North Platte
Basin Implementation Plan

Prepared for:

The North Platte Basin Roundtable

For submittal to

The Colorado Water Conservation Board

April 17, 2015

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Objectives

This report is designed to follow the framework of the Basin Implementation Plan Guidance (December 10, 2013) provided by the Colorado Water Conservation Board. Application of the guidance to local issues in the North Platte Basin and preparation of the report was overseen by the North Platte Basin Roundtable. To improve consistency, coherence, and relevance to local issues some sections of the plan were restructured as appropriate. According to the Guidance:

> "The purpose of the Basin Implementation Plans is for each basin [roundtable] to identify projects and methods to meet basin-specific municipal, industrial, agricultural, environmental, and recreational needs. The Basin Implementation Plans will inform and help drive Colorado's Water Plan."

The North Platte Basin Roundtable (NPBRT) is pleased to submit this Basin Implementation Plan for inclusion into the Colorado Water Plan process. The projects identified in this report meet a variety of important needs in the basin. Every effort was made to recognize the most appropriate goals, projects, and strategies to address the priorities of the roundtable. The NPBRT put forth their best efforts to comprehensively address water needs in the basin however, given the accelerated deadline and resource constraints, this report does not adequately identify all projects and issues in the basin. It is also important to note that due to the inherent tradeoffs surrounding water use in Colorado, all priorities and projects documented in this report are not equally and unanimously supported by all members of the roundtable.

Overview

The North Platte Basin Implementation Plan (NPBIP) was created by the North Platte Basin Roundtable (NPBRT) for submittal to the Colorado Water Conservation Board (CWCB). It is designed to support regional water planning through the roundtable process established by the Colorado Water for the 21st Century Act. The NPBIP builds on previous roundtable work to propose and fund projects for meeting water needs. The NPBIP also provides critical grassroots input to the forthcoming Colorado Water Plan (CWP).

To encourage locally-driven and balanced solutions to water supply challenges, the plan identifies water projects through targeted analyses of water issues in the basin. The NPBIP includes analyses of water shortages, water availability under variable hydrologic conditions, opportunities for improving environmental and recreational attributes in the basin, and various site-specific water supply issues. The ultimate purpose of the plan is to better identify water priorities in the basin and highlight planned projects that will excel at meeting these priorities in the near future.

The NPBIP process continues the important public education, participation, and outreach work that the NPBRT has been engaged with for almost ten years. The creation of the NPBIP included targeted

technical outreach to refine information on water needs and projects. It also included public outreach to gather input on key elements of the report and related aspects of operational protocols for the Colorado Division of Water Resources, described in Section 4. The NPBRT's ongoing outreach and education efforts will be critical throughout the development of the CWP.

Report Structure

The structure of this document generally follows CWCB BIP guidelines with some modifications to better address local issues, streamline the report, and focus on planned projects.

- **Introduction:** summarizes the current planning process, related outreach, major basin issues, and available information.
- **Section 1:** defines basin goals and corresponding targets or measurable outcomes.
- **Section 2:** summarizes water supply needs in the basin.
- **Section 3:** describes options to analyze projects and case studies.
- **Section 4:** identifies proposed projects, related constraints, and strategies for implementation.
- **Section 5:** summarizes conclusions and recommendations.

Section 1: Basin Goals

The NPBRT identified eight Basin Goals to establish priorities for water development and maintain important historical water uses in the North Platte Basin. Each goal is paired with Measurable Outcomes and a process for their achievement to provide a more concrete measurement of success.

North Platte Basin Goals

1. Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.
2. Increase economic development and diversification through strategic water use and development.
3. Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.
4. Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs.
5. Describe and quantify the nonconsumptive benefits of agricultural use.
6. Promote water rights protection and management through improved streamflow gaging data.
7. Enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health.
8. Support the equitable statewide application of municipal water conservation.

Section 2: Basin Needs

The NPBRT identified water needs by summarizing corresponding information from existing relevant sources and updates secured through targeted technical outreach.

- **Agriculture:** Agricultural shortages are significant even in years with above average annual streamflow, and are more than 60 percent in drought years. Average annual agricultural shortages are currently 89,000 AF and projected to be 110,000 AF by 2050. Interviews with agricultural water users during outreach meetings and NPBRT meetings highlighted issues with aging or non-functional infrastructure, resulting in historically irrigated acreage that has not been irrigated in several years. Feedback also highlighted concerns over the amount of acreage currently irrigated and potential long-term implications of irrigating less than the maximum acreage allowed under the Equitable Apportionment Decree.

- **Municipal and Industrial:** The North Platte Basin has addressed its municipal needs through the Walden Water Supply Improvement Project. The very small amount of ongoing and future industrial needs in the basin are met with available supplies and accounted for by JCWCD through the Three States Agreement.

- **Environmental and Recreational:** Environmental and Recreational needs are summarized and targeted through a weighted focus map based on the NPBRT's prioritization of attributes. This map uses the relative priority and concentration of environmental and recreational attributes to create a heat map that better indicates the concentration and relative importance of attributes per roundtable consensus. This map will be used in conjunction with an understanding of the individual environmental and recreational attributes to help target projects to address identified attributes in the basin, including both multi-purpose projects as well as specific environmental and recreational projects. The resulting map is detailed in Figure 12.

Section 3: Basin Evaluations

The NPBRT used the North Platte River Basin Water Resources Allocation Model, case studies, and mapping overlays to evaluate projects and project constraints. Modeling tools allowed for the evaluation of water availability to individual projects based on variable hydrology, water rights, and operations (e.g. proposed diversions, reservoirs, and management strategies). The modeling tools helped to evaluate three case studies to investigate basin-wide issues and opportunities with specific projects (i.e. irrigated acreage analysis, legally available flow, and an analysis of agricultural impacts on streamflows). Mapping overlays of project data and basin needs were used to provide a consistent methodology to review potential projects, highlight options for multi-use projects, and identify projects that may compete for available water. Section 3 of this report provides details on how these evaluations were conducted.

Section 4: Basin Projects

Projects are the primary focus of the NPBIP and the mechanism for addressing Basin Goals established in Section 1 of this report. This section summarizes projects that are highlighted for potential implementation, based on information presented in Section 4 of this report. Developed in close coordination with the NPBRT, the list of proposed projects is considered a current 'snapshot' of potential basin solutions that is expected to be continually refined by project sponsors. To strategically focus implementation these projects were determined to be the most effective at meeting basin goals and most likely to be feasible in the near future. Projects and the corresponding Basin Goals that they are designed to address are summarized in the following table.

Relationships between Basin Goals and Proposed Basin Projects

Project	Basin Goal							
	1	2	3	4	5	6	7	8
MacFarlane Reservoir	x		x	x	x			
Evapotranspiration Project	x							
Walden Reservoir	x	x	x					
Basinwide Augmentation Plan	x	x						
Hanson and Wattenberg Ditch Acreage	x		x					
Proposed Streamgage Installation	x					x		
Storage Protocol	x							
Irrigation Season Protocol	x							
Irrigated Acreage Assessment Protocol	x							
Proposed Willow Creek Reservoir	x		x					
Dam Ditch Headgate Improvement	x		x	x				
Canal Maintenance and Improvements	x		x	x	x			
Instream Diversion Structure Identification	x		x	x	x			
Verner State Wildlife Area – North Platte River Restoration		x		x				

Section 5: Recommendations

Each project proposed for the North Platte Basin requires a unique and systematic plan for implementation that includes discrete steps to maneuver the project from conception to completion. These 'implementation strategies' typically involve two primary categories of action prior to completion of the project: *securing project acceptance* and *demonstrating project feasibility*. Each step in the project implementation process includes various challenges (constraints), or potential key issues or circumstances that may limit the ability of a project proponent to implement the proposed project. For each constraint, there exists a corresponding strategy to successfully complete the project. The following table summarizes strategies to overcome constraints related to securing project acceptance and demonstrating project feasibility to allow implementation of projects proposed for the North Platte Basin. More detailed recommendations for each of these strategies is included in Section 5.

Project Constraints and Implementation Strategies

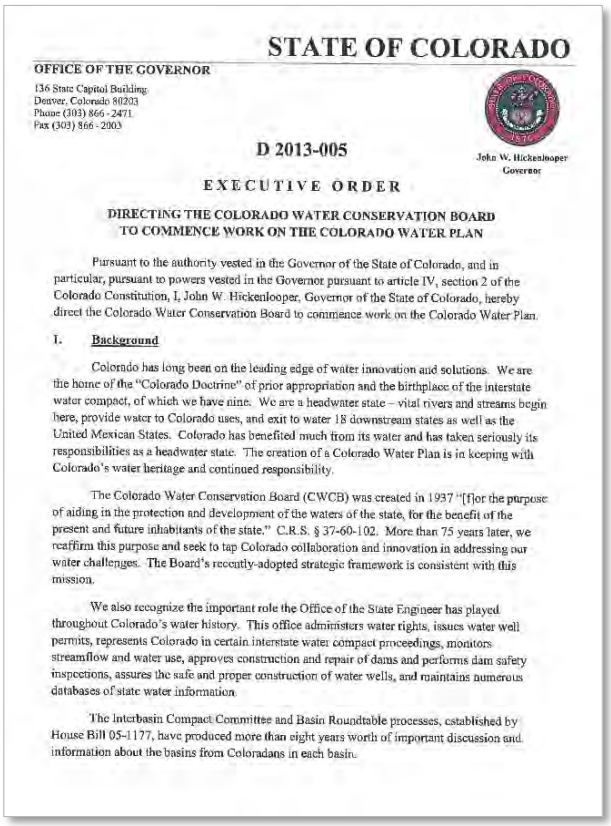
Category	Constraint	Strategies
Project Acceptance	Conflict	Partnerships Cooperative Strategies
	Perception	Public Education and Outreach Incentive-Based Programs
	Regulations	Cooperative Strategies Regulatory Streamlining
Project Feasibility	Cost	Creative Funding Mechanisms Partnerships and Cooperative Strategies
	Water Availability	Water Availability Analyses Water Administration Strategies
	Constructability	Feasibility Analyses Engineering Design

Introduction

Overview of the North Platte Basin Implementation Plan

Purpose

The North Platte Basin Implementation Plan (NPBIP) was created by the North Platte Basin Roundtable (NPBRT or roundtable) to follow the framework provided by the Colorado Water Conservation Board (CWCB) set forth in the Basin Implementation Plan (BIP) Guidance and supplemental guidance documents (CWCB 2013). The basin implementation plans are designed to advance regional water planning in each of Colorado's nine basins designated by the Colorado Water for the 21st Century Act in 2005, HB05-1177 (Section 37-75-101, et seq., C.R.S.). The plans seek to build on previous work to fulfill the roundtables' legislative mandate to "propose projects or methods, both structural and nonstructural, for meeting those needs and utilizing those unappropriated waters where appropriate". In addition, the BIPs serve as a critical grassroots input to the forthcoming Colorado Water Plan commissioned on May 14th, 2013 by Governor Hickenlooper's executive order D2013-005.



