections, a voluntary flow agreement, modification of exchange agreements, or working with a downstream senior water rights holder to get a conservation easement on his or her property.

7) There is an underutilized recreational reach, which has the potential to attract needed tourism dollars to a particular community:
   a. Improve access points.
   b. In-channel improvements – Develop a whitewater park (if boating related) or improve fishery.
   c. Develop and distribute a guide to publicize the recreational reach.
   d. Gold Medal Trout Fishery Designation.

Appendix A

Scientific Information Related to Environmental Attributes

Appendix A

Scientific Information Related to Environmental Attributes

The nonconsumptive portion of the basin roundtable implementation plans should identify clear measures of success and monitoring protocols to define when an ecosystem is sufficiently protected or has recovered. Meeting environmental and recreational needs will, in most situations in Colorado, require managing for nonconsumptive needs while also meeting current and future consumptive needs. Thus, basin roundtables need to consider both consumptive and nonconsumptive water needs, and may need to have ongoing mitigation to manage the environment as part of an integrated, adaptive planning approach. Because many nonconsumptive attributes depend on healthy waterways, this section highlights some of the basic physical and biological attributes that need to be considered when planning to maintain or restore a functioning freshwater ecosystem.

Generally, but not always, the factors that support environmental attributes also support recreational attributes. For example, a sustainable, healthy wild trout fishery is most likely in an environment that also has healthy riparian areas. There are situations, however, where nonconsumptive attributes conflict. For example, a native cutthroat trout population cannot be sustained in the same place as a recreational brown trout fishery. Moreover, the Voluntary Flow Program in the Arkansas River Basin balances flows that provide benefits to the "blue ribbon" trout fishery with ideal boating flows (which do not match with fishery objectives). These examples illustrate the importance of a comprehensive plan with clearly identified goals across all attributes and segments in a basin.

Formulating a plan to meet nonconsumptive needs requires understanding the ecological, hydrological, and physical conditions needed to sustain environmental and recreational attributes. It is also essential to identify and understand the policies and regulations that are in place to support those conditions. The following section briefly describes the scientific factors to consider when planning projects to maintain and protect environmental and recreational attributes. The section is organized into two categories—water quantity and habitat. Under water quantity, streamflow conditions, environmental flows, and connectivity are described. The habitat category includes water and habitat quality parameters, such as geomorphic setting, catchment condition, channel dynamics, streamside and floodplain vegetation, flow variability, nonnative species, bank stability, and instream heterogeneity.

Water Quantity

Streamflow

An overarching master variable of a river is its flow regime. Streamflow, or discharge, is the volume of water that moves over a designated point over a fixed period of time, often expressed as cubic feet per second (cfs). Flow is a function of water volume and velocity. The flow of a stream is directly related to the amount of water moving off the watershed into the stream channel. It is affected by weather, increasing during rainstorms and decreasing during dry periods. It also changes during different seasons of the year, increasing in the spring and early summer due to snowmelt and decreasing during the summer months when evaporation rates are high and vegetation is actively growing.

Streamflow is important because of its impact on water quality and on the living organisms and habitats in the stream. Stream velocity, which increases as the volume of the water in the stream increases, determines the kinds of organisms that can live in the stream (some need fast-flowing areas; others need quiet pools) and affects the amount of silt and sediment carried.

Streamflow also affects the quality, quantity, and timing of river-related recreation such as whitewater boating or recreational fishing. As flows increase, different paddling opportunities and challenges exist within ranges of flows on a spectrum—too low, minimal acceptable, technical, optimal, high challenge, and too high (Whittaker et al. 1993; Whittaker & Shelby 2002). Ensuring sufficient flow during late summer is particularly important for fisheries so that fish passage is maintained and temperatures remain within tolerance levels for fish, most notably trout, which are particularly sensitive to high temperatures.

Environmental Flows

Environmental flows are defined as the water regime provided within a river or wetland to maintain ecosystems in which flows are regulated and competing water uses occur. Thus, an environmental flow is the amount of water that can be allocated to maintain an ecosystem following a process of environmental, social, and economic assessment (**Figure A-1**).

The environmental flows concept has been derived from the Natural Flow Paradigm (Poff et al. 1997), which recognizes flow as vital to sustaining ecosystems and a key driver of aquatic ecosystems. Intuitively, it might seem that all of the natural flow, in its natural pattern of high and low flows, would be needed to maintain a near-pristine ecosystem (Dyson et al. 2008). However, many managers and scientists believe that some portion of flow could be removed without measurable degradation of the ecosystem. Multiple approaches and tools exist to determine how much flow is needed to sustain ecological and recreational attributes (some are described in **Appendix C**). These approaches and tools can assist in finding an acceptable balance between a desired ecosystem condition and other social and economic needs for water.

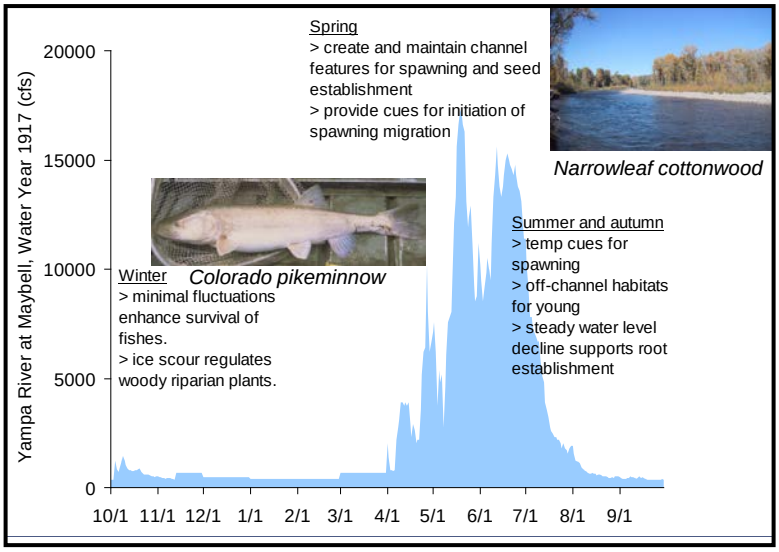


Figure A-1. Flow Dynamics and Ecological Relationships

Timing, or flow management, can be as critical to stream health as quantity of flow (**Figure A-1).** Variable high-flow events restore the following functions—channel maintenance, sediment transport, spawning and migration cues, scouring of riparian and upland vegetation in the channel, and reduction of invasive species. For these reasons, ISF prescriptions are needed to preserve the ecological health of a river. Reduced stream flow can significantly degrade aquatic and floodplain habitat; may cause loss of fish and wildlife; cause increased erosion, sedimentation, and concentrations of pollutants; and lead to either the loss or increase of river recreation opportunities.

Excess flows can negatively affect instream uses, fish life cycles, riparian habitat, riverbank health, sediment loading, and the safety of recreational rafters and anglers.

Connectivity

Connectivity is defined as the maintenance of lateral, longitudinal, and vertical pathways for biological, hydrological, and physical processes (Annear et al. 2004). Connectivity is a measure of the degree to which water, organisms, and suspended elements can move across the fluvial system landscape (**Figure A-2**). It refers to the flow, exchanges, and pathways that move organisms, energy, and materials through a watershed. For a river system, this continuum of hydrological, biological, and chemical interactions and connections is described along the same four dimensions used to describe the hydrologic system (Annear et al. 2004):

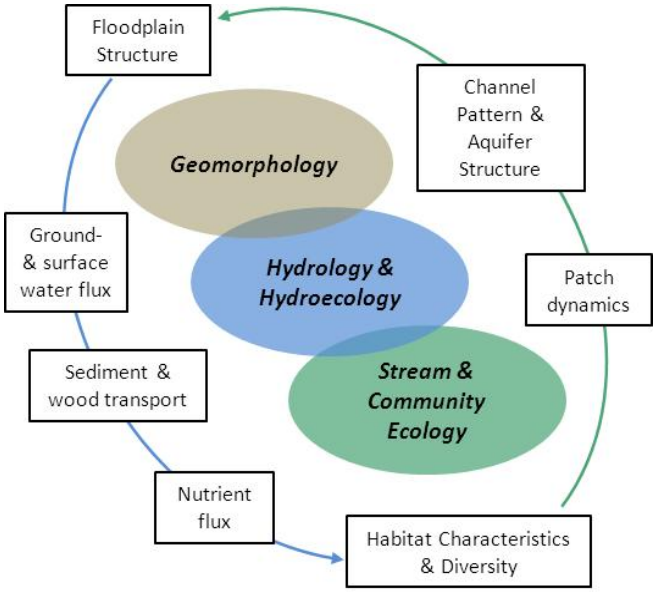


Figure A-2. Dimensions of Hydrologic Connectivity

- Longitudinal (upstream and downstream)
- Lateral (channel to floodplain)
- Vertical (below surface, in the sediment surrounding the channel)
- Temporal (continuity over time)

In some cases connectivity may be almost continuous, such as a mainstem river, or discontinuous, such as ephemeral tributaries, wetlands, or oxbows that are recharged during times of flood. Many native fish use inland waterways to migrate to different habitat at key stages in their life cycle, such as to breed, avoid predators and competitors, and to find feeding grounds. It is vital to ensure fish have access to these different habitat areas.

Longitudinal connectivity. Describes the degree of connection along the main direction of flow (upstream – downstream) for water, sediment, aquatic organisms, and other elements in the river. Some materials, such as sediment, may enter the system mainly as upstream inputs. Other elements, such as woody debris, may develop mainly within the system and either move downstream or remain close to the location they formed (**Figure A-3**). Longitudinal connectivity within a channel can be reduced by levee construction, channel incision, culverts, headgates, diversion practices, or reduced floods downstream from dams (Gergel et al. 2002).

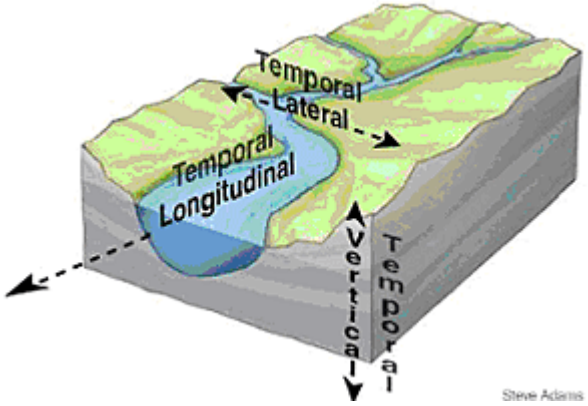


Figure A-3. Longitudinal, Lateral, and Vertical River Connectivity *Source: Minnesota DNR*

Lateral connectivity. Describes the degree of connection from the channel to the floodplain (i.e., across the landscape). Water and suspended elements in a stream floodplain system move out onto the floodplain only during flood events. The frequency and duration of flows affects lateral connectivity to a much larger degree than longitudinal connectivity because the degree of lateral connection is based upon the flow stage of the system. Human-induced lateral hydrological barriers include water storage or diversion activities that reduce peak discharges. The reduced peaks reduce the system's stage, which also decreases floodplain productivity, nutrient exchange, and dispersal of biota between the river and floodplain wetlands (Jenkins and Boulton 2003).

Vertical connectivity. Describes the mixing and interaction of surface water with groundwater in the sediments below the river in a biologically active zone known as the hyporheic zone (Poole et al. 2006). This zone is where water percolates through the soils adjacent to the open streambed and important microbial activity and chemical transformations occur. Vertical hydrological connectivity is less readily apparent in rivers, and its reduction through human actions is less obvious than disruptions to longitudinal and lateral connectivity. Vertical connectivity can be reduced by physical barriers that reduce permeability such as siltation and the clogging of pore spaces of streambed gravels (Hancock 2002), or physical changes that reduce hydraulic gradients, such as straightening and simplifying channel form or decreased flow dynamics.

Temporal connectivity. Describes the continuous physical, chemical, and biological interactions rivers display over time according to a rather predictable pattern. These temporal changes are important to the functioning of the ecosystem and underpin most river ecosystem processes (Kondolf et al. 2006). Over time sediment shifts, meanders form, bends erode, oxbows break off from the main channel, and channels shift and braid. A stream rises and falls according to seasonal patterns, depending on rain and snowmelt. Throughout most of Colorado, free-flowing rivers experience high water in spring/early summer, falling flows through the summer, moderate flows in fall, and base flows in winter. The watershed has adjusted to these normal fluctuations, and many organisms have evolved to depend on them. Temporal connectivity can be particularly important in ephemeral streams of Colorado's eastern plains (Falke et al. 2010).

Habitat

Geomorphic Setting

The geographic location, or geomorphic setting, of a river or wetland may determine habitat functions and the location within a watershed may determine the hydrologic or water quality functions. The shape of a river or stream channel from bank to bank and along its length determines: 1) how water in the channel flows, and 2) the amount of habitat available for aquatic and riparian wildlife. The channel shape also contributes to the stability of the stream section as a whole. As such, geomorphic setting is another master variable, affecting temperature, the amount of pools and riffles, and whether high flows create backwater habitat or replenish riparian plant communities. Ultimately, the geomorphology of a river or stream determines if the amount of water flowing through the reach is sufficient to sustain environmental attributes. The importance of geomorphic setting has been described at some length in the appendices on the relationship between riparian areas and flow in the WFET studies for the Colorado Basin and the Yampa-White Basin.

Water Quality

Water quality refers to the physical, chemical, and biological characteristics of water (U.S. Environmental Protection Agency (EPA) Water Quality website). Water quality factors include the

amount of sediment, salts, nutrients, metals, and other pollutants; the amount of available oxygen for aquatic species; and temperature. Changes in water quality can be caused by pollution from both point sources (such as industrial and treated sewage discharges) and diffuse sources (such as stormwater runoff from agricultural and urban areas). Physical factors (such as climate, geology, slope, and soil type) combine with the consequences of past and current land uses to affect the rate and volume of runoff from land and the flow in the waterway. Other factors that affect how much soil, nutrients, and other pollutants are carried by runoff into the waterway include the presence and quality of streamside and floodplain vegetation, ground cover, and agricultural and grazing practices. Flow dynamics are important for maintaining habitat, aquatic biodiversity, channel form, bank stability, and help to prevent the development of algal blooms.

Habitat Quality

"Habitat quality" incorporates all aspects of physical and chemical constituents along with biotic interactions. The definition of "habitat" can be narrowed to the quality of the instream and riparian habitat that influences the structure and function of the aquatic community in a stream. The natural and physical habitat structure, and associated hydraulic characteristics, can contribute to variations in species composition and abundance both within the stream channel and in the adjacent riparian zone (Peck et al. 2003).