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D 2013-005

EXECUTIVE ORDER

DIRECTING THE COLORADO WATER CONSERVATION BOARD TO COMMENCE WORK ON THE COLORADO WATER PLAN

Pursuant to the authority vested in the Governor of the State of Colorado, and in particular, pursuant to powers vested in the Governor pursuant to article IV, section 2 of the Colorado Constitution, I, John W. Hickenlooper, Governor of the State of Colorado, hereby direct the Colorado Water Conservation Board to commence work on the Colorado Water Plan.

I. Background

Colorado has long been on the leading edge of water innovation and solutions. We are the home of the "Colorado Doctrine" of prior appropriation and the birthplace of the interstate water compact, of which we have nine. We are a headwater state – vital rivers and streams begin here, provide water to Colorado uses, and exit to water 18 downstream states as well as the United Mexican States. Colorado has benefited much from its water and has taken seriously its responsibilities as a headwater state. The creation of a Colorado Water Plan is in keeping with Colorado's water heritage and continued responsibility.

The Colorado Water Conservation Board (CWCB) was created in 1937 "[f]or the purpose of aiding in the protection and development of the waters of the state, for the benefit of the present and future inhabitants of the state." C.R.S. § 37-60-102. More than 75 years later, we reaffirm this purpose and seek to tap Colorado collaboration and innovation in addressing our water challenges. The Board's recently-adopted strategic framework is consistent with this mission.

We also recognize the important role the Office of the State Engineer has played throughout Colorado's water history. This office administers water rights, issues water well permits, represents Colorado in certain interstate water compact proceedings, monitors streamflow and water use, approves construction and repair of dams and performs dam safety inspections, assures the safe and proper construction of water wells, and maintains numerous databases of state water information.

The Interbasin Compact Committee and Basin Roundtable processes, established by House Bill 05-1177, have produced more than eight years worth of important discussion and information about the basins from Coloradans in each basin.

The North Platte Basin Roundtable is one of nine grassroots water policy forums created by HB05-1177. The 1177 Act also created the Interbasin Compact Committee (IBCC) as a venue for the discussion of statewide water policy and management issues. The basin implementation plans now seek to embody the intent of the legislation to "encourage locally driven collaborative solutions to water supply challenges". Though the roundtable has no authority to implement specific water supply strategies, it brings varying interests together to coordinate and support effective water supply solutions in the basin.

As described in Sections 3 and 4 of this report, determining effective solutions relies partially on the use of the water supply planning tools of the Colorado Decision Support System (CDSS) that were previously developed for the basin. Since these modeling tools represent a majority of the needs in the basin over a long-term study period, they serve as a good platform to analyze basin-wide issues. The tools allow for a detailed analysis of site-specific and project-specific water shortages and availability under different hydrologic conditions. In addition, the tools help to quantify and locate water supply options in the basin through an analysis of multiple use opportunities, reservoir enlargements or reoperations, potential project competition, and the identification of other issues. When combined with projected

water supply needs and potential solutions, this modeling effort helps to inform the selection of the most appropriate projects to meet the basin's future water needs.

Outreach Process

The NPBIP process continues the public education, participation, and outreach work that the NPBRT has been engaged with for almost ten years. In 2013 and 2014, the Public Education, Participation, and Outreach (PEPO) Workgroup of the IBCC and the Basin Roundtable Education Liaisons worked with their basins to develop and implement updated Education Action Plans (EAPs). These plans are designed to reach out to stakeholder to inform them about how they are currently represented by the Roundtable process and how they can effectively participate.

During the NPBIP process NPBRT members participated in a public outreach meeting and targeted technical workshop meetings with both consumptive and environmental and recreational stakeholders. The public outreach meeting was announced in the local paper with an article about the NPBIP process. Over 20 members of the public attended to learn about the history of the roundtable and the current planning efforts. The technical workshops helped to identify specific water needs and projects in the basin as detailed in the NPBIP. The NPBRT is currently updating its EAP to continue important education and outreach efforts that will ultimately help to inform the creation of the Colorado Water Plan.

Report Structure

The structure of this plan follows the guidelines laid out by the Colorado Water Conservation Board (CWCB 2013) with some modifications to improve consistency, coherence, and relevance to local issues. Section 1 defines basin priorities (goals) and outlines specific mechanisms and targets for achieving the priorities (measurable outcomes). Section 2 summarizes previously identified water supply needs in the basin. Section 3 describes options to analyze projects that may address water supply needs. Section 4 identifies potential basin projects and strategies for their implementation. Section 5 provides summary conclusions on how well proposed strategies meet basin goals and recommendation for general project implementation strategies.

Separate consulting teams have completed BIPs for eight major river basins (North Platte, Yampa/White, Colorado, Gunnison, San Juan/Dolores, Rio Grande, Arkansas, and South Platte/Metro). Varying priorities for each basin necessitate that the eight BIPs will differ in focus, structure, content, and detail. It is understood that the CWCB requires a certain level of consistency in the eight BIPs to be able to extract and use BIP information to draft portions of the Colorado Water Plan. The following table is therefore provided to correlate BIP sections recommended in CWCB guidance with sections of the NPBIP.

CWCB Guidance	North Platte Basin Implementation Plan
Executive Summary	**Executive Summary**
1. Basin Goals and Measurable Outcomes	**1. Basin Goals**
2. Evaluate Consumptive and Nonconsumptive Needs	**2. Basin Needs**
2.1 Nonconsumptive Needs	2.4 Environmental and Recreational Needs
2.2 Consumptive Needs	2.2 Agricultural Needs 2.3 Municipal and Industrial Needs
3. Evaluate Consumptive and Nonconsumptive Constraints and Opportunities	**4. Basin Projects**
3.1 Current Basin Water Operations and Hydrology	**Introduction**
3.2 Water Management and Water Administration (Optional)	
3.3 Hydrologic Modeling (Optional)	**Introduction** and **3. Basin Evaluations**
3.4 Shortages Analysis	**2. Basin Needs** and **3. Basin Evaluations**
4. Projects and Methods	**4. Basin Projects**
4.1 Education, Participation & Outreach	**Introduction** and **4. Basin Projects**
4.2 Watershed Health	
4.3 Conservation Projects and Methods	**4. Basin Projects**
4.4 New Multi-Purpose, Cooperative, and Regional Projects and Methods	
4.5 M&I Projects and Methods	
4.6 Agricultural Projects & Methods	
4.7 Nonconsumptive Projects and Methods	
4.8 Interbasin Projects and Methods (Optional)	
5. Implementation Strategies for the Projects and Methods	**5. Conclusions and Recommendations**
6. How the plan meets the Roundtables' Goals and Measurable Outcomes	

Overview of the North Platte Basin

Layout and Interstate Agreements

The North Platte River Basin is a high altitude valley covering about 2,000 square miles in north central Colorado adjacent to Wyoming. The basin includes all of Jackson County, also known as North Park, and

the small portion of Larimer County that contains the Laramie River Watershed. Both the North Platte and Laramie Rivers flow north into Wyoming, and both are subject to use limitations stemming from Supreme Court Decrees.

Water use in the basin is dominated by irrigated pasture grass related to ranching operations, with over 400 irrigation ditches diverting from the mainstem and numerous tributary streams throughout the basin. Total irrigated acreage in the North Platte River Basin based on 2001 estimates is approximately 120,700 acres, consisting of 117,000 acres in North Park and 3,700 acres in the Laramie River Watershed. A portion of North Platte water is exported to the Front Range via the Michigan Ditch and Cameron Pass Ditch, with combined diversions of approximately 4,500 acre-feet per year to the Cache La Poudre River Basin.

The largest town in the basin, Walden, with a population of approximately 600 people, is centrally located in Jackson County. It serves as the central hub of the basin and a base for visitors to enjoy the many outdoor recreational activities in the basin. Hunting, fishing, hiking, and wildlife viewing opportunities abound throughout the basin, at locations that include the Arapaho National Wildlife Refuge, the Routt National Forest, and many Gold Medal Streams. Figure 1 presents the general topography and layout of the North Platte River Basin, and Figure 2 presents the location of State and Federal land ownership.