Nonnative species. The presence of nonnative species, including plants, animals, and microscopic organisms, is often a result of altered habitat conditions. While some nonnative aquatic species are relatively innocuous and do not compete with native species, many are successful at invading and spreading in an area, outcompeting native species, disrupting food chains, and changing nutrient cycles. In Colorado, predation or competition by nonnative fish species is a serious threat to the endangered and imperiled fish species and perhaps the most challenging to manage. Without natural checks on populations, invasive nonnative species thrive and can dominate an area. These changes can be harmful to both the ecosystem and local economy. For example, smallmouth bass pose a major threat to reproduction by endangered fish on the Yampa River, and the recent presence of quagga mussels threatens to harm recreational fisheries in reservoirs. Quagga mussels can potentially clog water delivery systems. In addition, nonnative plant species, such as tamarisk and Russian olive, can reduce species diversity in riparian habitats. Other nonnative plant species crowd out stream channels or small lakes, directly reducing habitat for fish and other aquatic species.

Bank stability. The stability of a river bank depends on a number of factors such as the size, geometry, and structure of the bank; the properties of the bank material; the hydraulics of flow in the adjacent channel; presence of vegetation; and climatic conditions (Thorne 1982). Riverbank erosion is a natural process, but often, human activities can have a significant impact on the rate of change (Chakraborty and Choudhury 2009). For example, the construction and operation of a reservoir can have a substantial effect on the stability of the river channel downstream from the dam. Primary changes introduced by a dam include a reduction in the river's sediment load and an alteration of the flow regime. Such artificially introduced changes may trigger an adjustment by the river as it attempts to re-establish an approximate equilibrium between the channel and the discharge and sediment load being transported.

Riparian plant communities. The riparian zone—the interface between terrestrial and aquatic habitats along streams and rivers—is a key component of river ecosystems, providing many ecological, aesthetic, and economic benefits (Arthington et al. 2006). The presence and quality of riverbank and floodplain vegetation can significantly influence instream water quality and habitat

structure. Riparian vegetation composition, structure, and abundance are governed to a large degree by flow regime and flow-mediated fluvial processes (Merritt et al. 2009). Floods maintain the active channel area and the surface and vegetation disturbance needed for diversity. Water provided to riparian areas during floods helps to maintain vegetation that is not able to persist in surrounding dry landscapes. River regulation typically reduces flood disturbance and sediment supply, permitting invasion by exotic plants (e.g., tamarisk) and slowing changes in plant communities that occur over time after a disturbance.

Instream heterogeneity. Habitat complexity (heterogeneity) is a primary factor affecting diversity of fish assemblages and the quality and quantity of physical habitat available to aquatic organisms in rivers and streams (Bunn and Arthington 2002). Habitat conditions are generally characterized in terms of current velocity, depth, composition of the stream bed, and instream cover, such as large woody debris, undercut banks, boulders, etc. (Bovee et al. 1998). Many riverine organisms have evolved life history strategies that correspond to the natural flow regime and are especially sensitive to changes in the magnitude, duration, frequency, timing, and rate of change of flow conditions (Richter et al. 1996).

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Appendix B

Examples of Measurable Outcomes

Appendix B

Examples of Measurable Outcomes

The emergence of new, complex water resources challenges has stimulated the development of a variety of new approaches to systematically plan, prioritize, and implement environmental actions. Measurable outcomes serve as a way to articulate, in determinate or quantifiable terms, the desired state of an attribute or target for nonconsumptive project planning. Measurable outcomes allow for stakeholders and basin roundtables to identify specific outcomes and track measures of success for local-scale projects and strategic basin roundtable implementation plans. The following annotated list includes several examples of organizations and programs that have identified specific measurable outcomes and adopted adaptive management frameworks for project planning.

Colorado Natural Heritage Program's Natural Heritage Ranking System

The CNHP Natural Heritage Ranking System has conducted inventories for rare animals, plants, wetlands, riparian areas, and plant communities across multiple scales. Their ranking system identifies those species and ecosystems most in need of protection and quantifies minimum requirements to maintain those attributes. Species and ecosystems are ranked on the global, national, and subnational/state/province levels. From these data, CNHP has developed Colorado's Biodiversity Scorecard, giving a comprehensive overview of the status of Colorado's biological wealth. CNHP is using species distribution modeling to refine and economize efforts to search for previously unknown populations. CNHP's work has been incorporated into CPW's "Colorado's Comprehensive Wildlife Conservation Strategy (CWCS)" to help identify criteria and develop lists of species of greatest conservation need. **Table B-1** depicts these criteria. The species with the greatest conservation needs identified by CNHP represent the diversity and health of the state's wildlife most in need of attention.

Table B-1. Criteria Used to Develop List of Species of Greatest Conservation Need in CWCS

Inclusion Criteria	***Meeting any of the following:***
	Listed as federal candidate, threatened, or endangered species under the Endangered Species Act (ESA)
	Classified as state endangered or threatened species, or species of special concern
	Global ranking scores of G1, G2, or G2 by the CNHP
	Identified as conservation priorities through a range-wide status assessment or assessment of large taxonomic divisions
	Assigned state ranking scores of S1 and S2 AND a global ranking score of G4 by the CNHP
Exclusion Criteria	***Species meeting the inclusion criteria were eliminated from the Species of Greatest Conservation Need listing if they met any of the following:***
	Occurs peripherally in Colorado but is common elsewhere AND for which management actions in Colorado are likely to have no population-level effects
	Very common but were placed on lists due to economic considerations (e.g., Mallard)

Nature Conservancy's Specific Conservation Targets

The Nature Conservancy's Ecoregional Planning process identifies specific conservation targets (i.e., the species, communities, and ecological systems that characterize the natural diversity of an ecoregion) and sets measurable conservation goals that specify the number and distribution of conservation targets that must be preserved in order to conserve the biological diversity of an ecoregion. Within this process, data on the location and condition of specific individual occurrences of conservation targets is then used to identify a portfolio of areas of biodiversity significance that meet the specified conservation goals to ensure the long-term survival of the ecoregion's natural diversity (Groves et al. 2000). The ultimate goal of ecoregional planning efforts is to conserve the biodiversity representative of an ecoregion—to keep the common species common and prevent extinction or decline of rare species. Because it is impractical to plan individually for each native species (there are over 3,000 species of native plants alone), conservation goals are typically set by species only for imperiled species while common species are maintained by conserving ecosystems or habitats. The targets occur at a variety of scales, from local to regional (TNC 2001).

An Ecoregional Assessment and Conservation Blueprint was published for the Southern Rocky Mountains in partnership with several conservation organizations and indicates that approximately 30 percent of a species historical rank should be preserved in order to maintain species viability. **Table B-2** is adapted from the report and indicates several conservation objectives depending on global rank and distribution within the Southern Rocky Mountains. The 2001 Southern Rocky Mountain report goes on to indicate where several individual species are in relation to these objectives. Some fish species examples are included in **Table B-3** below. According to this approach and the data, the Rio Grande, Greenback, and Colorado River cutthroat trout species have a sufficient number of populations to sustain species viability, while the roundtail chub, Colorado pikeminnow, and razorback sucker do not.

Table B-2. Species Viability
Quantifies numbers needed for viable species populations at different levels of rarity and species distributions

Conservation Category	Definition	Conservation Objectives	Conservation Goal Set by EDU
G1-G2/T1-T2	Endangered, threatened, imperiled	All viable/restorable occurrences up to 25	All occurrences per Ecological Drainage Units (EDU)
G3-G5 with Endemic Distribution	Vulnerable (rare/uncommon), apparently secure (uncommon but not rare), secure (common, widespread, and abundant)	At least 20 viable occurrences	At least 3 per EDU
Limited Distribution	50-90% of species' distribution is within ecoregion and species is limited to 2-3 ecoregions	At least 20 viable occurrences	At least 3 per EDU
Disjunct Distribution	Species distribution likely represents significant genetic differentiation from populations; >2 ecoregions separate this target distribution from its range	At least 15 viable occurrences	At least 3 per EDU
Widespread Distribution	10-50% of species distribution occurs within ecoregion and in more than 3 ecoregions	At least 10 viable occurrences	At least 2 per EDU
Peripheral Distribution	Less than 10% of species distribution occurs within ecoregion	At least 5 viable occurrences	At least 2 per EDU
Regional-Wide-ranging Species		At least 1 viable population; case by case evaluation	Initial focus on core habitat and landscape linkages

Table B-3. Conservation Goals/Results by Target
Shows a section of the Southern Rocky Mountain Report's Appendix 14

Scientific Name	Common Name	SRM Goal	Known Amount in Portfolio	Known % Goal Met
GILA ROBUSTA	ROUNDTAIL CHUB	25	5	20%
ONCORHYNCHUS CLARKI PLEURITICUS	COLORADO RIVER CUTTHROAT TROUT	20	135	675%
ONCORHYNCHUS CLARKI STOMIAS	GREENBACK CUTTHROAT TROUT	25	32	128%
ONCORHYNCHUS CLARKI VIRGINALIS	RIO GRANDE CUTTHROAT TROUT	20	101	505%
PTYCHOCHEILUS LUCIUS	COLORADO PIKEMINNOW	20	4	20%
XYRAUCHEN TEXANUS	RAZORBACK SUCKER	25	3	12%

The 2006 Central Shortgrass Prairie Ecoregional Assessment and Partnership Initiative also used the NatureServe/Natural Heritage Program ranking system to identify native species, plant communities, and ecological systems representative of the ecoregion to focus planning and conservation efforts. The process identified 146 animal and plant species that are state- and/or federally-listed, or are considered imperiled, endemic, or declining. Also included are species assemblages (black-tailed prairie dog animal community), shorebird aggregation areas, 117 natural plant communities, 21 terrestrial ecological systems, and 79 aquatic ecological systems that represent common species. The ultimate goal of the Assessment and Partnership Initiative is to conserve the biodiversity representative of the ecoregion—to keep the common species common and prevent extinction or decline of rare species. A set of "conservation targets" was selected, occurring at a variety of spatial scales from local to regional. Three levels of biological organization (terrestrial and aquatic ecological systems, natural plant and animal communities, and species) represented biological diversity, and were the focus of conservation planning and action. **Table B-4** provides a summary of initial goals for groups of targeted species and species assemblages (Neely et al. 2006).

Table B-4. Conservation Goals
Targeted species, expressed as three risk levels for developing various conservation scenarios

Distribution	High Risk Scenario	Moderate Risk Scenario	Low Risk Scenario
	Number of Viable Occurrences (post 1985)		
G1-G2 Species	All viable	All viable	All viable
G3-G5 Species			
Endemic	21	42	80
Limited	10	21	42
Disjunct	5	10	21
Widespread	5	10	21
Edge of Range	2	5	10

Playa Lakes Joint Venture Area Implementation Plan for Colorado

This plan, created by the Playa Lakes Joint Venture presents habitat management recommendations that, if implemented, should allow priority bird species to reach and sustain objective levels in the Shortgrass Prairie Bird Conservation Region of Colorado (BCR 18). The goal of this plan is to "communicate broad-scale, long-term habitat requirements needed to maintain or increase bird numbers at levels that satisfy socio-economic desires." Management recommendations in this plan are intended to direct attention and resources toward habitats and habitat management actions that are most important for priority bird species. This Implementation Plan is supportive of the North American Waterfowl Management Plan and the United States Shorebird Conservation Plan.

Several of the specific, quantitative recommendations from the plan support attributes identified by the basin roundtables. These include:

- Manage 22,099 acres of floodplain marsh for optimum shorebird foraging suitability (for shorebirds)
- Convert 72,154 acres of exotic riparian shrubland in the South Platte corridor to wet meadow (for short-eared owl)
- Create or render suitable an additional 1,237 acres of sandbars within the eastern stretch of the Arkansas River (for piping plover)
- Create or render suitable an additional 552 acres of sandy beach surrounding large reservoirs in the eastern Arkansas River drainage (for piping plover)

Dolores River Restoration Action Plan

The Dolores River Restoration Partnership has envisioned a Dolores River watershed dominated by native vegetation, where the threats from tamarisk and other associated invasive species have been mitigated and the riparian areas of the watershed continue to become more naturally functioning, self-sustaining, diverse, and resilient over time. To achieve this vision, the partnership created the Dolores River Restoration Action Plan. The purpose of this plan is twofold: 1) to articulate the science-driven, tamarisk related vision, goals, and site selection criteria common to Dolores River stakeholders in both Colorado and Utah to facilitate a consistent approach throughout the watershed; and 2) to initiate and facilitate an increased level of collaboration and communication among the stakeholders to enhance information transfer, adaptive management, and likelihood of large scale, meaningful success.

The plan clearly states an ecological goal for the restoration effort: Over the next 5 years (2010 to 2014) the partnership will increase the number of sustainable, healthy riparian and floodplain plant communities in the watershed while reducing those dominated by tamarisk and other invasive, nonnative plant species. To achieve this goal, several outcomes are expressed in specific, measurable terms, including:

- Tamarisk will be reduced to less than 5 percent of the vegetation cover within riparian areas (i.e., groundwater ≤ 2 meters).
- Other invasive, nonnative plants growing in areas where tamarisk is actively treated will be reduced to less than 15 percent of the vegetation cover within riparian areas and less than 25 percent within the drier upper terrace areas of the floodplain.
- The remaining percent vegetative cover where tamarisk is actively treated will be composed of desirable or native species at each tamarisk treatment site.
- Ninety percent of all riparian lands within the Dolores River watershed will meet above goals.
- There are approximately 2,600 acres of tamarisk infestation along the Dolores River mainstem below McPhee Dam. Approximately 1,900 acres of these tamarisk infestations were estimated in 2009 to occur on riparian sites. Therefore, this 5-year effort seeks to control tamarisk and actively or passively revegetate approximately 1,900 acres along the Dolores River at sites that will likely support riparian to mesic species.

American Whitewater's [Flow Studies]

American Whitewater's flow studies document water volumes necessary for a range of whitewater flows between minimum acceptable and optimum, using methodologies to obtain the supporting preference data. The flow studies are designed to give paddlers and river enthusiasts an opportunity to identify their preferred flows for a range of recreational experiences. Recommendations from these studies identify important boating reaches and quantify minimum, optimum, and maximum flows in those reaches to support whitewater recreation. American Whitewater has used several flow study methods to inform the Colorado Basin Supply and Demand Study. In addition, the flow study methods have been utilized in over 80 Federal Energy Regulatory Commission relicensing proceedings. The National Park Service's Hydropower Relicensing Program includes a document that summarizes the flow study methods.