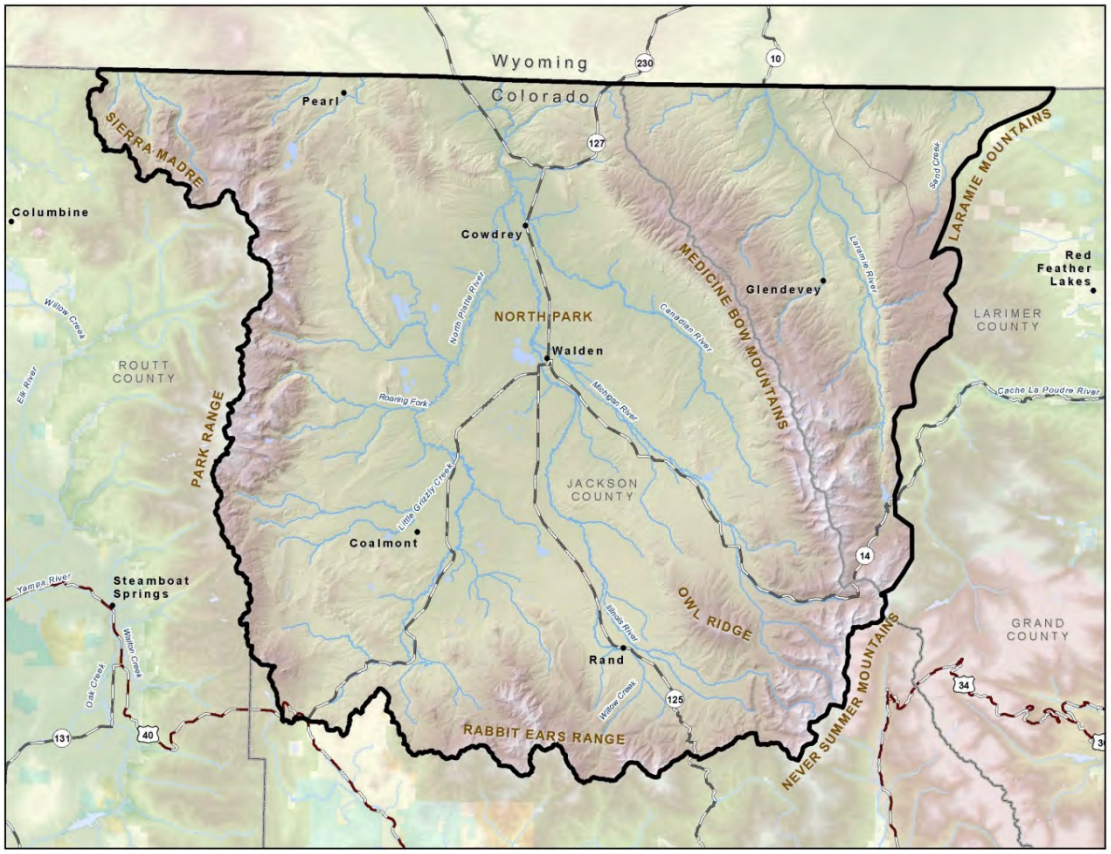


Figure 1: North Platte River Basin

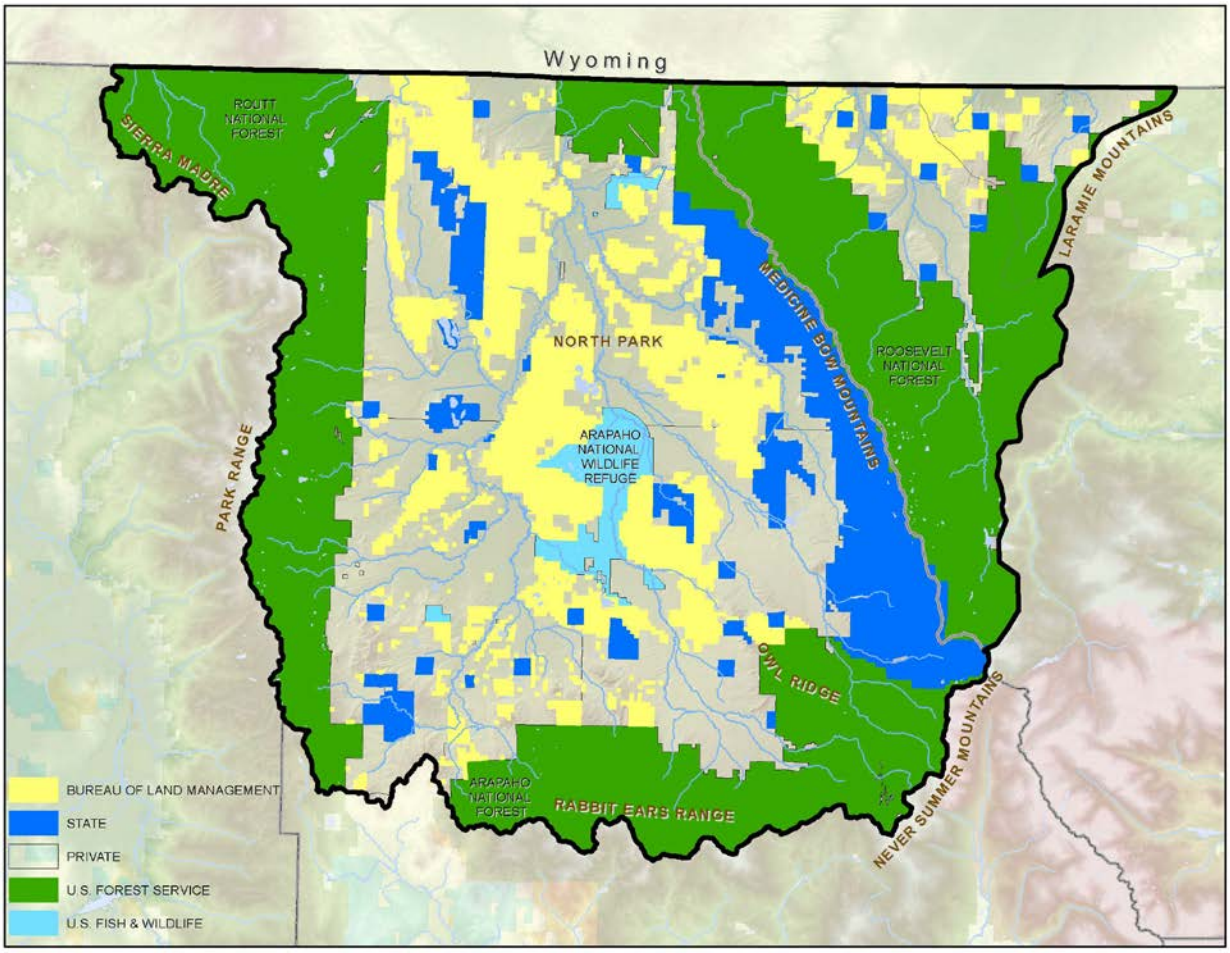


Figure 2: North Platte River Basin Land Ownership

The U.S. Supreme Court decisions that govern interstate water use in the basin include:

Nebraska v. Wyoming, 1945 (325 U.S. 589) – This decision equitably apportions water in the North Platte River between Colorado, Nebraska, and Wyoming. It limits total irrigation in Jackson County to 145,000 acres and allows 17,000 acre-feet reservoir storage annually during the irrigation season. In addition, the decree limits exports from the basin within Colorado to 60,000 acre-feet over ten years.

Wyoming v. Colorado, 1957 (353 U.S. 953) – This decision establishes the rights of Colorado and Wyoming to water in the Laramie River Basin. It limits Colorado's total diversions and exports from the Laramie River to 39,750 acre-feet per year, divided among specific water facilities.

Water use in the basin is also governed by the Three State Agreement of the Platte River Recovery Implementation Program (PRRIP) related to endangered species recovery efforts on the Platte River in Central Nebraska. The agreement allows for flexibility in the types of future water use by assigning a basin-wide baseline entitlement depletion amount for the North Platte Basin of Colorado. The baseline depletion currently limits consumptive water use to the volume associated with up to 134,467 irrigated acres and a county population of 2022 people.

Hydrology and Water Management

The headwaters of the North Platte River Basin originate in four primary mountain ranges that surround and divide the North Platte River and Laramie River watersheds; the Park Range, Rabbit Ears Range, Medicine Bow Range, and Laramie Mountains. With average annual precipitation in the mountains of approximately 40 inches per year, the many tributaries in the basin are fed by spring snowmelt resulting in peak runoff occurring in May and June. Streamflow decreases rapidly throughout the summer and is considerably lower by September and through the winter months.

There are a number of tributaries that join the North Platte River mainstem within Jackson County including the Illinois River, Michigan River, Canadian River, North Fork of the North Platte, Grizzly Creek, and Willow Creek. The primary tributary to the Laramie River is Sand Creek, which joins the river downstream in Wyoming. Figure 3 reflects these geographic features and sub-basin boundaries.

Water Rights Administration

Since the North Platte River Basin Roundtable area includes the Laramie River and Sand Creek, its water rights are administered by both Division 6 (District 47, North Platte River) and Division 1 (District 48, Laramie River and District 76, Sand Creek) of the Colorado Division of Water Resources (DWR). The majority of the basin and the entirety of Jackson County lie within Division 6, District 47. The water districts are delineated in Figure 3.

The priority and location of calling rights on the North Platte River vary throughout the year depending on hydrological conditions. In average years, many of the basin's administrative calls occur on smaller tributaries in the North Platte River watershed after the peak runoff. Larger tributary and mainstem calls are more common for a majority of the irrigation season in dry years, as recently experienced in 2002 and 2012. Review of administrative calls in the Laramie River watershed resulted in no historical calls.

"Basin" or "Watershed" – what do they mean?

The North Platte Basin Implementation Plan includes both the North Platte River Basin and the Laramie River Basin, but focuses primarily on operations, opportunities, and challenges in the North Platte River Basin. There are many references herein for the individual basins or combined basin as a whole; the following is a guide as to how the basins are references and what previous efforts have been completed in each basin.

- *North Platte River Basin* refers to the combined North Platte River and Laramie River Basins, and reflects the project area for the NPBIP.
- *Watershed* is used to refer to an individual basin, either the North Platte River *or* the Laramie River watershed.
- Only information for the North Platte River watershed is reflected in the SWSI 2010 reports for the North Platte River Basin; the North Platte River Basin Water Resources Planning Model; and the Historical Crop Consumptive Use Analysis for the North Platte River Basin.
- Information for the Laramie River watershed is included in SWSI 2010 reports for the South Platte River Basin and the Historical Crop Consumptive Use Analysis for the South Platte Decision Support System. A StateMod Water Resources Planning Model has not been developed for the Laramie River watershed.

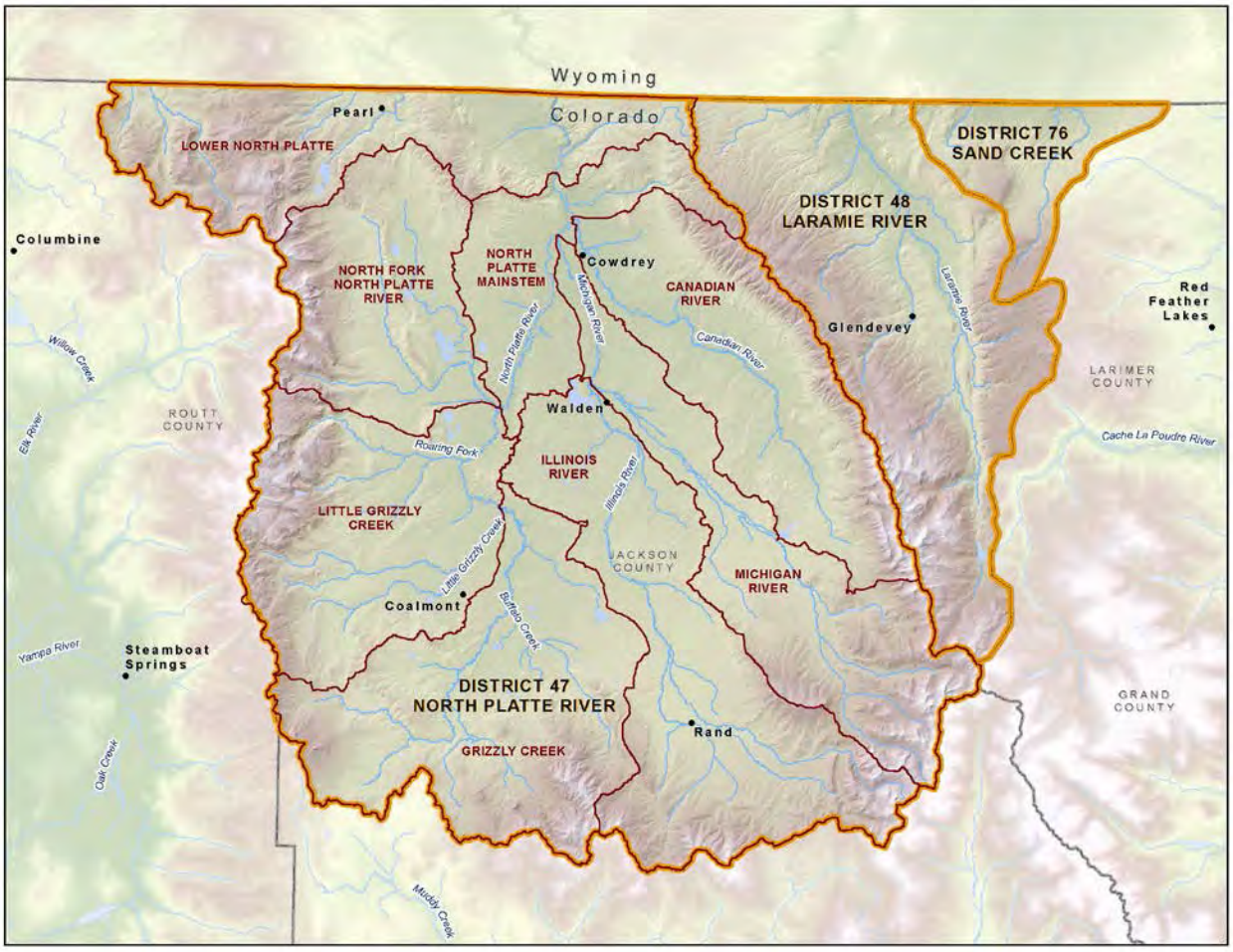


Figure 3: North Platte Basin Water Districts and Sub-basins

Water Quality, Watershed Management, and Forest Health

A number of organizations are tasked with monitoring and managing water quality and watershed issues in the North Platte Basin, from the Federal and State level to the watershed level. The Colorado Department of Public Health and Environment (CDPHE) includes two State organizations tasked with managing state water quality issues: The Water Quality Control Commission (WQCC) develops State water quality policies; and the Water Quality Control Division (WQCD) helps protect and restore water quality for public health and the environment. Between 2011 and 2012, the WQCD developed a number of reports aimed at assessing water quality that included the North Platte Basin. The information that follows draws largely from one of those reports, the 2011 Statewide Water Quality Management Plan. Appendix 2 includes several other references that focus on water quality and watershed issues.

The WQCC has classified water quality impairments related to specific parameters in *Regulation No. 93: Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List*. According to WQCC information, there are two stream segments in the North Platte basin classified as impaired with iron and dissolved oxygen affecting 51.9 stream miles. Development of the Total Maximum Daily Loads (TMDL) for these stream impairments is currently considered by CDPHE as a medium priority. A TMDL is

the maximum amount of a pollutant that a water body can receive and still maintain water quality standards. In addition, there is one scheduled point source improvement for a wastewater treatment facility in the basin.

The Owl Mountain Partnership prepared a watershed plan that will help Jackson County secure future grants for water quality protection and improvement projects. The watershed plan helps prioritize areas requiring special management practices and land management strategies, and identifies resources needed for implementation. The plan is intended to reflect local public participation in the process. The watershed plan recommends "actions to both improve nonpoint source water quality issues on impaired water bodies and maintain the high quality water in the remaining waters throughout Jackson County". According to the plan, nonpoint source pollutants may include:

- Excess fertilizers and pesticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from urban runoff and energy production;
- Sediment from unprotected construction sites, crop and forest lands, and eroding stream banks;
- Salt from irrigation practices and acid drainage from abandoned mines;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems.

In addition to water quality issues described above, watershed health also includes consideration for forest health and related water yield impacts. The North Platte Basin Roundtable has been monitoring the large outbreak and impacts of forest beetle kill and related potential wildfire issues in the basin through the funding of a major study by the U.S. Forest Service on pine-beetle management options. This study, currently close to completion, investigates the effects of disturbance and management of the Mountain Pine Beetle on water resources, in both quantity and quality. It compares how four management alternatives commonly used in beetle killed pine forests influence snow accumulation, streamflow (i.e. water yield), water quality, soil productivity, and forest recovery. In addition, a number of studies by C. A. Troendle and others investigate the impacts of forest insect mortality on increased water yield.

A wealth of on forest health is available from either the Colorado State University (CSU) Colorado State Forest Service (CSFS) or the U.S. Department of Agriculture (USDA) U.S. Forest Service (USFS). Appendix 2 provides internet links to many CSFS and USFS documents and sources of information related to forest health; forest management; forest insects, diseases, and disorders; and wildfire mitigation and education. The CSFS 2013 Report on the Health of Colorado's Forests indicates that though mountain pine beetle infestation is decreasing statewide due to the depletion of susceptible host trees, the North Platte basin continues to be greatly affected.

Efforts to address forest health in the North Platte Basin include Community Wildfire Protection Plans (CWPPs). CWPPs originated in the 2003 with the Healthy Forest Restoration Act (Senate Bill 09-001). This legislation placed an increased emphasis on community planning by requiring counties to identify wildfire hazards in unincorporated areas. To date, about 45 county-wide plans have been created (along with numerous community plans), all of which are on the CSFS website. In the North Platte Basin Jackson County and a number of communities have CWPPs in place at varying stages of implementation.

Overview of Available Basin Information

A number of previous efforts identified water supply planning tools, needs, issues, and potential solutions in the North Platte Basin. Most of the studies focused on the development of water supply planning tools or the identification of water supply needs and issues, with only a preliminary look at solutions. This plan focuses primarily on the solutions by using previously developed tools and information to identify and encourage the implementation of the most effective strategies to meet identified needs.

A thorough inventory was conducted of existing water planning information and reports relevant to the North Platte Basin. The inventory includes a variety of documents referenced throughout this report. Appendix 2 is a reference of available reports and information that is organized according to major technical categories (i.e. Water Supply and Demand, Water Quality and Watershed Health, Climate and Drought, and Public Outreach). It is provided as a useful reference guide on locating more detailed information pertaining to the basin. Each referenced document includes a brief description and, where available, an online link to provide immediate access to a key organization or document. The following information provides brief descriptions of the more essential documents and tools used to support completion of this report, beginning with modeling tools.

Modeling Tools

Detailed water supply planning tools were developed as part of the Colorado Decision Support System (CDSS). The CDSS consists of a database of hydrologic and administrative information related to water use in Colorado as well as a variety of tools and models for reviewing, reporting, and analyzing the data. The "North Platte River Basin Water Resources Planning Model" (North Platte Model), encompassing the North Platte River (Water District 47), is one of many CDSS water resources planning models for major river basins in Colorado.

The North Platte Model is a water allocation model that determines the availability of water to individual users and projects based on hydrology, water rights, and operational practices. All the CDSS models are implementations of "StateMod", a code developed by the State of Colorado for application in the CDSS project. The North Platte Model "Baseline" data set simulates current demands, current infrastructure and projects, and the current administrative environment over the longer, variable hydrologic conditions experienced from 1956 through 2007. As a tool designed to test the impacts of proposed diversions, reservoirs, water rights, and/or changes in operations and management strategies the CDSS models and their related documentation are an excellent resource for this NPBIP report.

In addition to the North Platte Model User's Manual, the "Historical Crop Consumptive Use Analysis, North Platte River Basin" (2012, HCU Report) report serves as a valuable reference for the preparation of this Basin Implementation Plan. The HCU Report and supporting consumptive use model detail 100 percent of the basin's historical crop consumptive water use, serving as the foundation of further agricultural shortage analyses performed for this NPBIP.

The Laramie River and Sand Creek basins were not included in the North Platte Modeling effort; however the "Historical Crop Consumptive Use Analysis, South Platte Decision Support System" (2010) report includes the historical crop consumptive use for these basins, providing an understanding of both depletions and shortages. Since a water allocation model for the Laramie River and Sand Creek Basins have not been developed, water availability and other hydrological analyses for these watersheds were not included in this NPBIP effort.

Basin Studies

The most recent basin study is the CWCB's Statewide Water Supply Initiative 2010, North Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment, June 2011 (2011 Report). As the report that summarized basin-specific data from the Statewide Water Supply Initiative 2010 (SWSI 2010), the 2011 Report was the most comprehensive analysis of existing and projected (to the year 2050) water supply needs in the basin to date. In addition to identifying consumptive and nonconsumptive water needs, the 2011 report cataloged projects to meet these needs. These "identified projects and processes" or IPP's included both consumptive and nonconsumptive projects. In the North Platte Basin However it is important to note that only one consumptive IPP was included: the Town of Walden's Water Supply Project, which has since been completed.

The development of the NPBIP further identified and analyzed potential projects to meet both consumptive and environmental and recreational needs in the basin, as prioritized by the roundtable. The NPBRT's unique prioritization of water needs in the basin was an asset that helped inform the analyses for this report.

The Goals and Measurable Outcomes in Section 1 of the NPBIP build upon the roundtable's identified next steps for addressing future needs as documented in the 2011 Report:

- Refine the potential future consumptive use volume requirements.
- Include diversification of North Platte Basin economy in rating process.
- Include concomitant benefit to nonconsumptive needs in rating process.
- Decide how the final rank-ordered list might be used in the future for decisions on projects, new businesses, and/or new recreational opportunities in the basin.

Another primary report relied on in this study is the CWCB's Water Supply and Needs Report for the North Platte Basin, June 2006 (2006 Report). Like the 2011 Report, the 2006 Report sought to inventory water supplies and demands in the North Platte Basin. As the initial effort to comprehensively assess water use in the basin for the SWSI process, the 2006 Report is a good reference for general basin information. The 2006 Report looked at projected water supplies and demands out to the year 2030. It cataloged consumptive projects, but did not identify nonconsumptive projects.

Where to find more information:

- North Platte River Basin Water Resources Planning Model User's Manual, CWCB and DWR 2012. Web Link
- Historical Crop Consumptive Use Analysis, North Platte River, CWCB and DWR 2012. Web Link
- Historical Crop Consumptive Use Analysis, South Platte Decision Support System, CWCB and DWR 2010. Web Link
- SWSI 2010, North Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment, CWCB 2011. Web Link
- CWCB's Water Supply and Needs Report for the North Platte Basin, CWCB 2006. Web Link

Section 1: Basin Goals

1.1 Introduction

Past reports referenced in the introduction of this report include an initial assessment of water supply goals for the North Platte Basin. These goals helped to inform the discussion of the basin's priorities for this plan. These initial goals from the SWSI documents were discussed at NPBRT meetings during the BIP process and consequently went on to provide a foundation for the goals and measurable outcomes identified in this plan. Instead of creating a separate subcommittee, the NPBRT members decided to consider issues related to the BIP process at regular monthly NPBRT meetings. Member input led to refinement of the goals and measurable outcomes at NPBRT meetings in September through December of 2013.

1.2 Basin Goals

The North Platte Basin Roundtable identified eight primary basin goals. The principal objective underlying all of the goals is the maximum beneficial use of water allowable under the Equitable Apportionment Decree while maintaining compliance with the Three State Agreement.