As with many nonconsumptive attributes, streamflow is only one of the many variables that may affect recreational resources. Other factors that affect actual recreational use include but are not limited to the time of year, weather conditions, and river access. It is important to consider nonflow related parameters along with flow in any measurement of floatboating conditions.

Colorado Parks and Wildlife's [Programs]

Colorado's Wildlife Action Plan and the Colorado Recovery and Conservation Plans are designed to take a strategic habitat conservation approach using an adaptive resource management framework composed of five key elements—biological planning, conservation design, conservation delivery, decision-based monitoring, and assumption-driven research. This approach establishes specific, measurable objectives and uses models relating populations to limiting factors to target management and assess its impacts. A "taxonomy of actions" was developed for species and for habitats to summarize this information in a consistent format. Conservation actions for species and key habitats were prioritized on a scale of High, Medium, or Low, based on expert input, existing recovery/ management plans, and staff experience/expertise (CWCS 2006). The process is designed to be iterative and focused on developing and refining a conservation strategy, making efficient management decisions, and using research and monitoring to assess accomplishments and inform future iterations of the conservation strategy. The Action Plan is not an Endangered Species Recovery Plan, nor is it a type of regulatory or "decision" document. Its purpose is to identify the state's wildlife conservation needs in order to foster greater consistency in conservation efforts among all members of Colorado's wildlife conservation community and others with a stake in Colorado wildlife conservation.

The CPW's Conservation and Recovery Plans target specific species and includes an extensive list of amphibians, birds, fish, and mammals. One example, the Greenback Cutthroat Trout Recovery Plan, established two central measurable outcomes. The first was to simply maintain existing populations of greenback trout populations. The second was more quantitative, setting out to restore the greenback cutthroat trout to nonthreatened status within its native range and delist the species by the year 2000. These goals can be accomplished by maintaining at least 20 stable greenback populations occupying at least 50 hectares (124 acres) of lakes and ponds and 50 kilometers (31 miles) of stream. These measurable outcomes exemplify the quantitative targets that guide restoration and planning practices in the Conservation and Recovery Plans.

The Range-wide Conservation Agreement and Strategy is a collaborative effort across multiple states signed in 2006 to maintain roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), and flannelmouth sucker (*Catostomus latipinnis*) populations to a degree sufficient to ensure

persistence of each species within their ranges. The process established measurable criteria to evaluate the number of populations and individuals within each population required to maintain the three species throughout their respective ranges. These approaches or others can be used by stakeholders to set goals for meeting nonconsumptive needs, and to build long-term implementation plans that identify projects at the local scale while maintaining and integrating those projects into basinwide and statewide objectives.

The following objectives are outlined in the strategy:

- Develop and finalize a conservation and management strategy (strategy) acceptable to all signatories that will provide goals, objectives, and conservation actions to serve as consistent guidelines and direction for the development and implementation of individual state wildlife management plans for these three fish species
- Establish and/or maintain roundtail chub, flannelmouth sucker, and bluehead sucker populations sufficient to ensure persistence of each species within their ranges
- Establish measurable criteria to evaluate the number of populations required to maintain the three species throughout their respective ranges
- Establish measurable criteria to evaluate the number of individuals required within each population to maintain the three species throughout their respective ranges
- Establish and/or maintain sufficient connectivity between populations so that viable metapopulations are established and/or maintained
- As feasible, identify, significantly reduce, and/or eliminate threats to the persistence of roundtail chub, bluehead sucker, and flannelmouth sucker that: 1) may warrant or maintain their listing as a sensitive species by state and federal agencies, and 2) may warrant their listing as a threatened or endangered species under the ESA

Colorado's Recovery Implementation Programs

The Upper Colorado River Endangered Fish Recovery Implementation Program (UCRRIP) and San Juan River Endangered Fish Recovery Implementation Program (SJRRIP) are unique partnerships of local, state, and federal agencies; water and power interests; and environmental groups working to restore and manage stream flows and habitat, boost wild populations with hatchery-raised endangered fish, and reduce negative interactions with certain nonnative fish species to achieve natural, self-sustaining populations of the endangered fish. The UCRRIP is recovering humpback chub, bonytail, Colorado pikeminnow, and razorback sucker in the Colorado River and its tributaries in Colorado, Utah, and Wyoming. The UCRRIP relies on measurable outcomes to develop and implement management actions and measure success. The recovery goals describe conditions necessary for downlisting the fishes from endangered to threatened and for removing them from ESA protection (delisting). Recovery goals identify the number and age of fish that comprise a specified number of self-sustaining wild populations. They also identify site-specific management actions that reduce threats to the species. **Table B-5** provides a synthesis of the recovery goals and management actions for each of the four endangered fish species. **Table B-6** quantifies progress on management action and recovery, and specifies opportunities for and constraints on meeting original goals and timelines.

Table B-5. Demographic Criteria for Recovery
*modified from the Upper Colorado River Endangered Fish Recovery Program

Downlisting	Delisting
Colorado pikeminnow	
Over a 5-year monitoring period:	*For 7 years beyond downlisting:*
• Maintain the Upper Basin metapopulation • Maintain populations in the Green River and Upper Colorado River sub-basins ("no net loss") • Green River sub-basin population >2,600 adults • Upper Colorado River sub-basin population >700 adults • Establish 1,000 age 5+ subadults in the San Juan River	• Maintain the Upper Basin metapopulation • Maintain populations in the Green River and Upper Colorado River sub-basins ("no net loss") • Green River sub-basin population >2,600 adults • Upper Colorado River sub-basin population >1,000 adults OR Upper Colorado River sub basin population >700 adults and San Juan River population >800 adults
Bonytail chub	
Over a 5-year monitoring period:	*For 3 years beyond downlisting:*
• Maintain reestablished populations in the Green River and Upper Colorado River sub-basins, each >4,400 adults • Maintain established genetic refuge of adults in Lower Basin • Maintain two reestablished populations in the Lower Basin, each >4,400 adults	• Maintain populations in the Green River and Upper Colorado River sub-basins, each >4,400 adults • Maintain genetic refuge of adults in Lower Basin • Maintain two populations in the Lower Basin, each >4,400 adults
Razorback sucker	
Over a 5-year monitoring period:	*For 3 years beyond downlisting:*
• Maintain reestablished populations in Green River sub-basin and EITHER in Upper Colorado River sub-basin or San Juan River, each >5,800 adults • Maintain established genetic refuge of adults in Lake Mohave • Maintain two reestablished populations in Lower Basin, each >5,800 adults	• Maintain established populations in Green River sub-basin and EITHER in Upper Colorado River sub-basin or San Juan River, each >5,800 adults • Maintain genetic refuge of adults in Lake Mohave • Maintain two populations in Lower Basin, each >5,800 adults
Humpback chub	
Over a 5-year monitoring period:	*For 3 years beyond downlisting:*
• Maintain the six populations ("no net loss") • One core population in Upper Basin > 2,100 adults • One core population in Lower Basin > 2,100 adults	• Maintain the six populations ("no net loss") • Two core populations in Upper Basin > 2,100 adults • One core population in Lower Basin > 2,100 adults

Table B-6. Recovery Programs' Progress to Recovery (2011-2012)

Species	Timeline to Downlist/Delist (Years)	Progress Made on Management Actions' to Remove Threats to Recovery and Status of Meeting Demographic Criteria
Colorado Pikeminnow	2013/2020	**Management Actions:** 78% of the actions required by U.S. Fish and Wildlife Service (USFWS) to downlist have been met or partially met. **Demographics:** IF, Colorado and Green river populations do not decline significantly from current levels and 1,000 age-5 fish are present in San Juan River **(moderate to high likelihood) – downlisting could occur in 2013.**
Bonytail	2020/2023	**Management Actions:** 72% of the actions required by USFWS to downlist have been met or partially met. **Demographics:** Stocking programs in the Green and Colorado rivers have been marginally successful. **There is not enough new information to suggest the 2020 deadline should be revised**.
Razorback Sucker	2020/2023	**Management Actions:** 85% of the actions required by USFWS to downlist have been met or partially met. **Demographics:** Stocking programs in the Green, Colorado, and San Juan rivers appear to be successful. Although neither program has initiated population estimation, **current information indicates the 2020 timeline is still achievable.**
Humpback Chub	2016/2019	**Management Actions:** 60% of the actions required by USFWS to downlist have been met or partially met. **Demographics:** IF, over a 5-year period, one of the five Upper Basin populations rebounds to meet the "core criteria" of 2,100 adults, and the other Upper Basin populations increase **(low to moderate likelihood) - downlisting could occur in 2016.**

Upper Colorado River Wild & Scenic Management Plan Alternative

The Upper Colorado River Wild & Scenic Stakeholder Group (SG) represents a diverse range of interests who have worked together since 2008 to develop an Upper Colorado River Wild & Scenic Stakeholder Group Management Plan (SG Plan to protect the Outstandingly Remarkable Values (ORVs) identified in the BLM and USFS Eligibility Reports for Segments 4 through 7 of the Upper Colorado River. The SG Plan aims to protect all ORVs while focusing on recreational fishing (in Segments 4 through 6) and recreational floatboating (in Segments 4 through 7). The SG Plan uses two distinct tools—"ORV Indicators" (characterizing the range and quality of the ORVs) that will be used to gage whether the ORVs are being protected; and "Resource Guides" (reflecting ranges for factors such as flow, temperature, and water quality) that will be used as a source of information among others to inform SG discussions under the plan.

This plan adopts a tiered system for implementation of management measures for the protection of the ORVs. Tier 1 Long-Term Protection Measures (e.g., Appropriation of CWCB ISF rights) are expected to provide significant protection of the ORVs. Tier 2 Cooperative Measures (e.g., acquisition of water rights for ISF purposes) will complement the Tier 1 measures and may serve to maintain or enhance the ORVs. Tier 3 Measures allow a stakeholder to elevate an issue to the Stakeholder Group. The SG Plan's implementation procedures provide a feedback loop to periodically assess and confirm that the management measures under the plan, in coordination with the BLM and USFS other land management actions, are protective of all ORVs.

Routt County Livability Index

The Routt County Livability Index provides an example of efforts to quantify the economics of environmental services and quality of life indicators. The livability index serves as a tool to measure change relating to metrics for four economic/quality of life aspects in Routt County—Economic, Environmental, Social, and Civic. The index compares Routt County's livability to other mountain communities in Colorado that have social/economic and demographic similarities. The index is first and foremost a decision support tool. It measures a series of indicators over time to provide quantitative evidence of whether the community is becoming more or less "livable."

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Appendix C

Tools and Resources for Project Planning

Appendix C

Tools and Resources for Project Planning

The annotated list in this appendix includes scientific, technical, and policy tools and resources used to establish baselines and metrics for nonconsumptive needs. These tools represent a small subset of existing scientific tools and resources that have been narrowed to include those commonly used in, or specifically developed for, Colorado. As the basin roundtables or project proponents consider use of the tools described in this appendix they will need to consider the applicability and limitations of the tool that may apply to the issue they are addressing. The CWCB does not promote the application of any specific analysis procedure or tool.

The tools are organized into two main categories—environmental and recreational. The environmental tools focus on physical and biological factors (e.g., how much water is needed in a river system) to meet environmental targets and attributes for nonconsumptive needs. The environmental tools have been further classified by the scales for which they are designed and implemented. "Basin scale" tools operate at the watershed, or basin, level whereas "local scale" tools tend to focus at the river reach level. The recreational tools include resources for conducting usage surveys, quantifying necessary streamflow, and decision support systems for determining baseline conditions for recreational outcomes. Note that the flow-related tools do not necessarily consider the influence of non-flow related variables that may affect the condition of the resource. In addition, it is important to consider site-specific physical and biological measurements and observations during project planning implementation and evaluation. The Toolbox user may also refer to **Appendix G** as a resource for contacting people with knowledge, expertise, and access to additional tools and resources for planning nonconsumptive projects.

Environmental Tools

Basin Scale

Several environmental tools can be used at the basin-wide scale. While these tools are helpful in understanding the basin, they are not sufficient to indicate what should be done in a particular reach or location. Site specific local tools are needed for these purposes.

Watershed Flow Evaluation Tool - WFET. The WFET is a newly developed approach that is being tested and evaluated. It is a desktop tool that uses existing information to provide a regional framework for examining the risk of ecological change related to stream flow alteration, at a watershed or regional level. The WFET helps basin stakeholders assess the vulnerability of nonconsumptive attributes by associating the risk of ecological response with potential flow regime changes. The three major steps in the development of the WFET are: 1) use existing data and expert opinion to develop flow-ecology relationships by stream type, 2) develop a hydrologic foundation of daily natural and altered flows, and 3) combine flow-ecology relationships and the hydrologic foundation to assign risk status for specific attributes across entire watersheds at a reach or subbasin scale. Thus far, the Colorado and Yampa-White Basin Roundtables have developed the WFET.

Steps 1 and 2 for developing the tool are highly dependent on existing data and models. During a pilot WFET project, the project team found that the tool could not be developed for the Fountain Creek Watershed because relevant data to inform the flow-ecology relationships did not exist. The issues

with applying the WFET process for Fountain Creek included streamflow data were sparse, water management has caused rapid and ongoing changes in channel morphology, and flows have been augmented rather than depleted. In the Gunnison and Southwest Basins, data and models exist, but development of the tool would still require investment to ensure modeling and application of the WFET is consistent with those particular geographies. For the Colorado and Yampa-White Basins, the WFET could be used in the future to assist in understanding basin-scale flow-related risks due to water management changes.

As with other flow-related tools, the WFET does not explicitly consider the influence of non-flow related variables to the condition of a resource, which may play a significant role in mitigating for changes in flow, or for causing ecological concerns despite adequate flows being available. For these reasons, when estimating risk to an attribute, the WFET does not confirm or measure that an actual resource impact or consequence has occurred.