To provide a concrete measurement of success in meeting existing and future water needs, each goal is paired with measurable outcomes. Each of the goals includes a brief narrative description and process for achieving the goal along with the specific measureable outcomes. In order to ensure that each measurable outcome is attainable and realistic, each goal includes a process for achievement. The goal processes include tasks, items for inclusion in the NPBIP, and other steps or mechanisms necessary to help achieve the goal and ultimately, the measurable outcomes.

The NPBRT created productive measurable outcomes that avoid arbitrary targets or unrealistic objectives that could hinder the measurement of future successes. The measurable outcomes are based on the analyses performed in Sections 3 and 4 of this report and may be quantitative or qualitative.

North Platte Basin Goals

1. Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.
2. Increase economic development and diversification through strategic water use and development.
3. Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.
4. Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs.
5. Describe and quantify the nonconsumptive benefits of agricultural use.
6. Promote water rights protection and management through improved streamflow gaging data.
7. Enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health.
8. Support the equitable statewide application of municipal water conservation.

Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement

The unique and primary factor governing water use in the North Platte is the Equitable Apportionment Decree. Instead of having an interstate compact like many other basins in Colorado, this decree stems from court cases involving Nebraska, Wyoming, and Colorado in 1945 and 1953 (325 U.S. 589, and 345 U.S. 981). Also unique to the North Platte Basin, instead of limiting the volume of beneficial water use, the decrees limit the irrigated acreage allowable in the basin. In the 1945 decree, the acreage was originally limited to 135,000 acres based on the estimated land irrigated and irrigable in 1940. However, this limit was increased to 145,000 acres per amendments in the 1953 decree as part of negotiations involving the Glendo Reservoir Project in Wyoming.

The other factor that constrains water use in the basin is the Three State Agreement of the Platte River Recovery Implementation Program (PRRIP). The PRRIP is a recovery effort designed to assist four endangered species on the Platte River in Central Nebraska. The target endangered species include three birds (piping plover, whooping crane, and least tern), and one fish (pallid sturgeon). The agreement allows for flexibility in the types of future water use by assigning a basin-wide baseline entitlement depletion amount for the North Platte Basin of Colorado. The baseline depletion currently limits consumptive water use in the basin to a volume of depletions associated with the irrigation of up to 134,467 acres and an increase in county population to 2022 people. The baseline entitlement depletion may be allocated to other water activities (i.e. beyond irrigation and existing M&I use) at the discretion of the Jackson County Water Conservancy District.

The Agreement among the U.S. Fish and Wildlife Service, The State of Colorado, the Jackson County Water Conservancy District, and the South Platte Water Related Activities Program, Inc. includes the following language concerning irrigation in the North Platte Basin and the baseline entitlement for depletions:

> *[The South Platte Water Related Activities Program] SPWRAP and Colorado agree to support the maintenance of the District's baseline entitlement for depletions associated with annual irrigation of up to 134,467 acres in the North Platte Basin and the other uses within the baseline entitlement during the first 13-year increment, and during each of the following increments, under the Program. As a signatory to the Platte River Recovery Program Agreement, the [U.S. Fish and Wildlife] Service concurs and for purposes of this Agreement re-asserts that depletions associated with the irrigation of up to 134,467 acres and the other uses within the baseline entitlement represents the District's ' existing uses' baseline entitlement.*

Due to minimal development potential, water use in the Laramie River Basin is not featured prominently in this report. Colorado's water use in the Laramie Basin is also governed by a Supreme Court decree (Wyoming v. Colorado, 353 U.S. 953, 1957) that limits Colorado's total diversions and exports from the Laramie River to 39,750 acre-feet per year, divided among specific water facilities.

Therefore, this report focuses on maximizing the beneficial water use in the North Platte Basin within the limitations of the Equitable Apportionment Decree and Three State Agreement. The traditional agricultural uses contemplated under the decrees' limits to irrigated acreage have spurred the discussion of future water use and development in this report, complemented with strategies to meet environmental and recreational uses in the basin.

Process:

- Preserve Colorado's baseline entitlement depletion allowance associated with the irrigation of 134,467 acres under the Colorado Plan for Future Depletions set forth in the Three State Agreement (and all future increments) through an increase in irrigated acreage or allocation to other uses.
- Encourage the development of consumptive uses as prioritized by the roundtable. Refine roundtable's potential future consumptive use list and volume requirements.
- Identify specific locations in the Basin where consumptive shortages or opportunities exist, and the factors that may be causing the shortages. Quantify the shortages in time, frequency, and duration.
- Recommend potential solutions in collaboration with local water users. Recommendations should include an initial analysis of hydrology (water variability), cost, financing, and permitting. Solutions will include storage and supplemental supplies (e.g. augmentation plans) to mitigate late season shortages.
- Maximize the effectiveness of recommended solutions for meeting multiple objectives (i.e. consumptive and environmental and recreational).

Measurable Outcomes:

- Develop three projects from the list of recommended solutions by 2020.
- Incrementally bring up to 17,000 additional acres under irrigation by 2050.
- Develop 37,000 AF of additional storage (doubling of current storage) by 2050.

Increase economic development and diversification through strategic water use and development

As a predominantly agricultural economy with recreational and industrial components, water use in the North Platte Basin is closely tied to the health of its economy. The small size of the community means the economy is also greatly affected by changes in population. A slow decline in population since the 1950 census makes the current economic development efforts especially pertinent. Therefore, to the extent possible, the NPBRT seeks to encourage balanced economic development through strategic water use.

A recent increase in energy development has shown signs of corresponding increased water use along with positive economic impacts in the basin. Oil production has been joined by increasing oil shale development partially attributable to improvements in hydraulic fracturing technology. Though the new hydraulic fracturing technologies use more water than previous development methods and often use the water to extinction, they still represent a relatively small amount of water use. According to a paper jointly prepared by the Colorado Division of Water Resources, CWCB, and the Colorado Oil and Gas Conservation Commission, statewide water use for hydraulic fracturing is not projected to surpass 20,000 acre-feet until after 2015, and represents slightly more than one tenth of one percent of total water use in Colorado.

Initial concepts for strategic water development were discussed during the creation of the 2011 report and cataloged therein. Concepts and very preliminary estimates of water use from this brainstorming session included:

- Renewable energy development, including biomass (200 acre-feet per year [AFY])
- Energy and mineral development, including sand and gravel (300 AFY)
- Aquaculture (500 AFY)
- Forest products, including chip board (10,000 AFY)
- Greenhouse agriculture (5000 AFY)
- Water bottling/brewery/distillery (50 AFY)
- Snowmaking as water storage (5000 AFY)
- Water theme park (100 AFY)
- Golf course (100 AFY)
- Feedlot and/or slaughter house (50 AFY)

Process:

- Promote projects with potential for beneficial economic impacts and economic diversification for Jackson County.
- Research the feasibility and structure of a potential basin-wide augmentation plan to cover small amounts of consumptive use associated with various water development projects.

Measurable Outcomes:

- Increase county sales tax revenues five percent by 2020.
- Increase hotel/campground occupancy by five percent by 2020.
- Diversify the economic base of Jackson County with creation of two new businesses associated with strategic water use and development by 2020.

Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.

To preserve the use of critical historical water rights, current infrastructure in the North Platte Basin must be restored, maintained, and modernized. It is particularly important to preserve infrastructure that enables the use of water rights and irrigated acreage that predate the Equitable Apportionment Decree. The maintenance of existing infrastructure often serves to be the most efficient and prudent option. Furthermore, in many cases restoration or modernization efforts serve to address multiple purposes, such as improved diversion reliability and accuracy, lower maintenance costs, the potential addition of hydropower generation, and improved fish passage. Therefore the project recommendations in Sections 4 and 5 of this report include efforts focusing on the restoration, maintenance and modernization of existing water infrastructure. The North Platte Basin will continue to focus the resources of the CWCB's Water Supply Reserve Account funds on this effort, along with other potential funding opportunities.

Process:

- Identify specific locations where infrastructure requires improvement or replacement to preserve or maximize existing uses.
- Recommend potential solutions in collaboration with local water users. Evaluating solutions to infrastructure needs will include an initial analysis of cost, financing, and permitting.

Measurable Outcomes:

- Develop three projects from the list of recommended solutions by 2020.

Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized environmental and recreational needs.

Healthy rivers and wetlands have always been a critical component to the economy and way of life in the North Platte Basin. The NPBRT seeks to maintain healthy rivers and wetlands to support all uses in

the basin, both consumptive and environmental and recreational. Based on the work of the NPBRT, the 2011 Report identified and prioritized important nonconsumptive needs in the basin. As the only basin to prioritize their nonconsumptive needs, the NPBRT now stands to build on this effort by further focusing water project efforts. The 2011 Report cataloged completed, ongoing, and planned nonconsumptive projects. The projects were mapped along with the nonconsumptive needs in Figures 3-1 through 3-4 of the SWSI 2010 Report as an initial analysis of where identified nonconsumptive needs are addressed.

In particular, wetlands have been the focus of previous studies, some of which have been funded by the North Platte Roundtable through the CWCB's Water Supply Reserve Account. Among these WSRA-funded studies, the Ducks Unlimited Irrigated Meadow Conservation Program Phase 1 identified the second most productive waterfowl habitat in Colorado, along with potential projects to maintain or restore this habitat. WSRA funds also helped to identify wetlands via the Colorado Natural Heritage Program (CNHP) of Colorado State University. However, due to the controversial designation of "potential conservation areas" on various private lands, the resulting study, "The Identification and Assessment of Important Wetlands in the North Platte River Watershed", was not fully supported by the roundtable. In 2013, a study of wetlands in the basin was also performed by the Intermountain West Joint Venture, a multistate nonprofit focusing on the conservation of bird habitat through partnerships.

This report seeks to refine strategies for meeting environmental and recreational needs in the North Platte Basin through the use of the roundtable's previous prioritization, nonconsumptive project recommendations, and nonconsumptive components of multipurpose projects. An emphasis on multiple purpose projects is carried throughout the analysis, where applicable.

The North Platte Basin contains a number of instream flow water rights. However, the NPBRT officially supports the JCWCD's position opposing new instream flows below any existing diversion. In a letter to the CWCB, dated December 19, 2006, the roundtable expressed its opposition to new instream flows below existing diversions, indicating that such new rights could injure and interfere with present and future beneficial water use in the basin, potentially limiting full water use permitted under the Equitable Apportionment decree (Appendix 3).

The ranked nonconsumptive attributes for the NBRT as documented in Section 2 of the 2011 Report include:

1. Important Stream Fishing
2. Important Lake Fishing
3. Waterfowl hunting/riparian and wetland wildlife viewing
4. Waterfowl/Shorebird and Crane Habitat
5. Amphibians
6. Significant Wetland Plant Communities
7. Whitewater and Flatwater Boating
8. River Otter
9. Bald Eagle and Osprey

10. CWCB minimum Instream Flows, Minimum Lake Levels
11. Class 1 Waters + Wild and Scenic Eligibility
12. Lake Chub

As articulated in the 2011 Report: "the challenge and opportunity for the roundtable is to decide how to use this nonconsumptive attribute ranking for solicitation and prioritization of future projects." This report seeks to capitalize on this opportunity by appropriately prioritizing and funding future projects.

Process:

- Identify locations where environmental and recreational needs are not being met.
- Improve the quality, quantity, and use of fisheries for beneficial economic impacts.
- Recommend potential site-specific solutions in collaboration with local water users. Recommendations should include an initial analysis of hydrology (water variability), cost, financing, and permitting. Solutions may include stream restoration projects, operational flow agreements, multiple purpose storage projects, fish-friendly diversion structures, etc.
- Maximize the effectiveness of recommended solutions for meeting multiple objectives (i.e. consumptive as well as environmental and recreational).
- Continue to ensure the successful implementation of the endangered species program to protect existing and future in-basin uses.
- Improve the quality and use of fisheries for beneficial economic impacts.

Measurable Outcomes:

- Increase fishing user days by five percent by 2020.
- Increase waterfowl hunting and viewing days by five percent by 2020.
- Develop three projects from the list of recommended solutions by 2020.

Describe and quantify the environmental and recreational benefits of agricultural use.

Previous discussions at the NPBRT and IBCC have noted the beneficial effects that the extensive agricultural water uses in the North Platte Basin have on environmental and recreational uses. Section 3 of this report describes and details how delayed irrigation return flows and the irrigation water stored in the "soil reservoir" provides benefits to stream flows and environmental and recreational water uses in the North Platte Basin. This information provides further emphasis for the importance historical water uses along with the potential for the ongoing development of mutually beneficial multipurpose projects. In addition, a paper published jointly by the Colorado Cattlemen's Association and Partner's for Western Conservation, details numerous recommendations on how to support and implement multipurpose water projects. This document, created through a facilitated process involving members of Colorado's environmental and agricultural communities, may serve as a valuable resource for future project development (see reference and link in Appendix 2).

Process:

- Describe the nexus between agricultural uses and environmental and recreational uses.
- Identify instances where environmental and recreational needs are sustained and supported by agricultural water use. Quantify the positive impacts of agricultural water use in time, frequency, and duration.

Measurable Outcomes:

- Complete at least two new multi-purpose water projects in the North Platte Basin by 2025 that meet multiple needs as identified in this report and other studies.

Promote water rights protection and management through improved streamflow gaging data.

The North Platte Basin has only one streamflow gage, the North Platte River near Northgate gage, with a significant historical record and is the only gage in the basin with a complete streamflow record for the entire NPDSS modeling study period (1950 – current). Other gages in the basin have collected data for a handful of years, helping with the creation of the NPDSS and understanding of local hydrology, but failing to provide an ongoing long-term benefit. There are currently five streamflow gages in the basin with recent records (2012 or more current) operated and maintained by USGS or DWR:

- Illinois Creek near Rand
- Michigan River near Meadow Creek Reservoir
- Michigan River at Walden
- North Platte River near Northgate
- Michigan River near Cameron Pass

The collection of better and more consistent streamflow data could greatly help effective water management in the basin. Therefore, any additional streamflow information that can be collected, either from new or previous gage locations, will be useful in understanding the complex hydrology of the basin in support of administrative and planning efforts.

Process:

- Use the NPDSS and previous documentation to identify specific locations where new or restored gaging stations would provide important data for ongoing water management, modeling, and use.
- Develop partnerships to install and operate new gaging stations.

Measurable Outcomes:

- Install and operate two gaging stations at two new or previous locations by 2020.

Enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health.

The North Platte Basin Roundtable recognizes that maintaining the health of its forests is important to long term water management. Therefore, the NPBRT has been monitoring the outbreak and impacts of forest beetle kill and related potential wildfire issues in the basin. The NPBRT funded a major study by the U.S. Forest Service on pine-beetle management options through the CWCB's Water Supply Reserve Account. The NPBRT intends to remain involved in monitoring and addressing forest health issues in the basin.

Process:

- Review, distribute, and implement the findings of the USFS Pine-Beetle Study in the North Platte Basin, funded by CWCB's Water Supply Reserve Account Program.

Measurable Outcomes:

- Maintain roundtable communication with appropriate federal and state liaisons to stay informed on management activities related to beetle kill impacts in the North Platte Basin by having a roundtable presentation at least once a year.

Support the equitable statewide application of municipal water conservation.

The NPBRT supports the statewide application of municipal water conservation techniques as an essential and cost effective tool to help in meeting Colorado's water supply needs. The NPBRT supports the extensive water conservation efforts of major Colorado water providers, and encourages further conservation as permitted by technology, economics, and legislation.

The NPBRT supports a wide variety of water conservation methods including municipal conservation programs, strategic growth and development, and landscape limitations. The NPBRT believes that the best way to promote statewide water conservation is through incentive-based measures as opposed to regulatory methods. To maximize water savings and avoid an unnecessary burden on smaller rural water providers, the NPBRT supports focusing conservation efforts on covered entities.

Process:

- Support the use of state funding to provide incentives for reaching municipal conservation and efficiency standards.
- Work with appropriate entities to ensure that statewide conservation strategies and any related legislation allow flexibility to meet the needs of local governments.

Measurable Outcomes:

- Comply with future statewide municipal conservation strategies and any related legislation by 2020 or as appropriate.

Section 2: Basin Needs

2.1 Introduction

Beyond identifying the roundtable's goals or priorities, the first step in strategically implementing water projects and other management options in the North Platte Basin is to identify needs. In order to focus on project implementation, this report is designed to build on previous data of water needs from SWSI 2010 and other relevant sources. As stated in the Basin Implementation Plan Guidance: "this section will summarize existing reports and information that may be relevant to the Basin Implementation Plans (e.g. SWSI 2010 demands, IPPs, vulnerabilities from the drought plan)."

While the NPBIP process does not include a systematic update of consumptive and environmental and recreational water needs, pertinent new information is included as noted. The CWCB plans to provide a comprehensive update of water needs to maintain its technical foundation for statewide water planning in the SWSI 2016 report. New information compiled in this report will be further updated by the CWCB as part of the SWSI 2016 process.

Targeted technical outreach was performed to strategically refine information on water needs in the basin for this report. Technical workshop meetings were held for both consumptive and environmental and recreational water interests. The consumptive workshop focused on verifying current irrigated acreage, examining historic irrigated acreage, and exploring potential projects to maintain and/or increase irrigated acreage. The nonconsumptive workshop focused on strategies for examining a nonconsumptive gap and planned projects to meet environmental and recreational needs. In addition to the workshops, targeted phone, personal, and e-mail communication helped to update information as necessary. Updated information relating to water needs and a nonconsumptive focus map is detailed in Section 2.4. Project data resulting from the technical outreach process is summarized in Section 4.

2.2 Agricultural Water Needs

Summary of Process

To provide an analysis of existing agricultural water use and needs, the SWSI process used the Colorado Decision Support System (CDSS) modeling effort to provide a summary. The SWSI 2010 analysis then built on the CDSS modeling output to estimate current and future 2050 demands and shortages. Unlike municipal use, agricultural needs are defined as existing shortages and not projected future needs based on expansion. In other words the majority of irrigated agriculture in the North Platte Basin does not and historically has not received a full supply needed by the crops.

A comprehensive analysis of current and historical agricultural demands and shortages was completed through the Colorado Decision Support System (CDSS) modeling efforts in the North Platte Basin using StateCU, a generic, data driven consumptive use model. The consumptive use (CU) modeling for the Laramie River basin was completed in March of 2010, while the CU modeling for the North Platte River basin was completed in October of 2012. The results from these CU modeling efforts are used to inform the surface water allocation model and summarize the agricultural conditions in the basin.

Figure 4 provides a general schematic outlining the approach taken in the CU analysis. The analysis uses irrigated acreage, climate data, growing season parameters, and crop coefficients to estimate Crop Irrigation Water Requirement (CIR) using the Original Blaney-Criddle methods on a monthly time step. The CU analysis was adapted to the unique climatic conditions and high elevation in the North Platte River basin through the use of calibrated crop coefficients, as outlined in the "Historical Crop Consumptive Use Analysis North Platte River Basin", 2012.

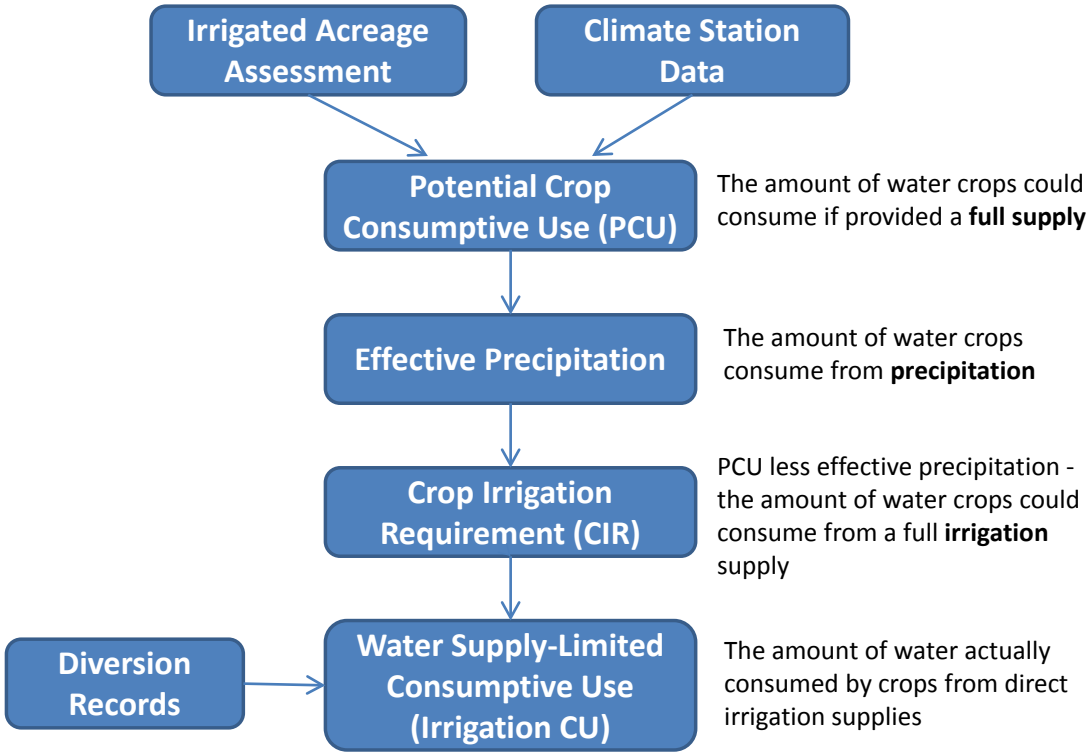


Figure 4. CU Analysis Approach

Irrigated acreage in the North Platte River Basin and Laramie basins used in the CU analysis, was delineated for 1956, 1976, 1987 and 2001 to account for changes in irrigated acreage over time. Subsequent to the CU analysis, the Colorado Division of Water Resources (DWR) completed acreage delineations for 2005 and 2010 for the North Platte and Laramie basins and annually thereafter in the North Platte River basin (2011, 2012, and 2013). The delineated acreage reflects parcels irrigated each year and is further attributed with crop type and diversion structure by the DWR. All crop types in the North Platte and Laramie basins are assigned as High Altitude Grass Pasture. This acreage information is stored under each diversion

structure in Colorado's Water Resources Database, referred to as HydroBase and available in a GIS layer on the CDSS website. The changes in irrigated acreage over time are generally associated with water availability, as opposed to loss of acreage due to changes in irrigation practices or water rights purchase and transfer of use.