Colorado Wetlands Inventory. Wetlands are critical water-dependent resources that support clean water and health habitats. The CNHP, in collaboration with CPW, the EPA, and several other contributing partners has developed a website that is the most comprehensive information available on the extent and distribution of wetlands in Colorado. This website is called the Colorado Wetlands Inventory. There are two main sections of the Colorado Wetlands Inventory:

1. The Colorado Wetlands Inventory Mapping Tool, which displays several different datasets depicting the location and classification of wetlands in Colorado. Digital mapping of wetlands is still limited in our state, but is increasing every year. Through the mapping tool, viewers can see the status of several major wetland mapping efforts and the actual mapped polygons. Datasets displayed in the mapping tool include:

    - Wetland mapping produced by National Wetlands Inventory (NWI), both digital polygons and scanned images.
    - Riparian mapping produced by CPW:
        - Wetland mapping produced by local governments (Boulder and Summit Counties)
        - Potential fen mapping produced by various parties
        - Potential playa mapping produced by Rocky Mountains Bird Observatory (RMBO). PDF maps of playas and a GIS shapefile containing information about playas can be found here.

    In addition to the wetland datasets, the Colorado Wetlands Inventory Mapping Tool includes two data products created by CNHP:

    - Potential Conservation Areas (PCAs) drawn for wetland and riparian dependent elements. These PCAs represent wetland and riparian areas with high biodiversity value across Colorado.
        - Modeled Intensity of Wetland Stressors. This statewide model that integrates stress form transportation networks, development, resource extraction, and hydrologic modification into one seamless map, highlighting areas of high potential stress and low potential stress for aquatic resources.

2. The Colorado Wetlands Inventory Profiles and Summary Page, which compiles and summarizes available wetland information shown in the mapping tool.

GeoPDFs. During the SWSI 2010 process, each basin developed a unique map showing focus areas with nonconsumptive environmental and recreational water needs. The basin and statewide maps were 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., razorback sucker, roundtail chub, kayaking, etc.) is summarized as well as information designated by the basin roundtables through creation of tables associated with their maps. To utilize the maps interactively select the tools dropdown list, then select the analysis tools arrow, and then click on the "object data tool." A user must triple click a reach for additional information that will appear on the left side. More detailed instructions for using the nonconsumptive GeoPDFs and for downloading and utilizing Adobe Reader are available in **Appendix D** of the SWSI 2010 report.

Local Scale

Local, site-specific studies can provide sufficient detail on a given location, which may suggest how a specific project or method can be utilized for meeting a noconsumptive need. However, due to the expense of these studies, only a few sites are typically funded.

Physical Habitat Simulation - PHABSIM. PHABSIM is part of a broad conceptual and analytical framework for addressing stream flow management issues called the Instream Flow Incremental Methodology (IFIM) (Stalnaker et al. 1995). PHABSIM predicts physical microhabitat changes associated with flow alterations. It provides a variety of simulation tools, which characterize the physical microhabitat structure of a stream and describes the flow-dependent characteristics of physical habitat in light of selected biological responses of target species and life stages. When interpreting PHABSIM results, an assumption is normally made that flow-dependent physical microhabitats are useful in determining carrying capacity, and therefore are related to the ISF needs or impacts of flow variations on fish or other aquatic organisms in streams.

River 2D. River2D is a two-dimensional hydrodynamic model that has been customized for fish habitat evaluation studies. The River2D model suite actually consists of four programs—R2D_Bed, R2D_Ice, R2D_Mesh, and River2D. These programs are typically used in succession and then used to solve the water depths and velocities. Ultimately, River2D is used to visualize and interpret the results and perform PHABSIM type fish habitat analyses.

R2Cross. The R2CROSS tool is one of the standard techniques employed by state and federal agencies to model instream hydraulic parameters and develop ISF recommendations in Colorado. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Rosgen Stream Classification. Rivers are complex natural systems. A classification system is often used to stratify river reaches into groups that share common physical characteristics. The purpose of Rosgen's classification system is to classify streams based on quantifiable field measurements to produce consistent, reproducible descriptions of stream types and conditions. There are four levels in Rosgen's classification hierarchy—geomorphic characterization (Level 1), morphological description (Level 2), stream condition assessment (Level 3), and validation and monitoring (Level 4). Initially,

streams are grouped by water surface slope, entrenchment, width/depth ratio, and sinuosity into categories A - G. Streams are then further divided into categories 1 - 6 based upon dominate channel materials. The resulting value is given as an alpha-numeric combination, such as C4. A stream categorized as C4 thus has certain describable properties, regardless of its location. River restoration based on the principles of the Rosgen geomorphic channel design approach is most commonly accomplished by restoring the dimension, pattern, and profile of a disturbed river system by emulating the natural, stable river. Restoring rivers involves securing their physical stability and biological function, rather than the unlikely ability to return the river to a pristine state.

Local and Basin Scale

Collaborative Modeling for Decision Support (CMDS) is an approach to decision-making that supports negotiation among disagreeing parties with computer simulation models. CMDS refers to various, largely independent and isolated efforts to integrate two rapidly growing, but largely distinct approaches to decision-making: negotiation/bargaining as a means of resolving water resource decision-making disputes, and development of computer-based systems models intended to support water resource management. The heart of CMDS is that models are built *with* participants and decision-makers rather than *for* participants and decision-makers (Bourget et al. 2013).

Various specific techniques exist and they differ slightly, but all share the key ingredients of collaborative computer modeling and collaborative decision-making. One such technique is Shared Vision Planning (SVP). SVP grew out of federal water resources planning practices to create a collaborative approach to formulating water management solutions that combines three distinct practices: 1) traditional water resources planning, 2) structured public participation, and 3) collaborative computer modeling. Although each of these elements has been applied for many years, what makes SVP unique is the integration of these elements to create a decision-relevant model that represents a "shared vision" of the problem. A test application of SVP was applied to the Halligan-Seaman Water Management Plan being pursued by Fort Collins and Greeley. The "test" was to determine if participants wanted to pursue SVP as an approach to permitting in lieu of the traditional federal process (as defined by the National Environmental Policy Act [NEPA]). After 2 years of robust work using CMDS, project proponents chose to not use SVP and instead stick to the better known process. SVP has been applied in the Great Lakes, the Potomac River Basin, the southeastern U.S., the Rio Grande River Basin, and many other regions of the U.S. and the World.

Links and references:

- http://www.sharedvisionplanning.us/index.cfm - contains background material, implementation guides, research papers, and more.
- Collaborative Modeling for Decision Support in Water Resources: Principles and Best Practices http://www.computeraideddisputeresolution.us/bestpractices/index.cfm
- Bourget, Elizabeth C., Stacy M. Langsdale, Marjan van den Belt, 2013. Featured Collection Introduction: Collaborative Modeling for Decision Support as a Tool to Implement IWRM. Journal of the American Water Resources Association (JAWRA) .49(3):605–608.
- Palmer, Richard N., Hal E. Cardwell, Mark A. Lorie, and William Werick, 2013. Disciplined Planning, Structured Participation, and Collaborative Modeling — Applying Shared Vision Planning to Water Resources. Journal of the American Water Resources Association (JAWRA) .49(3):614–628

Indicators/Monitoring. Indicators provide an effective tool to measure progress and performance. Generally, an indicator focuses on a small, manageable set of information that gives a sense of the bigger picture, and eliminates the need to measure everything. The choice of an indicator is important as to whether it gives sufficient "sense of the bigger picture." Many different types of indicators have been developed and can be used to reflect a variety of aspects of ecosystems, including biological, chemical, and physical. For example, an **indicator species** is an organism or population whose presence, absence, or abundance reflects a specific environmental condition. Indicator species can signal a change in the biological condition of a particular ecosystem, and thus may be used as a proxy to diagnose the health of an ecosystem.

Watershed Assessment of River Stability and Sediment Supply - **WARSSS**. WARSSS is a three-phase technical framework of methods for assessing suspended and bedload sediment in rivers and streams. Excess sediment has been a leading cause of water quality impairment across the nation for years, but methods to assess sediment problems and plan solutions have been limited. WARSSS is a technical procedure developed by Dr. David L. Rosgen for water quality scientists to use in evaluating streams and rivers impaired by excess sediment.

Biological Assessments. EPA's Monitoring and Assessment program has a number of tools and programs available focused on water quality. Biological assessments are evaluations of the condition of waterbodies using surveys and other direct measurements of resident biological organisms (macroinvertebrates, fish, and plants). Biological assessment results are used to answer the question of whether waterbodies support survival and reproduction of desirable fish, shellfish, and other aquatic species—in other words, if the waterbodies meet their designated aquatic life uses. There are a variety of biological assessment programs in the U.S. including:

- Wadeable Streams Assessment
- Lake and Reservoir Bioassessment and Biocriteria, Technical Guidance Document, August 1998
- Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, 2nd edition
- 2002 Summary of Biological Assessment Programs and Biocriteria Development, Streams and Wadeable Rivers
- Stressor Identification Guidance
- Estuaries and Coastal Marine Waters Bioassessment and Biocriteria Technical Guidance

Recreational Tools

Creel Surveys. There are a number of different methods that can be used to quantify needs for recreational purposes—from desktop methods to resource intensive surveys about user experiences. Similarly, for recreational fishing, Creel surveys measure angler satisfaction using a variety of different data collection methods. Angler satisfaction is often quantified as Total Fishing Effort (TFE) and Catch/Unit Effort (CPUE). Angler satisfaction is also directly related to biomass and species diversity and indirectly related to river flows, temperature, and water quality. However, these attributes are incorporated into the habitat tools discussed above.

Surveys to assess streamflow needs for whitewater recreation. American Whitewater has developed a survey based approach to assessing the relationship between streamflows and quality of recreational experience. There are two components to this approach. First, an online survey is conducted with commercial and noncommercial paddlers, who evaluate flows for whitewater boating on targeted river segments. Respondent data is collected and organized to identify minimum, acceptable, and optimum flows for whitewater boating, summarized in curves that describe the quality of boating opportunities for each measured streamflow. Respondents also report flows that provide certain recreational experiences or "niches" from technical low water to challenging high water trips. American Whitewater has used several flow study methods to inform the Colorado Basin Supply and Demand Study. In addition, the flow study methods have been utilized in over 80 Federal Energy Regulatory Commission relicensing proceedings. The National Park Service's Hydropower Relicensing Program includes a document that summarizes the flow study methods.

Variables other than streamflow can be the predominant factors that influence actual recreational use. As a result, it is important to consider nonflow related parameters in any measurements of floatboating conditions. Another tool is collection of river usage information by floatboaters through vehicle or boat counting, querying commercial boating operations, or obtaining usage information collected by others such as the BLM. As with all survey methods, adequate sample size and verifying results on the ground are necessary to ensure that the results accurately reflect a diverse set of recreational users of a given stream segment.

Appendix D

Projects and Methods Mapping

Appendix E

Nonconsumptive Projects and Methods Funding Opportunities

Appendix E

Nonconsumptive Projects and Methods Funding Opportunities

There are several ways that funding can be acquired for environmental and recreational water development. Existing federal and state programs can be drawn on and new programs at the state and local levels can also be created to provide funding. Accessing state funding can be relatively straightforward for certain types of projects. Obtaining federal funding can be considerably more challenging. Other funding entities also exist, ranging from local government through philanthropic foundations. This funding landscape can be challenging to navigate. As part of the Toolbox, this section on funding is intended to provide guidance on those funding sources that are most likely to be accessed by basin roundtable members and other nonconsumptive stakeholders in Colorado. This section should not be viewed as an exhaustive list of possible funding sources.

Several comprehensive lists of funding sources have been compiled. Perhaps the most relevant lists for funding nonconsumptive needs projects and methods in Colorado are **Tables 3-7** and **3-8** in Section 3 of the SWSI 2010 report. These tables list, respectively, federal and state funding sources along with descriptions of several aspects of the funding sources (e.g., purpose, eligibility, etc.). The Colorado Watershed Assembly has a list of both private and public funding opportunities. An even more comprehensive national list can be found for free by going to the Red Lodge Clearinghouse funding database. Another useful resource for those seeking information on potential sources of federal funding for conservation is the Catalog of Federal Funding Sources for Watershed Protection. This online database can be queried by type of funding (e.g., grants, loans, cost sharing), eligible organization types, and matching funds requirements. The database recognizes more than 30 different keyword search terms including fisheries, floodplain or riparian zone, invasive species, restoration, source water protection, and wetlands. TNC has compiled a Compendium of Financing Sources and Tools to Fund Freshwater Conservation. This Compendium highlights several innovative and nontraditional funding sources.

Among these large sets of ever-evolving funding sources, there is a relatively small set of sources that are currently and actively being used in Colorado by individuals, landowners, watershed groups, nongovernmental organizations, and others to implement nonconsumptive projects and methods. **Table E-1** lists the most commonly used funding sources, their general purpose, and a link to the funding source website. While CWCB funding sources have been important for many nonconsumptive projects over the past several years, these funds are most easily accessed and best put to use when complemented with other sources of funding.

Table E-1. Most Prominent or Commonly Accessed Funding Sources for Nonconsumptive Projects and Methods in Colorado

Funding Source	Purpose	For further information
CWCB Instream Flow Acquisition Fund	ISF acquisitions; also includes more specialized funding from Species Conservation Trust Fund for ISF acquisitions that benefit threatened, endangered, or candidate species.	http://www.cwcb.state.co.us/NR/rdonlyres/E6DA70D1-1D32-41D2-BF26-67A1BD6092E9/0/19.pdf SWSI 2010, Section 3, Table 3-8.
CWCB Water Supply Reserve Account	Fund water activities approved by the basin roundtables.	http://cwcb.state.co.us/IWMD/WaterSupplyReserve/ SWSI 2010, Section 3, Table 3-8.
CWCB Current Task Order Support for Nonconsumptive Projects	Technical support to basin roundtables.	http://ibcc.state.co.us SWSI 2010, Section 3, Table 3-8.
CWCB Healthy Rivers Fund	Locally based water projects and planning.	http://cwcb.state.co.us/WatershedProtectionFloodMitigation/Watershed/WatershedRestorationProgram.htm SWSI 2010, Section 3, Table 3-8.
CWCB Watershed Restoration Grants	Provides planning, engineering, and construction services for watershed/stream restoration studies and projects.	http://cwcb.state.co.us/WatershedProtectionFloodMitigation/Watershed/WatershedRestorationProgram.htm SWSI 2010, Section 3, Table 3-8.
DOLA Conservation Trust Fund	Implementation of projects that benefit state and local parks, recreation facilities, open space, environmental education, and wildlife habitat.	http://www.dola.state.co.us/dlg/fa/ctf/index.html SWSI 2010, Section 3, Table 3-8.
CDPHE / US EPA – 319 Program	Mitigating nonpoint source pollution to impaired Colorado water bodies.	http://www.epa.gov/OWOW/NPS/cwact.html http://www.cdphe.state.co.us/wq/nps/index.html SWSI 2010, Section 3, Table 3-8.
State of Colorado- Colorado Conservation Easement Tax Credit	Protecting lands through conservation easements.	http://www.revenue.state.co.us/fyi/html/ SWSI 2010, Section 3, Table 3-8.

Table E-1. Most Prominent or Commonly Accessed Funding Sources for Nonconsumptive Projects and Methods in Colorado

Funding Source	Purpose	For further information
CWCB Instream Flow Tax Credit	Provides financial incentive for ISF donations to the CWCB.	http://www.coloradowatertrust.org/acquisitions/tax-credit/ SWSI 2010, Section 3, Table 3-8.
Species Conservation Trust Fund Grants	Funds projects to protect native species and promote recovery of endangered species.	Colorado Revised Statutes Title 24 Article 33 Section 24-33-111.
CPW Habitat Stamp	Acquiring or preserving wildlife habitat.	http://wildlife.state.co.us/ShopDOW/AppsAndLicenses/HabitatStamp/ SWSI 2010, Section 3, Table 3-8.
CPW Fishing is Fun Program	Improve fishing opportunities for anglers.	http://wildlife.state.co.us/Fishing/ResourcesTips/FishingIsFunProgram SWSI 2010, Section 3, Table 3-8.
CPW Colorado Wetland Wildlife Conservation Program	Preserve, restore, enhance, and create wetlands and adjacent habitat.	http://wildlife.state.co.us/LandWater/WetlandsProgram/ SWSI 2010, Section 3, Table 3-8.
GOCO Legacy Initiative	Implement projects of regional or statewide importance that preserve land and water, enhance critical wildlife habitats, create new state and local parks, construct trails, and provide environmental education.	http://www.goco.org/GrantPrograms/Legacy/tabid/ 125/Default.aspx SWSI 2010, Section 3, Table 3-8.
GOCO Open Space Program	Open space protection.	http://www.goco.org/GrantPrograms/OpenSpace/tabid/119/Default.aspx SWSI 2010, Section 3, Table 3-8.
North American Wetlands Conservation Act (NAWCA)	Provides matching grants for wetlands conservation projects for the benefit of wetlands-associated migratory birds and other wildlife.	http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm
WQCC Watershed Protection Fund	Protect lands and waterways in Colorado's watersheds.	http://www.cdphe.state.co.us/op/wqcc/SpecialTopics/CWPF/colowtshdprot.html SWSI 2010, Section 3, Table 3-8.

Table E-1. Most Prominent or Commonly Accessed Funding Sources for Nonconsumptive Projects and Methods in Colorado

Funding Source	Purpose	For further information
U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) – Wetland Reserve Program (WRP)	Restoring, protecting, and enhancing wetlands and associated uplands on private land.	http://www.nrcs.usda.gov/PROGRAMS/wrp/ SWSI 2010, Section 3, Table 3-7.
USDA NRCS – Wildlife Habitat Improvement Program (WHIP)	Creating high quality wildlife habitats for species of national, state, tribal, or local significance.	http://www.nrcs.usda.gov/programs/whip/ SWSI 2010, Section 3, Table 3-7.
NRCS – Environmental Quality Incentives Program (EQIP)	Soil, air, water, and other natural resource concerns.	http://www.nrcs.usda.gov/PROGRAMS/eqip/ SWSI 2010, Section 3, Table 3-7.
US EPA – Targeted Watershed Grant Program	Water quality improvement along with habitat improvements.	http://www.epa.gov/twg/ SWSI 2010, Section 3, Table 3-7.
US EPA – Wetland Program Development Grants	Water quality improvement along with habitat improvements.	http://www.epa.gov/owow/wetlands/grantguidelines/ SWSI 2010, Section 3, Table 3-7.
U.S. Bureau of Reclamation (USBR) – Water SMART Grants	Projects that reduce conflicts through water conservation, efficiency, and markets.	http://www.usbr.gov/WaterSMART/ SWSI 2010, Section 3, Table 3-7.
USFWS Partners for Fish & Wildlife	Restoring habitat on private lands including wetlands and riparian areas.	http://ecos.fws.gov/partners/viewContent.do?viewPage=home SWSI 2010, Section 3, Table 3-7.
USFWS Sport Fish Restoration Program	Restoring and better managing America's declining fishery resources.	http://wsfrprograms.fws.gov/Subpages/GrantPrograms/SFR/SFR.htm SWSI 2010, Section 3, Table 3-7.

Table E-1. Most Prominent or Commonly Accessed Funding Sources for Nonconsumptive Projects and Methods in Colorado

Funding Source	Purpose	For further information
Colorado River District Grant Program	Development of a new water supply; improvement of an existing water supply system; measures to improve instream water quality; measures that promote water use efficiency; sediment reduction measures; implementation of watershed management actions; tamarisk control measures.	http://www.crwcd.org/page_193
David & Lucile Packard Foundation, Conservation and Science Program	Watershed protection and restoration.	http://www.coloradowater.org/Private%20Funding%20Opportunities/#David
Gates Family Foundation	Promoting long-term stewardship of land, water and other natural resources.	http://www.gatesfamilyfoundation.org/
National Fish and Wildlife Foundation: Bring Back the Natives	Restoring, protecting, and enhancing native aquatic species, especially on lands on or adjacent to federal agency lands.	http://www.nfwf.org/AM/Template.cfm?Section=charter_programs_list&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=24293
National Fish and Wildlife Foundation: Upper Colorado Native Fishes Keystone Initiative	Develop a network of watershed-scale areas where entire native fish communities would be restored and protected.	http://www.nfwf.org/AM/Template.cfm?Section=Fish_&CONTENTID=22456&TEMPLATE=/CM/ContentDisplay.cfm
National Fish and Wildlife Foundation Pulling Together Initiative	Support weed partnerships, including those focused on tamarisk and Russian olive eradication.	http://www.nfwf.org/AM/Template.cfm?Section=Home&TEMPLATE=/CM/HTMLDisplay.cfm&CONTENTID=25307
Walton Family Foundation	Creating cleaner, healthier rivers.	http://www.waltonfamilyfoundation.org/
Save the Colorado River Campaign	Protect and restore the health of the Colorado River.	http://www.savethecolorado.org/grants.php

Appendix F

Case Studies

Appendix F

Case Studies

The following section provides a series of case studies to offer real world examples of nonconsumptive projects and methods planned and implemented throughout Colorado. Using the template and challenge statements from Section IV, these projects illustrate how problems were identified, which tools were used to analyze conditions for attributes, how projects and methods were developed, and which implementation solutions were employed. The goal of these case studies is to demonstrate how basin roundtables should identify attributes and set targets at the basin-scale first, categorize important projects and reaches for implementation, and follow the template to define measurable outcomes. The case studies include:

- Lower Blanco River Restoration Project
- Parks and Wildlife Instream Flow Recommendations for an Increase in Flow for East Elk Creek
- Upper Gunnison River Water Conservancy District Recreational In-Channel Diversion and the Gunnison Whitewater Park
- Upper Colorado River Wild and Scenic Stakeholder Group's Management Plan Alternative
- Donation by Colorado Water Trust of Peabody Ditch Water Rights to Colorado Water Conservation Board for Instream Flow Use
- South Platte: Haren Recharge Wetland Development
- The Greenway Foundation River Vision Implementation Plan (RVIP)

Case Study: Lower Blanco River Restoration Project

The San Juan-Chama Diversion project came online in 1971, and since that time the Lower Blanco River has been reduced to small flows in an over-wide stream bed. The river no longer has the seasonal flows to shape the channel bed, create scour pools, and maintain spawning gravel beds. In many locations the mature riparian vegetation is not next to the flowing water. Wetland features at the margins of the channel are infrequent. Water temperatures are elevated in the summer months because of shallow and wide flow conditions. There is only limited habitat available for salmonids and other aquatic species.

STEP 1: Challenge/Problem Statement

The Lower Blanco River Restoration Project seeks to restore some of the aquatic life functions that were lost when a major portion of the river's historic flow was diverted to New Mexico to meet Colorado River Water Compact obligations. Attributes protected = Trout.

STEP 2: Decision Making Process

The condition of the Lower Blanco River after the San Juan-Chama Diversion was of great concern to property owners along the river. The Lower Blanco Property Owners Association (LBPOA) was formed in 1985, and one of its early initiatives was to start looking for help to fix the river. There was

little help offered by the federal agencies administering the Diversion project, but the State of Colorado through the CWCB was forthcoming with assistance. The science of river restoration was still in its infancy; however, the CWCB saw the need and provided grant funding to plan for and implement a river restoration Demonstration Project on the Lower Blanco River. A "Restoration and Fish Habitat Enhancement Plan" was prepared by Dave Rosgen in 1992, which provided a detailed analysis of the changed hydrologic and aquatic conditions in the river, and made specific recommendations on how to rehabilitate stream and aquatic functions within the limitations of a reduced hydrologic regime. Implementation of the restoration work began in 1993, and after monitoring the work for several years, a second phase of implementation was undertaken in 1996. Phases 1, 2, and 3 were complete by 2002 and had completed work on approximately 2.75 miles of the river. After a several-year hiatus where the LBPOA continued to seek funding for the project, implementation work began again in 2007. In the fall of 2007, a single private landowner near the bottom of the Lower Blanco valley funded restoration work on his 1.0-mile stretch of the river. Then in 2008-2009 the LBPOA completed another 3.25 miles of river restoration (Phases 4 and 5) with funding assistance from the NRCS, the Southwestern Water Conservation District (SWCD), and the San Juan Water Conservancy District (SJWCD). The final 2 miles of restoration were completed in the early fall of 2010 with funding provided from these same entities. With the completion of this final section (Phase 6), the Lower Blanco River, totaling nearly 10 miles, has been restored from the Highway 84 intersection to the confluence with the San Juan River.

What Can We Do?

STEP 3: Identify Measureable Outcomes

Due to flow alteration from upstream conversion, channel reconstruction and aquatic and riparian restoration are necessary.

Channel Reconfiguration was chosen as the right tool to restore poor aquatic habitat. The reconfigured channel maintains channel capacity for a 100-year flood event. It also helps maintain or improve domestic well levels.

Are The Attributes Secure?

Habitat, Water Quality, Flows

STEP 4: Categorize Scientific Needs

Habitat: Reconfiguration improved the natural stability of the channel, fish habitat, fish spawning locations, water quality, riparian/floodplain functions, and aesthetics.

STEP 5: Implementation Process

Planning/Assessment: A "Restoration and Fish Habitat Enhancement Plan" was prepared by Dave Rosgen in 1992, which provided a detailed analysis of the changed hydrologic and aquatic conditions in the river, and made specific recommendations on how to rehabilitate stream and aquatic functions within the limitations of a reduced hydrologic regime.

Design: Each phase of the project was designed as funding became available. Reconfigured channel length (Project Phase) was determined by the available funds. A detailed hydraulic water surface profile computer model (HEC-RAS 4.0) was developed for a representative reach of the project area. The model demonstrated that the reconfigured design would convey and contain the 100-year flood with no appreciable rise in flood elevation.

Permitting: A series of Nationwide #27 permits issued by U.S. Army Corps of Engineers (USACE) (likely this would require an individual 404 permit today)

- Floodplain Development Permit required by Archuleta County
- 401 Water Quality Permit required by Colorado Department of Public Health and Safety – Water Quality Control Division

Construction:
Phase I: Fall 1999, 1.1 miles, $227,500 Rock cost - $37 each
Funding sources = EPA 319 $96,000, CWCB $80,000, SWCD $10,000, SJWCD $10,000, LBPOA $30,000, Archuleta County $1,500

Phase II: Spring 2004, 2.2 miles, $387,000 3,900 rocks installed = 22 Cross Vanes, 29 J hooks, 41 Deflectors, 91 Habitat Rocks.
Funding sources = EPA 319 $250,000 CWCB $80,000, SWCD $25,000, SJWCD $20,000, LBPOA $12,000

Phase III: Summer 2008, 1.14 miles, $183,500 2,500 CY rock installed = 15 Cross Vanes, 17 J hooks, 6 Deflectors, 71 Habitat Rocks, 30 Sill Rocks.
Funding Sources = NRCS EQIP $95,000, CWCB $30,000, SWCD $25,000, SJWCD $20,000, LBPOA $12,000, Archuleta County $1,500

Phase IV: Fall 2009 – Spring 2010, 2.02 miles, $348,463 2,450 CY Rock Installed = 28 Cross Vanes, 3 J hooks, 11 Short Vanes, 34 Deflectors, 105 Habitat Rocks, 185 Sill Rocks
Funding Sources = NRCS EQIP $91,463, CWCB $132,000, Fish and Wildlife Resources Fund and Southwest Basin Roundtable $100,000, LBPOA $25,000

Phase V: Fall 2010, 1.93 miles, $255,000 2420 CY Rock Installed = 20 Cross Vanes, 5 J hooks, 10 Short Vanes, 35 Deflectors, 90 Habitat Rocks, 80 Sill Rocks
Funding Sources = NRCS EQIP $95,000, CWCB $150,000 WSRA Statewide Funds, SJWCD $10,000

Monitoring: Annual macro-invertebrate monitoring for 3 years as specified by USACE permit.

Typical Restored Section. Photo of newly constructed point bar with dense bank vegetation. Note the rock structure and deeper water river-left, creating good fish holding potential beneath the overhanging riparian vegetation.

Case Study: Parks and Wildlife Instream Flow Recommendation for an Increase in Flow for East Elk Creek

The State of Colorado's Instream Flow Program (ISFP) was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (See §37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire ISF and natural lake level water rights. In order to encourage other entities to participate in Colorado's ISF program, the statute directs the CWCB to request ISF recommendations from other state and federal agencies.

CPW has historically been one of the primary entities that submit ISF recommendations to the CWCB. CPW actively participates in the ISFP in order to meet Colorado's policy "… that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors … and that, to carry out such a program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" (See §33-1-101 (1) C.R.S.).

In keeping with this statutory mandate, CPW will frequently review past appropriations to determine their efficacy to preserve the natural environment to a reasonable degree. The science of determining ISFs is continuing to evolve. Current ISF science is indicating that older single flow year-round ISF recommendations are often inadequate to fully provide such preservation. In some cases, it has been determined that past recommendations are inadequate to fully provide such preservation. In such cases, CPW may recommend an increase in the previously decreed ISF amounts. If appropriated, these increases are decreed with a new junior appropriation date. The previous decree remains, and the increase is administered under its own priority.