Climate data from the Walden climate station was used in the CU analysis. This climate station, which is managed by the National Climatic Data Center (NCDC), is representative of most of the irrigated acreage in the basin and has a long period of record. Other climate stations in the basin were not used in the analysis since they were too far from irrigated acreage, not representative of climate conditions on irrigated land, and/or have shorter periods of record requiring several years of data to be filled. Monthly temperature and precipitation data is used in the CIR calculation.

Water supply information reflects diversions to irrigation for each structure as recorded by the DWR and stored in HydroBase. Water supply information included in the CU analysis reflects irrigation diversions taken under direct rights and released from reservoirs. Estimates of conveyance loss and application efficiency reduce the total irrigation supply to simulate system losses experienced in the delivery of water to the crop. Diversions in excess of CIR, generally in the early season, are stored in the soil moisture "reservoir" and are available to the crops later in the season when diversions may not be available. Efficiency information allows the quantification of irrigation diversions not consumed by the crop, but returned to the river system, often in months after diversion.

The analysis then uses the estimated CIR, water supply information, conveyance and application efficiencies, and soil reservoir considerations to estimate Water Supply-Limited Consumptive Use (Irrigation CU).

The approach and results of the CU analysis for the North Platte River watershed are detailed in the "Historical Crop Consumptive Use Analysis, North Platte River Basin" and in the "Historical Crop Consumptive Use Analysis, South Platte Decision Support System" for the Laramie River watershed.

For the purposes of this report, agricultural "demand" refers to CIR, or the amount of water crops would consume if given a full water supply. Irrigation CU refers to the amount of water actually consumed from irrigation supplies and agricultural shortage refers to the difference between CIR and irrigation CU. Shortages are defined for the entire growing season and consequently reflect the amount of water the irrigator could have put to beneficial use if water was physically and legally available. (*Note that this standard definition is slightly different from the definition used in the SWSI 2010 report, where the term "demand" was used to represent water supply-limited or irrigation CU.)*

Where to find more information:

- The "Historical Crop Consumptive Use Analysis, North Platte River Basin" (2012) report and the StateCU Consumptive Use Analysis data set for the North Platte Basin can be found on the CDSS website (cdss.state.co.us)
- The "Historical Crop Consumptive Use Analysis, South Platte Decision Support System" (2010) report and the StateCU Consumptive Use Analysis data set for the South Platte Basin can be found on the CDSS website (cdss.state.co.us)

As discussed in the SWSI 2010 report, current agricultural demands, irrigation CU, and shortages were based on averages of the most recent ten years of available information from the CDSS modeling effort. At the time of the SWSI analysis, this 10-year period reflected 1997 to 2006 estimates in the North Platte River Basin, and included one of the worst drought years on record (2002). For comparison, agricultural shortages basin-wide were nearly 40 percent on average over the ten year period, and over 65 percent in 2002. Selection of this time period and inclusion of the drought year in the analysis led to a conservative estimate of shortages in the basin.

In addition to the crop CU estimated through the CDSS modeling efforts, SWSI 2010 includes CU associated with agricultural activity including livestock CU, stockpond evaporation, and CU incidental to delivering irrigation water. The CU estimates for these activities, defined as Non-Irrigation Demand, were originally developed in support of the annual Consumptive Use and Losses Report for tributaries to the Colorado River in the State of Colorado developed by the Bureau of Reclamation. Livestock CU and stockpond evaporation are small components of the total CU, generally less than one percent of agricultural use in the basin. Incidental CU of water diverted for irrigation, however, was estimated to be ten percent of Irrigation CU in the SWSI 2010 analysis. Although this percentage was not developed specifically for the North Platte basin, it is believed to be a reasonable estimate to represent vegetative consumptive use that occurs along canals and in tailwater areas (i.e. areas of surface runoff from irrigation). SWSI 2010 reports the sum of Irrigation CU from the CDSS modeling effort plus the CU from agricultural activities (non-irrigation demand) for the most recent ten year period available as the total current agricultural depletions.

In the SWSI 2010 report projected irrigation CU in the year 2050 was developed by estimating the amount of irrigated acreage in the North Platte River Basin in 2050 and scaling the current irrigation CU by the ratio of the 2050 irrigated acreage to current irrigated acreage. This approach assumes historical climate conditions will continue into the future and that irrigation CU is directly linear to irrigated acreage. Irrigated acreage in the basin was projected to be 145,000 acres in 2050, which is consistent with the maximum allowable irrigated acreage under the Equitable Apportionment Decree.

A discussion of agricultural needs in the North Platte Basin is not complete without a mention of the economic connectivity to other agricultural markets in Colorado. This was detailed in the SWSI 2010 report with the following text box:

North Platte Basin Agricultural Linkages to the South Platte and Arkansas Basins

Members of the North Platte Basin Roundtable acknowledge agricultural economic linkages to the South Platte and Arkansas Basins. While we do not offer quantitative data, the following general economic indicators represent potential areas that could be quantified for further economic analysis. In the broadest sense, agricultural dry up in the South Platte and Arkansas Basins will result in an industry-wide domino effect, negatively impacting Colorado agriculture. The general public does not seem to grasp the significant negative impacts that agricultural dry-up would likely have on food security in Colorado and beyond.

- Generally, the deterioration of the agricultural infrastructure due to agricultural dry up in the South Platte and Arkansas Basins would significantly increase the cost of doing agricultural business in the North Platte River Basin. The situation is further exacerbated by the increasing cost of fuel.
- North Platte producers would need to travel significantly further distances west and east to do business. Cattle and hay markets would be impacted by increasing cost of production due to the increase in transportation costs if agricultural auctions and sale barns were to close their doors.
- Feed lots that currently purchase North Park commodities may decline, thus negatively impacting the lesser quality hay market.
- North Platte producers' costs of doing business would increase significantly if ranch feed and supply stores declined in Front Range counties.
- Profit margins of local ranch feed, supply, and service businesses would likely decline in the face of increased transportation and shipping costs to maintain adequate local inventories.
- The number of veterinarians serving the cattle producers would likely decline in our region and it would be difficult to maintain herd health at a reasonable cost.

Recent Updates

Irrigation CU and shortages have been analyzed and summarized in many different ways. The summaries reported in the CDSS Historical Crop Consumptive Use Report and SWSI 2010 for the North Platte River Basin provide the magnitude of the historical, current, and potential future CIR, irrigation CU and shortages. However, they do not discuss the variability of crop use seasonally, in different hydrological conditions, or assess why the shortages occur.

The SWSI 2010 report reflects an average annual agricultural shortage of 89,000 acre-feet in the North Platte River Basin. The NPBIP process included presentations at the NPBRT which discussed the CU analysis, including specific crop type and calibrated coefficient information, and the results of the analysis specific to the basin. To verify the shortage information and focus on projects that could feasibly meet agricultural needs, the presentation focused on three categories of agricultural shortages:

> ***Physical*** shortages are those experienced by the crop due to lack of physical supply. This type of shortage is often seen later in the irrigation season by irrigators on smaller tributaries. Even though the irrigation water rights may be in priority, there is not enough physical supply. Although these shortages are exacerbated in dry years, on many of the tributaries physical flow is not sufficient to meet the CIR for the entire growing season even in wet years.

Legal shortages are those experienced by a crop due to lack of legal supply; there may be physical supply at a ditch headgate, but it must be bypassed to meet downstream senior water rights. This type of shortage is often seen later in the season by irrigators with junior water rights in average and wet years, and may be the situation for junior irrigators the entire growing season in dry years.

Irrigation Practice **"**shortages" are those experienced by the crop due to specific irrigation practices; the irrigator may have physically and legally available supply but chooses not to irrigate. This is not considered a true "shortage" by the water users in the basin as it reflects the necessity of reducing or ceasing irrigation to allow the land time to dry prior to haying or grazing. It also reflects when irrigation no longer occurs because there is not enough time left in the growing season for an additional cutting. Note that even though this is not considered a shortage by water users, it is reported as such, along with physical and legal shortages, in order to quantify the difference between CIR and actual consumptive use in SWSI and other statewide planning efforts.

Due to the prevalence of irrigated acreage on small tributaries and the general shortage of late season streamflow, physical shortages are generally the most common in the North Platte River Basin, followed by legal shortages, and then irrigation practices.

The SWSI 2010 report did not characterize agricultural shortages as gaps. However, the NPBRT has determined that agricultural shortages do constitute a legitimate and longstanding water supply gap in the basin. Therefore, the NPBRT defines the agricultural gap in the basin as the full extent of the shortages identified by the analyses of SWSI 2010 and this report.

The agricultural demands and shortages from the previous studies were refined for this report. The CDSS modeling effort provides the platform to examine agricultural demands and shortages on a more detailed level, both spatially and temporally, as required for the analysis of proposed projects in this report. The additional detail provided by the model and used in this effort includes explicit representation of specific ditches in the basin, and calibrated model assessments of monthly CIR, Irrigation CU, and shortages over the 1975 to 2007 time period.

The NPBIP analysis verified the accuracy of model data for irrigated acreage and agricultural shortages through NPBRT meetings and the NPBIP consumptive technical workshop. The analysis was performed at a more detailed scale than what was provided in the SWSI 2010 report, including:

- The magnitude of demand and shortages were summarized by sub-basin
- Seasonal/monthly trends were investigated under different hydrological conditions (wet, dry, and average)
- Amount of CU met by direct diversions and from the soil moisture reservoir were summarized
- General commonalities and differences between sub-basins (and their causes) were discussed

In the late irrigation season, diversions are frequently limited due to physical or legal flow constraints. Mid to late season demands throughout the basin are often partially met when crops use water stored in the soil reservoir originating from diversions during the runoff months. Often higher diversions during

the runoff months are perceived by non-irrigators as excessive. However, an analysis of water supplies shows that basin-wide, the use of soil storage accounts for about 20 percent of the total irrigation CU. This irrigation practice has been employed since ranching began in the basin and considering the impact it has on CU, warrants further examination and documentation as a "case study" in Section 3.