STEP 1: Challenge/Problem Statement:

In 2008-2009, CPW recommended an increase on East Elk Creek due to the fact that it supports a naturally reproducing brook trout fishery, experiences heavy recreation use due to its proximity to Blue Mesa Reservoir, and because it runs through the Sapinero State Wildlife Area. Additional cross-section modeling and application of current guidelines indicated that the decreed summer flow amounts between April 1 and October 31 should be increased by 0.7 cfs.

STEP 2: Decision-Making Process

The decision-making process began with the recommending entity. In this case, CPW became concerned with the adequacy of the existing ISF when biologists noted that during the last drought cycle, flow rates on East Elk Creek became almost too low to support fish life. Without an increase in the existing appropriation, it was feared that new junior appropriators could divert water during drought periods for extended periods of time, which would leave the brook trout population susceptible to thermal stress. It was feared that inadequate protection could lead to the complete loss of the fishery on the stream over time. In addition, CPW noted that this area had been affected by overgrazing, which resulted in a BLM action to remove grazing on these lands so that the stream could meet riparian and fish management objectives. CPW believed that an ISF increase was justified because the stream provides a high recreational value to sportsman due to its proximity to Blue Mesa Reservoir and the Sapinero State Wildlife Area.

What Can We Do?

STEP 3: Identify Measureable Outcomes:

The objective was to ensure that East Elk Creek had sufficient flows appropriated under the state's Instream Flow and Natural Lake Level Program that would result in reasonable preservation of the natural environment. CPW worked through the ISFP to appropriate the required water rights because by statute only the CWCB can hold such water rights.

Attributes and Tools. To determine the adequacy of the existing decreed flow amounts, CPW and BLM biologists reviewed past R2Cross Modeling results and modeled two new cross-sections on East Elk Creek. After reviewing the results, it was determined that the decreed 1.5 cfs flow amount only met two of the three required hydraulic model criteria. Although average depth and wetted perimeter criteria were met in most riffle locations, average velocity through the riffle was inadequate. BLM and CPW biologists believe that the velocity criteria are critical for maintaining suitable stream temperatures and dissolved oxygen concentrations for salmonids.

Are The Attributes Secure?

Once CPW determined that an increase of the ISF on East Elk Creek was necessary, the agency's ISF coordinator formally brought the recommendation to the CWCB Stream and Lake Protection Staff at the CWCB's February 2008 ISF workshop.

Habitat, Water Quality, Flows

STEP 4: Categorize Scientific Needs.

CWCB Staff reviewed the findings and associated scientific data to assure that the recommendation met the CWCB's statutory requirement to 1) Determine whether there is a natural environment that can be preserved to a reasonable degree if the CWCB's water right is granted; 2) whether a natural environment will be preserved to a reasonable degree by the water available for the appropriation; and 3) whether such environment can exist without material injury to water rights. Once staff completed its review, it made its recommendation that the CWCB form its intent to appropriate an increase in ISF rights on East Elk Creek.

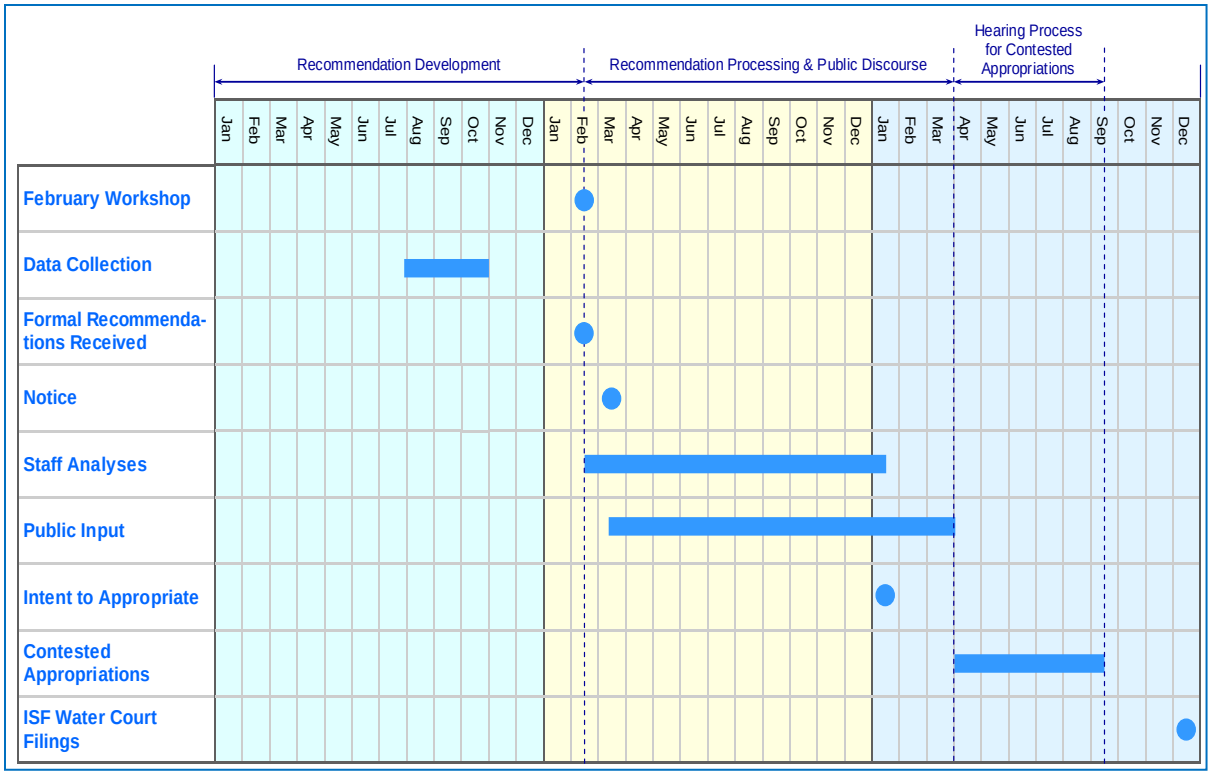
STEP 5: Implementation Process:

Implementation Plans

This process was initiated by CPW as part of their mandate to protect, preserve, enhance, and manage the state's wildlife resources. However, any person or entity may make an ISF recommendation to the CWCB. Such recommendations must be with specificity and in writing. Please refer to CWCB's Rules Concerning the Colorado Instream Flow and Natural Lake Level Program.

*Note that at times state and federal agencies may cooperate with one another and/or other stakeholders in making an ISF recommendation.

The timeline below provides an overview of how the appropriation process unfolds from data collection through water court filing.



Operations. Once appropriated, CWCB will legally protect its decreed water rights in water court by thoroughly reviewing the monthly water court resumes and filing statements of opposition to applications that have the potential to injure its rights. In addition, CWCB will monitor and place calls for its water rights as against out-of-priority diversions. However, in many cases there are no gaging stations on an ISF reach that can be used for administrative purposes. In these cases CWCB relies on the recommending entities, Division of Water Resources water commissioners, and other stakeholders to alert CWCB staff to low flow concerns. If it is determined that a gage would result in administration of the CWCB's rights, staff will consider installing an appropriated measuring device depending on funding availability and other factors.

Case Study: Upper Gunnison River Water Conservancy District Recreational In-Channel Diversion and the Gunnison Whitewater Park

STEP 1: Challenge/Problem Statement

"...to protect [Gunnison's recreational] water resource that is so valuable to [the Gunnison] community, both as a recreational amenity and an important source of revenue" - Robert Drexel, president of the Upper Gunnison River Water Conservancy District (UGRWCD), UGRWCD press release dated December 22, 2005.

STEP 2: Decision-Making Process

The decision-making process created to obtain a RICD water right for the Gunnison Whitewater Park was undertaken by UGRWCD and included discussions and authorization in public meetings and also negotiation and execution of an Intergovernmental Agreement between Gunnison County and UGRWCD. Other stakeholders that participated in the creation of the Gunnison Whitewater Park included the City of Gunnison, Western State College's Todd Crane Center for Outdoor Leadership, Colorado Division of Wildlife, El Pomar Foundation, Gunnison County Metropolitan Recreation District, local boaters, outfitters, and engineers. Also, the CWCB, the State and Division Engineers for Water Division No. 4, and the UGRWCD entered into an agreement resolving their opposition to UGRWCD's RICD water right for the whitewater park.

It is important to note that the decision-making environment is slightly different today than it was when the UGRWCD obtained a RICD for its whitewater park. The RICD statute was amended in 2006 to provide additional guidance to the CWCB and the water courts when they are conducting their reviews of RICD applications and proposed decrees.

*Note that only a county, municipality, city and county water district, water and sanitation district, water conservation district, or water conservancy district may file a water right application for a RICD.

STEP 3: Identify Measureable Outcomes

The purposes of the UGRWCD RICD was to protect water supplies for recreational purposes, improve the recreational experience that existed within a certain reach by modifying the river channel, to ensure protection of Gunnison County's investments in the course, and to ensure that the purpose and function of the Gunnison Whitewater Park can be maintained in the future, notwithstanding development of other water rights on the Gunnison River.

STEP 4: Categorize Scientific Needs

The primary goals for the whitewater park are to provide beginners and novices a course to practice their skills on moving water, during low flows; and at higher flows, a course that may be used for slalom events, play boating, cart wheeling, whitewater rodeos, etc.

STEP 5: Implementation Process

Implementation Plans

Fundraising for the project included t-shirt sales and contributions from the following entities:

- Gunnison County
- City of Gunnison
- Todd Crane Center for Outdoor Leadership
- Colorado Division of Wildlife Education
- The Gunnison County Metropolitan Recreation District Grant
- The City of Gunnison Challenge Grant
- Western State College's Gunnison Whitewater Park Development Class
- El Pomar Grant/GHS
- Upper Gunnison River Water Conservancy District

Additionally, Western State College's Recreation Department and the Todd Crane Center for Outdoor Leadership both played a major role in the design and development of the park by hosting a special topics class in spring 2003. The class oversaw the planning and development of many of the park's amenities such as the bathrooms, changing rooms, rules and regulations, nature trails, and message board.

Although the Gunnison Whitewater Park stakeholders did not seek funds from the CWCB, current CWCB funding sources that may be available for the design and construction of a whitewater park include:

- Construction Fund Non-Reimbursable Project Investment Grant Program
- Severance Tax Trust Fund Operational Account Grant Program
- WSRA Grant Program

The design of the whitewater course was performed by Recreational Engineering and Planning through Gunnison County. Construction was completed in 2002 and the final course contains six water features including river-wide U structures and offset double deflectors. The primary materials used in construction were grouted boulders. Construction costs were approximately $200,000. USACE regional general and nationwide permits were obtained for construction and subsequent maintenance activities.

Also in 2002, the UGRWCD filed for the RICD water right in water court and participated in a hearing before the CWCB. Note that since that time, the CWCB's process has changed and RICD applicants now participate in a public deliberation in front of the board. Cost for the RICD water right and legal fees were approximately $475,000. The decree for the RICD was issued in 2006 and was made absolute in 2012.

Operations. The Gunnison Whitewater Park has provided recreational boating experiences for many boating enthusiasts since 2002 and has been host to the Annual Gunnison River Festival and the 2010 USA Freestyle Kayaking Point Series.

The RICD court decree requires that the RICD be able to be adequately measured and administered by using the USGS Gunnison River gage at Gunnison and account for intervening diversions between that gage and the whitewater course.

Maintenance is performed by the county and operation of the RICD water right is performed by UGRWCD.

The UGRWCD RICD is a tool that can be utilized to protect the nonconsumptive needs of this major recreational segment of the Gunnison River. Currently the UCRWCD is perfecting the right.

Construction photos


Photos of completed project


References:

- McLaughlin Whitewater Design Group (July 2010). Whitewater Course Evaluation, Selected Venues in the State of Colorado.
- http://www.ugrwcd.org (December 19, 2011).
- http://gunnisoncounty.org/whitewaterpark (December 19, 2011).
- Decree and Findings of Fact for Division 5 Case No. 02CW038 (dated January 12, 2006).

Case Study: Upper Colorado River Wild & Scenic Stakeholder Group's Management Plan Alternative

STEP 1: Challenge/Problem Statement

As part of their resource management plan revision process, the BLM and USFS identified four reaches of the Colorado River as potentially suitable for Wild & Scenic River designation. Numerous stakeholders did not want these reaches deemed suitable and wanted to find an alternative way to protect the ORVs identified by the federal agencies such as recreational fishing and wildlife. Other stakeholders were in favor of deeming the reaches suitable, but were willing to work to find a way to provide the same or a greater level of protection for the ORVs using a different approach. The agreed upon goal was to develop a management plan alternative that the BLM and USFS could adopt in lieu of a finding of suitability.

STEP 2: Decision-Making Process

The stakeholders formed the Upper Colorado River Wild & Scenic SG, comprised of representatives of East and West Slope local governments and water providers, recreational interests, conservation groups, water users, and landowners. Representatives of state and federal agencies participated in SG discussions and helped develop the Upper Colorado River Wild & Scenic Stakeholder Group Management Plan (SG Plan). The plan's primary focus is on stream-influenced ORVs, including wildlife, botanical, scenic, recreational floatboating, and recreational fishing. The timing for submittal of the plan was dictated by the BLM/USFS NEPA process for the resource management plan revisions.

Assembling Stakeholder Group: Participation in the SG was open to all stakeholders, with the main constraint being the ability to spend the time required to work on the plan. Because of the complexity and number of issues that needed to be addressed, the SG contracted with a facilitator to assist the SG with reaching consensus and producing the necessary documents.

Issue Clarification / Contributing Factors: The SG members spent a significant amount of time working through their divergent interests to formulate a mutually acceptable goal for the SG Plan, which is "to balance permanent protection of the ORVs, certainty for the stakeholders, water project yield, and flexibility for water users." The SG Plan aims to protect all ORVs with a focus on recreational fishing and recreational floatboating.

STEP 3: Identify Measureable Outcomes

To develop a SG Plan that would: 1) be acceptable to the BLM/USFS and the public (via the NEPA process) as an alternative to a finding of suitability for the subject reaches of the Colorado River; and 2) result in a neutral deferral of a finding of suitability for those reaches. The intent of the SG Plan is to balance permanent protection of the ORVs, certainty for the stakeholders, water project yield, and flexibility for water users.

Choosing the right tool(s) to address the challenge: The SG Plan uses two distinct tools—"ORV Indicators" (characterizing the range and quality of the ORVs), which will be used to gage whether the ORVs are being protected; and "Resource Guides" (reflecting ranges for factors such as flow, temperature, and water quality).

Long-Term Protection Measures and Voluntary Cooperative Measures in the SG Plan—cooperative voluntary efforts of interested water users, local governments, and other entities to protect (and perhaps enhance) the ORVs in ways that coordinate with federal agency management. Such measures may include, but are not limited to:

- ISF water rights on the subject reaches of the Colorado River. Appropriation of new ISF water rights will protect base flows and preserve the natural environment on the Colorado River to a reasonable degree. This measure was chosen because it provides permanent protection under decreed water rights.
- Delivery of water to senior water demands downstream of the subject Colorado River reaches, and water deliveries to the 15-Mile Reach in the Grand Valley pursuant to the Upper Colorado River Endangered Fish Recovery Program. These measures were chosen because, while they do not guarantee permanent protection, they are expected to result in ongoing protection of the ORVs, absent a material change in circumstances.
- Acquisitions of water for ISF use to preserve or improve the natural environment (potentially protect higher flows than the appropriated base flows).
- Coordinated timing/scheduling of late summer and early fall reservoir releases to meet annual reservoir target elevations that can help satisfy late season flow demands.
- Storage and subsequent release of historical consumptive use and return flows.
- Use of Windy Gap System: Depending on the hydrology, operations, agreements, and other circumstances, Northern's Municipal Subdistrict may be able to allow the use of excess capacity in the Windy Gap system for the diversion and storage of water for the benefit of the ORVs.
- Spring peak enhancement: Spring flushing flows could be enhanced through the coordinated bypass of reservoir inflow during the spring runoff.
- Cooperative flow management: Voluntary flow management programs can be used as a water management tool.

STEP 4: Categorize Scientific Needs

To protect the ORVs, the SG Plan will use identified Long-Term Protection Measures and voluntary Cooperative Measures of the Stakeholder Group. Examples of the protective measures include the appropriation of CWCB ISF water rights, delivery of water to senior water demands downstream of the subject Colorado River reaches, and water deliveries to the 15-Mile Reach in the Grand Valley pursuant to the Upper Colorado River Endangered Fish Recovery Program. These measures will be used for maintaining and enhancing flow-related values within a given stream reach, while meeting downstream demands such as those for the endangered fish species, through the collaborative operation of water facilities and other cooperative efforts. The appropriation of ISF water rights is a

measure that specifically addresses the recreational fishing and wildlife ORVs. The attributes addressed by the ISF water rights are brown trout, rainbow trout, and mountain whitefish, which constitute the basis for the recreational fishing ORV, and flannelmouth sucker, bluehead sucker, roundtail chub, and river otter and bald eagle habitat.

STEP 5: Implementation Process

Implementation Plans

With exception of the ISF water rights appropriation, the SG Plan's long-term protection measures are already in place. Implementation of the SG Plan's cooperative measures will be done under the relevant entity's specific authority and will be addressed on a case by case basis. Using the ISF water rights appropriation as an example, the following illustrates implementation of the SG Plan. As indicated by the plan, the SG provided a written recommendation to the CWCB for the appropriations under the CWCB's ISF Rules.

Planning/Assessment: As part of developing the ISF recommendation, the SG retained Miller Ecological Consultants to provide additional biological information to the SG regarding the habitat needs of certain fish species within the proposed ISF reaches on the Colorado River. The resulting report, dated February 18, 2011, is titled "Instream Flow Report for the Colorado River from Kremmling downstream to Dotsero, Colorado." CPW performed an independent analysis and submitted its own ISF recommendation to the CWCB on June 30, 2011. The SG also conducted a water availability analysis with guidance from CWCB staff. The CWCB applied to water court for these ISF water rights on November 30, 2011.

Design: N/A.

Permitting: No permitting process required for the SG Plan.

Construction: N/A.

Monitoring: The SG Plan includes a Monitoring Plan as well as requirements for periodic reporting to BLM and the USFS. The SG Plan also includes provisions addressing governance, representation, decision-making, funding, and agency coordination.

NOTE: This summary only touches upon the basic elements of the SG Plan. For more details, go here.

Case Study: Donation by Colorado Water Trust of Peabody Ditch Water Rights to Colorado Water Conservation Board for Instream Flow Use

STEP 1: Challenge/Problem Statement:

The Colorado Water Trust (CWT) entered into an option agreement to purchase the Peabody Ditch water rights (Peabody rights), with the intent of donating the water rights to the CWCB for ISF use to preserve and improve the natural environment on Boulder Creek and the Blue River in Summit County. Adding the Peabody rights to the CWCB's ISF water rights portfolio would benefit the trout fishery on Boulder Creek and the Gold Medal rainbow and brown trout fishery on the subject reach of the Blue River, making those environmental attributes more secure.

STEP 2: Decision-Making Process:

The CWT began working with the CWCB staff to develop the information needed to bring the proposed water right donation to the CWCB. The CWCB's process for evaluating and accepting offers of water for ISF use is governed by Rule 6 of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program (ISF Rules), which can be found here. While the example addressed in this document was a donation of a water right to the CWCB, the CWCB also can acquire water rights by purchase, lease, or other contractual arrangement. This document uses the term "acquisition" to refer generally to all of these mechanisms. After the CWCB accepts a water right for inclusion in the ISF Program, the CWCB must apply to water court to obtain a decreed right to use the water for ISF purposes.

CWCB Process: Under ISF Rule 6, the CWCB must consider the following factors when considering a proposed water acquisition:

- Reach of stream where acquired water will be used
- Historical use and return flows
- Location of other water rights on reach
- Potential for material injury to existing decreed water rights
- Natural environment that may be preserved or improved by proposed acquisition
- Effect of proposed acquisition on:
  - Interstate compact issues
  - Maximum utilization of waters of state
- Whether the water will be available for subsequent use downstream
- Water administration issues, if any
- Cost to complete the transaction or other associated costs

Acquisition Agreement: Every water acquisition requires a written agreement between the CWCB and the donor, seller, or lessor of the water right. The agreement:

- Is developed cooperatively with water right owner
- Outlines the terms and conditions of the conveyance
- Can address:
  - Water court responsibilities
  - Stream flow monitoring
  - Protection and enforcement of the conveyed right
  - Special terms requested by the owner, such as drought reservations

Water Court Process: The water court process for changing the use of a donated water right to ISF use is the standard process used for other types of water rights changes. The applicant must provide information on historical consumptive use and return flows and the proposed new use of the water right. Also, terms and conditions to prevent injury to other water rights on the subject stream must be included in the resulting water court decree.

Studies/Reliance on Expert Opinion: To evaluate a water right offered to it for ISF use, CWCB reviews technical and legal analyses, including a historical consumptive use analysis, and for water rights purchases or leases, research into the validity of title to the water right and an appraisal of the water right. These analyses must be performed by professionals in the field of analysis.

What Can We Do?

STEP 3: Identify Measureable Outcomes:

Because the CWCB is the only entity in the state that can hold ISF water rights, the CWT chose the ISF Program as the tool best suited to protecting water under the Peabody rights throughout the ISF reaches on Boulder Creek and the Blue River, and thereby protecting the environmental attributes present in those reaches. Merely leaving that water in the stream most likely would result in it being diverted by the next water user on the stream and would fail to achieve the desired protection of the natural environment and environmental attributes on Boulder Creek and the Blue River.

Are The Attributes Secure?

Habitat, Water Quality, Flows

STEP 4: Categorize Scientific Needs:

Environmental Flows.

STEP 5: Implementation Process:

In preparation for submitting the proposed donation of the Peabody rights to the CWCB, the CWT had a preliminary historic consumptive use analysis of the Peabody rights performed. That analysis was necessary to inform the CWCB of the projected yield of the Peabody rights that would be available for ISF use.

Implementation Plans

Monitoring: The final result of this project is a water court decree authorizing the CWCB to use the changed Peabody rights to preserve and improve the natural environment to a reasonable degree. Project monitoring consists of monitoring existing stream gages to ensure protection and enforcement of the changed rights.

Photo: Boulder Creek above confluence with Blue River

Case Study: Haren Recharge Wetland Development

As intense competition for water resources between municipal, industrial, and agricultural demands continues to escalate along the South Platte River in southern Weld County, the amount of high-quality wetland habitat for waterfowl and shorebirds in the area has diminished. Further, recent water transfers and dry-up of agricultural lands has continued to hasten wetland loss. Additionally, Colorado has a commitment to deliver water down the South Platte during critical times of the year. Wetlands that recharge groundwater that flows into the South Platte have proven to be an effective tool for increasing flows during critical times. Such recharge projects are multi-purpose in nature, and have helped multiple federal, state, regional, and private organizations realize water development, wildlife, and conservation goals.

STEP 1: Challenge/Problem Statement

Diversion of water for municipal and industrial use from agricultural lands along with changes in irrigation practices has reduced the number and area of high-quality wetlands along the South Platte River in Weld County. These wetlands are essential for meeting conservation goals for the region. Ducks Unlimited proposed to construct wetlands to partially reverse this trend while also helping to meet the need to re-time flows in the South Platte River. Attributes addressed: Waterfowl, Shorebirds, Hunting, and Birding opportunities.

STEP 2: Decision-Making Process

Analysis of long-term trends in the region indicated that habitat amount and habitat quality have declined in recent decades. Constructing wetland habitat will at least partially counteract this decline.

Ducks Unlimited (DU) proposed to construct 60 acres of wetlands that would provide high-quality, shallow wetland habitat, designed and located to include important groundwater recharge function.

STEP 3: Identify Measureable Outcomes

The Haren Wetland Development is a large-scale wetland recharge project located near the South Platte River in southern Weld County. Approximately 50 acres of recharge wetlands were created on dried up agricultural land to generate recharge credit and provide waterfowl habitat. Recharge basins were created by constructing contour terraces in portions of the property served by water delivery from the Western Ditch. Measurable outcomes include both total number acres of wetlands and amount of water applied to those wetlands.

STEP 4: Categorize Scientific Needs

Habitat: The project was designed to benefit migrating waterfowl and other wetland-dependent waterbirds. The project is adjacent to Chestnut Slough, a regionally important wintering roost area for ducks, geese, and other wildlife species. The site sits immediately adjacent to and above Chestnut Slough. Recharge from the wetland development will positively impact water regimes in Chestnut Slough, increasing its utility to wintering birds. The shallow-water basins provide these birds with roosting cover during critical periods of their trans-continental journey, but, more importantly, they provide food resources in a manner designed to maximize foraging efficiency. This is important to send these birds to their breeding grounds on the northern prairies in the best body condition possible, thus ensuring the highest productivity (i.e., clutch size, brood survival, and returning fall flights).

STEP 5: Implementation Process

Propose project, assemble partners, and secure funding: DU worked with United Water and Sanitation District (UWSD) and a private landowner (Mr. Haren) to develop this project. Funding was secured from the CWCB and the North American Wetlands Conservation Act.

Implementation Plans

Project survey and design: DU conducted a survey of the project area and developed a topographic map with 6-inch contours in order to estimate microtopography and landfall in the project area. DU's engineers worked with UWSD and Mr. Haren to develop a detailed project design, including schematics of wetland impoundments, water level control structures, water delivery infrastructure, and the proper placement of diversions and ditches.

Diversion structure and water delivery: DU, in association with UWSD, constructed a high-capacity headgate capable of diverting at least 40 cfs of ditch flow into the recharge wetland on the Haren site. This high-capacity water diversion provides rapid water delivery into recharge wetlands.

Recharge wetland construction: DU in association with UWSD and Mr. Haren oversaw construction of all land and water improvements necessary to flood multiple recharge wetlands on the Haren property, totaling 50 acres of new wetlands. The construction included embankments, running feeder ditches to new recharge wetlands and the installation of appropriate water measurement devices.

Case Study: South Platte River Master Plan – River Vision Implementation Plan

The Greenway Foundation's River Vision Implementation Plan (RVIP) for the South Platte River emerged from the integration and prioritization of projects identified in the River South Master Plan (RISO) and the River North Master Plan (RINO). RVIP builds on the collaborative and focused effort between private and public partners over the past 35 years which has created the South Platte River Greenway, as well as the implementation of environmental and recreational improvements along the River's numerous tributaries. Historically, this partnership has resulted in collective investments of more than $80 million from public and private entities which have sparked more than $5 billion in economic resurgence throughout the 10.5 miles of riverfront in Denver -- 3.5 miles in the RINO Corridor and 7 miles in the RISO Corridor.

STEP 1: Challenge/Problem Statement

The stretch of the South Platte River described by RVIP is a fully developed watershed. Urbanization and development to the river's edge have channelized the South Platte River through Denver. The engineered channel has a relatively consistent geometry (flat bottom with steep side slopes) that provides little variation in flow depth and velocity and does not provide adequate habitat for wildlife within the river. Invasive species dominate the vegetation along the river, blocking views and access.

The focus of RVIP has been to take all of the recommendations from the RINO and RISO Plans and compile them into a priority based set of recommendations focused on their ability to be implemented. The overall goal of RVIP is to return the river to riparian conditions to the extent possible, provide access to the river, improve aquatic and riparian habitat, and to provide educations opportunities to inform the public about the river.

STEP 2: Decision Making Process

The Greenway Foundation and the City and County of Denver Parks and Recreation Department (DPR), recognizing the need for a renewed vision for the South Platte River, partnered in March 2008 to develop the RINO Greenway Master Plan. The purpose of this plan was to build upon the greenway improvements initiated in the 1970s and identify opportunities to renew a future vision for the South Platte River Greenway. The River North Greenway Master Plan was completed in March 2009, focusing on the three and one-half miles of the South Platte River within the RINO Corridor. The Greenway Foundation and DPR, with the additional support and engagement of the CWCB, the Urban Drainage and Flood Control District (UDFCD), Denver Public Works (DPW) and Denver Water (DW), initiated a collaboration to create the River South Greenway Master Plan in April 2009. The River South Greenway Master Plan establishes a new, contemporary vision for the remaining reach of the river. The plan also recommends guidelines for parks; recreational, environmental, and flood control enhancements; expanded public open space; aesthetic enhancements; and improved water quality within the river's channel.

Projects were categorized and organized based on implementation timeframes and degree of intervention.

What Can We Do?

RVIP organized their projects into three categories. Short-Term/Priority projects are those identified to be completed in the next 5 years. Mid-Term projects will be completed within 6 to 15 years. Long-Term projects will be implemented in 16 or more years.

STEP 3: Identify Measureable Outcomes

The current Short-Term/Priority projects encompass five project areas along the South Platte: Grant Frontier and Overland Regional Park (Southern Platte Valley); Vanderbilt and Johnson-Habitat Parks; Sun Valley Riverfront Park; Confluence Park; and a proposed Art Bridge (Northern Urban Greenway Corridor). Within those five projects, nearly 50 recommendations from residents, property owners, involved government agencies, and neighborhoods have been compiled.

Most of the riverine corridor in the project area includes a very narrow riparian zone, typically less than 50 feet wide along each bank. Herbaceous and woody species—listed on the Colorado noxious, invasive, or exotic pest plant/weed list—are common within the riparian corridor. In addition to state and city recommendations and actions to remove these species from natural areas, this type of vegetation decreases ecosystem biodiversity and can block views of and access to the river. The primary goals of the prioritized RVIP projects are to promote ecosystem restoration and enhance the recreational value of the river corridor through Denver. Project elements include re-grading river banks, where feasible, to re-establish riparian floodplains; implementation of in-channel recreation and habitat improvements by modifying existing grade control structures and providing additional in-channel structures to achieve variation in flow depth and velocity suitable for target fish species; removal of non-native and invasive vegetation and re-establishment of native vegetation; and promoting connectivity with the river through improved regional trails and river edge access.

STEP 4: Categorize Scientific Needs

Habitat, Water Quality, Flows

Habitat: There are multiple types of projects represented in RVIP, including Grant Frontier Park, which is improving river accessing, creating riparian/wetland/riverbank enhancements, eliminating non-native and invasive vegetation, planting native vegetation, and incorporating multi-

objective recreation and habitat improvement structures within the banks of the river; Vanderbilt/Johnson-Habitat Park improvements will create an environmental education hub for urban children, families, and outdoor enthusiasts and will include an outdoor classroom, fire ring overlook plaza, tent pads, river access improvements, and removal of non-native and invasive vegetation; and the Central Greenway Corridor improvements, which is focused on regional pedestrian trail improvements.

Implementation Plans

STEP 5: Implementation Process

Three of the five RVIP priority projects are being designed and will be constructed by June 2015 as part of the South Platte River Vision Program. The River Vision Program is a $15 million recreation and habitat improvement program along the South Platte River from approximately Evans Avenue to Alameda Avenue. This program is being funded by a public/private partnership with the City and County of Denver ($5.4 million), UDFCD ($1.7 million), Great Outdoors Colorado ($4.6 million), the CWCB ($750,000), the Shattuck and Rocky Mountain Arsenal Natural Resource Damage Settlement Funds ($2.7 million), the EPA ($190,000), CPW ($80,000), and other private donors ($90,000).

The city and other stakeholders are implementing the priority RVIP projects as a single program to provide both schedule and financial benefits. For instance, construction cost efficiencies can be realized by using the same contractor under a single contract. The program elements will be sequenced to facilitate construction early and the work can be accomplished within the next 2 years. In addition to benefits associated with improved river access, removal of non-native and invasive vegetation, enhanced riparian floodplains, the aquatic and riparian corridor improvements in this reach of the river result in a longer continuous reach of high quality native species habitat in a reach of the river that has suffered urban impacts for many generations.

Design milestones include production of 30-, 60-, 90-, and 100-percent design drawings; the project team has submitted the 30 percent and 60 percent designs and is currently working on the 90 percent design. The city is in the process of selecting a Construction Manager/General Contractor to perform pre-construction services (scheduling, cost estimating, and constructability reviews), and ultimately manage construction of the proposed improvements. The Notice to Proceed for pre-construction services will occur after completion of 60 percent design. The Guaranteed Maximum Price (GMP) will be negotiated after completion of 90 percent design drawings, and the Notice to Proceed for construction services will begin after the design drawings are complete.

Appendix G

Existing Programs

Appendix G

Existing Programs

The following table highlights several existing programs and policies that can serve as resources for stakeholders planning a nonconsumptive project. Examples in the table are divided into three main categories:

- Instream flows for environmental and recreational purposes
- Habitat protection, restoration, and enhancement
- Planning, administrative, and regulatory programs

These projects and methods can serve as a useful resource and provide precedent for practitioners designing a project or developing an implementation plan.

Table G-1. Possible Projects and Methods for Meeting Nonconsumptive Needs in Colorado

Method	Cost	Process/Contact	Examples of Implementation
INSTREAM FLOWS			
New ISF and Natural Lake Level Appropriations: CWCB authorized by §37-92-102 (3) to appropriate ISF water rights for in-channel use and natural lake level water rights to preserve the natural environment to a reasonable degree.	• Site-specific data collection by scientists required for identification of natural environment and quantification of flows. • Coordination with CWCB and CPW staff may reduce costs. • $5000 for R2Cross in small streams; $50,000 to $75,000 for River2D in rivers.	• Anyone can recommend ISF appropriation. • One-year notice and comment process after supporting scientific data is compiled. • See CWCB Rules Concerning the Colorado Instream Flow and Natural Lake Level Program (ISF Rules).	• Since 1973, 1,500+ water rights appropriated covering over 9,000 miles of stream and 400+ lakes. • 15 Mile Reach of Colorado River. • Dominguez Canyon Wilderness Area ISFs (pending). • Colorado River ISFs as alternative to Wild and Scenic (pending).
ISF Acquisitions: CWCB authorized by §37-92-102 (3) to acquire existing water rights for ISF use to preserve or improve the natural environment to a reasonable degree.	• Historic consumptive use analysis of senior water rights can be expensive. • Limited funding available for purchases and leases of water. • Usually involves water court process.	• Proposed ISF acquisitions evaluated by CWCB staff to determine potential to benefit environmental attributes. • Two-meeting Board approval process. • See ISF Rule 6. • Water court process.	• Donation by City of Boulder of water rights on Boulder Creek. • Colorado Water Trust donation of water rights on Boulder Creek/Blue River. • Purchase of irrigation right to re-water Washington Gulch and supplement Slate River flows.
Temporary transfer of water rights to instream flows: Under certain circumstances, a water user can temporarily loan an agricultural water right to the Board without the need for water court approval (see 37-83-105(2) C.R.S.)	• $35-$500 or more per acre-foot leased, depending on source and location.	• Contact Colorado Water Trust or CWCB ISF Program.	• Colorado Water Trust ISF lease on the Yampa River. • Colorado Parks and Wildlife loan of released water from Lake Avery.
Alternative Agricultural Water Transfer Mechanism: CWCB is funding projects that explore untested mechanisms for environmental interests to work with irrigators.	• $100,000 or more, depending on the complexity of the legal and technical analyses.	• Contact CWCB.	• Lake Canal / ReGenesis / The Nature Conservancy pilot on the Cache la Poudre.

Table G-1. Possible Projects and Methods for Meeting Nonconsumptive Needs in Colorado

Method	Cost	Process/Contact	Examples of Implementation
Transfer or maintenance of consumptive water rights for wetland and ISF purposes: Transfer or maintenance of senior consumptive water rights can contribute to maintenance of wetland and instream habitats.	• Costs range broadly depending on mechanism for protection.	• Work with private water rights holders as appropriate.	• Most conservation easements in Colorado perpetually tie water rights to the eased property.
RICDs: Local governmental entities can appropriate water associated with in-channel structures to protect it in the channel for the minimum stream flow needed for a reasonable recreation experience.	• Costs for building a structure can be $100,000 or more. Appropriating the water right requires staff and attorney fees.	• For more information see http://cwcb.state.co.us/environment/recreational-in-channel-diversions/Pages/main.aspx.	• Salida – Arkansas River. • Town of Avon. • City of Longmont. • City of Steamboat Springs.
Re-timing of flows through wetland recharge projects	• Low $10s of thousands for wetland enhancement or creation without property acquisition; up to $1M or more if properties must be eased or acquired.	• Contact Ducks Unlimited.	• Tamarack Project. • Ovid Project.
Infrastructure improvements as a means to improved flows	• Small diversions: $10s of thousands. • Medium diversions: $100-$200k. • Large diversions $500k-$1M+.		
Reservoir Reoperation	• $50M/dam >20MAF. • $20M/dam 3-5MAF. • $10/AF for <2MAF.	• Depends heavily on who owns and operates reservoir.	• Flaming Gorge (through Recovery Program). • Arkansas River.
Voluntary Flow Agreements & Policy Mechanisms for Long-term Security	• Costs are largely staff resources.	• Depends heavily on who owns and operates water rights.	• East Slope and West Slope interests' agreement to maintain senior rights associated with the Shoshone Power Plant, even if plant is not calling for all of its water right.

Table G-1. Possible Projects and Methods for Meeting Nonconsumptive Needs in Colorado

Method	Cost	Process/Contact	Examples of Implementation
PROTECTION, RESTORATION, ENHANCEMENT			
Channel Restoration & Instream Habitat Improvements: Used to restore aquatic habitat such as pools for trout.	• $100,000 to $1,000,000+, depending on length of stream or river being worked on.	• Contact CWCB Watershed Restoration Program or Colorado Watershed Assembly.	• Cache Creek – Arkansas River. • Rio Blanco.
Conservation Easement: Voluntary agreements that preclude certain uses of land such as subdivision for development.	• Often $150-$500 per acre, but highly dependent on locations. Can be partially or fully donated with state and federal tax benefits.	• Contact local land trust, statewide land trust (The Nature Conservancy, Colorado Open Lands, Trust for Public Land), or Land Trust Alliance.	• Rio Oxbow, and multiple other examples on the Rio Grande.
Fencing of riparian areas or for grazing management: A tool for enhancing riparian habitat.	• $1.20 per foot for permanent fencing. $2500 for stock tank.	• Contact Colorado Parks and Wildlife Wetlands Program.	• Brett Grey Ranch (Steele's Fork).
Culvert replacement: Re-establishes connectivity of fish habitat.	• $10k to $100s of thousands, depending on the fix and the road; typically $60,000 or more.	• Contact Colorado Parks and Wildlife or Trout Unlimited.	• Culvert replacement /retrofit for cutthroat connectivity on the Routt NF.
Building barriers to fish passage: inhibits movement of undesirable species into high-priority habitats, especially for cutthroat trout.	• $5,000 to $100s of thousands or more, depending on stream size, materials, and accessibility.	• Contact Colorado Parks and Wildlife or Trout Unlimited.	• Barriers constructed on and adjacent to the Routt NF.
Diversion structure reconstruction or enhancements: Improves fish passage, boater safety, and diversion efficiency.	• $20,000 for small structures; $250,000 for medium and large structures (CCC Ditch); $750,000 to $2M for very large structures (Relief Ditch; Hartland Dam).	• Contact structure owner.	• Hartland Dam. • CCC Ditch. • Relief Ditch.
Riparian Habitat Restoration: Improves streamside habitat.	• $500-$1500 per acre (average of approximately $1200 per acre in tamarisk/Russian olive projects.	• This work is typically done through partnership with watershed group, federal agency, or weed association.	• San Miguel River.

Table G-1. Possible Projects and Methods for Meeting Nonconsumptive Needs in Colorado

Method	Cost	Process/Contact	Examples of Implementation
Wetland restoration: Provides habitat to waterfowl, shorebirds, and amphibians.	• $50,000 per site, including contractors and materials.	• CPW Wetlands Program (http://wildlife.state.co.us/LandWater/WetlandsProgram/Pages/WetlandsHome.aspx) or local Wetland Focus Areas committee are good first points of contact.	• Multiple projects in North Park, lower South Platte, and San Luis Valley led by Ducks Unlimited and/or Colorado Parks and Wildlife.
Watershed Restoration Planning: Typically a comprehensive plan for restoration across an entire watershed.	• Costs are staff. An initial plan can be done for $50-100,000, but costs can reach $250,000 or higher.	• Colorado Watershed Assembly. http://www.coloradowater.org/Watershed%20Planning.	• Roaring Fork Conservancy.
PLANNING, ADMINISTRATIVE, REGULATORY			
Local Land Use Regulations: Riparian /wetland setbacks.	• Costs are mostly staff of regulating entity, but could include consulting costs of $10,000-$50,000.	• Contact city or county land use planning office.	• San Miguel County. • Boulder City. • Larimer County.
Range Management of riparian areas, or upland habitat for bank stability, habitat, and water quality on both private and public land.	• Costs are usually staff for planning process, but may include fencing and watering locations.	• For federal lands, check planning processes and ways to engage.	• BLM grazing management plans on the Dolores River.
National Environmental Policy Act reviews. Includes Environmental Assessments or Environmental Impact Statements.	• Engagement is often volunteer, but also includes staff time for nonprofits.	• Contact lead agency overseeing the NEPA process (e.g., USACE; Bureau of Reclamation).	• All major proposals: Moffat firming, NISP, Halligan-Seaman, Windy Gap.
Wild and Scenic processes provide protections for environmental, recreational, and scenic values on rivers.	• Costs are almost entirely staff, but developing "alternatives" to Wild & Scenic may cost $100,000 or more for supporting studies and up to $100,000 for facilitation.	• Contact appropriate federal planning agency (i.e. BLM, USFS, etc.) or create an alternative public planning processes.	• River Protection Workgroup. • Cache la Poudre is only river designated Wild & Scenic in Colorado. • Upper Colorado River Wild and Scenic Stakeholder Group Management Plan Alternative.

Table G-1. Possible Projects and Methods for Meeting Nonconsumptive Needs in Colorado

Method	Cost	Process/Contact	Examples of Implementation
Salinity Control Program improves irrigation infrastructure to maintain crop production while reducing total diversions and salt-laden return flows.	• Variable depending on type and size of project. For guidance, contact: Steve Miller Colorado Water Conservation Board steve.miller@state.co.us	• Contact US Bureau of Reclamation. http://www.usbr.gov/uc/progact/salinity/index.html.	• Uncompahgre Valley.
CPW Management Plan Implementation	• Costs vary depending on action being taken. Implementation of plans can employ a variety of other mechanisms listed in this table.	• Wildlife.state.co.us.	• Arkansas darter.
Endangered Species Recovery Programs	• Costs and funding (~$15M per year in Upper Colorado River Basin) are appropriated through Congress.	These programs have established composition, structure, work plans, etc. See websites for more info: http://www.coloradoriverrecovery.org http://www.fws.gov/southwest/sjrip/ https://www.platteriverprogram.org/Pages/Default.aspx	• Upper Colorado River Endangered Fish Recovery Program. • San Juan River Basin Recovery Implementation Program. • Platte River Recovery Implementation Program.