As described above, the NPBIP analysis focused on identifying shortages by sub-basin, shortages due to varying hydrology, and the category (cause) of shortages. Appendix 4 graphically provides this information by tributary, which is required to evaluate the ability of specific projects to mitigate shortages. Figures 5 and 6 provides a graphical summary of the basin wide annual agricultural CU directly from surface water (SW) diversions , CU from water stored in the soil reservoir during the runoff, and shortages.

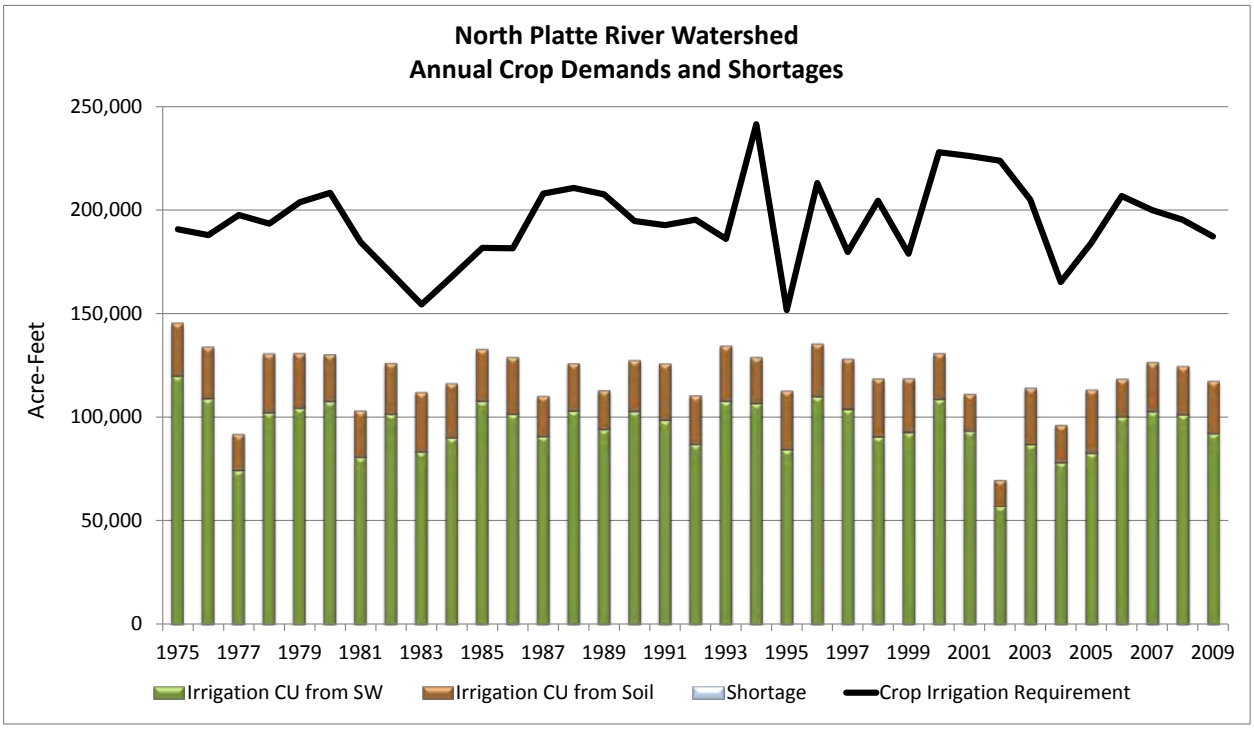


Figure 5. North Platte River Watershed Annual Crop Demands and Shortages

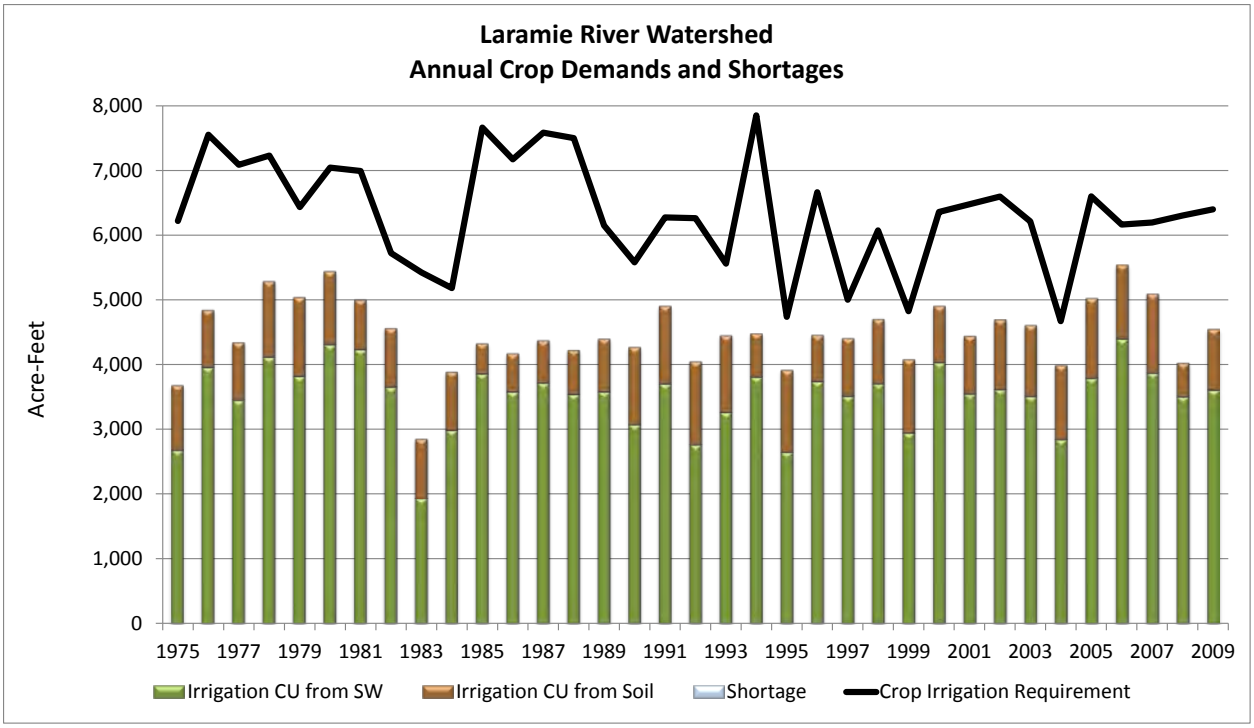


Figure 6. Laramie River Watershed Annual Crop Demands and Shortages

The agricultural shortages detailed above are exacerbated in drought conditions. The CWCB's 2013 *Colorado Drought Mitigation and Response Plan* contains more information on potential drought impacts in the basin and throughout the state.

Summary of Needs

The SWSI 2010 report estimated that irrigated acreage in the North Platte River Basin would conservatively remain the same as its current amount of approximately 117,000 acres or increase to as much as 145,000 acres in 2050. The maximum amount of 145,000 acres, a 24 percent increase of current acreage, coincides with the maximum allowable irrigated acreage under the Equitable Apportionment Decree. The SWSI 2010 current and future 2050 agricultural demand and shortages for the North Platte River Basin are summarized in Table 1.

Table 1. SWSI 2010 Average Annual Agricultural Summary

Analysis	Irrigated Acres[1]	Crop Irrigation Requirement (CIR) (AFY)	Irrigation CU (AFY)	Shortage (AFY)	Non-Irrigation Demand (AFY)
Current	117,000	202,000	113,000	89,000	12,000
2050	145,000	250,000	140,000	110,000	14,000

[1] The information presented in Table 1 reflects only the North Platte River watershed; this information as originally presented in SWSI 2010 does not include the Laramie River watershed. The Irrigated Acreage, CIR, Irrigation CU, and Shortage for the Laramie River watershed are presented herein.

The primary issues concerning Agricultural needs in the North Platte Basin include:

1. Summaries in SWSI 2010 illustrated large shortages in the basin, over 40 percent on average annually. Further refinement of the CDSS model results reflects large annual shortages even in years with above average annual streamflow, and shortages of more than 60 percent in drought years.
2. Interviews with agricultural water users during outreach meetings and NPBRT meetings highlighted issues with aging or non-functional infrastructure, resulting in historically irrigated acreage that has not been irrigated in several years.
3. Technical outreach meetings and NPBRT meetings also highlighted concerns over the amount of acreage currently irrigated and potential long-term implications of irrigating less than the maximum acreage allowed under the Equitable Apportionment Decree.

In response to these issues, the North Platte BRT has identified BIP goals to:

- **Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.**
- **Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.**

2.3 Municipal and Industrial Water Needs

Summary of Process

In 2004, the Colorado Water Conservation Board (CWCB) completed the Statewide Water Supply Initiative (SWSI) Phase 1 Study, which included a reconnaissance level water use forecast that evaluated water needs through 2030. The SWSI 1 report included an evaluation of Municipal and Industrial (M&I) Demand (i.e. all of the water use of a typical municipal system including residential, commercial, industrial, irrigation, and firefighting) and Self-Supplied Industrial (SSI) Demand (i.e. large industrial water uses that have their own water supplies or lease raw water from others). Key sections of that report addressing M&I water needs include: Section 5 (Projected Water Use), Section 6 (Water Needs Assessment), Appendix A (State of Colorado Population Projections 2000 to 2030), and Appendix E (Statewide M&I and SSI Water Demand Projections). The SWSI 1 activities related to M&I water use included:

- Collection of available statewide water use demographic and weather data;
- Evaluation of available information to determine factors that influence M&I water use;
- Review of M&I water use studies conducted throughout the state;
- Preparation of a statewide forecast of future urban water use to the year 2030; and
- Assessment of the current level of conservation efforts by county.

In 2006, the CWCB completed the Water Supply and Needs Report for the North Platte Basin, which presented information contained in the SWSI 1 Report specific to the North Platte Basin as a starting point for the North Platte Basin Roundtable to develop the needs assessment required by the Interbasin

Compact Process. Section 5 of that report describes the Consumptive Water Supply Needs in the North Platte Basin. In 2009, CWCB published a draft "State of Colorado 2050 Municipal and Industrial Water Use Projections" report, with updated information that reflected feedback received from the Basin Roundtables and other interest groups on the SWSI report.

In 2011, the CWCB completed the “Statewide Water Supply Initiative 2010”, which includes Section 4 (Consumptive Needs Assessments) as an update of SWSI M&I water use projections using an extended forecast horizon of 2050. Also in 2011, the CWCB completed the North Platte Basin Needs Assessment Report, which presented information contained in the SWSI 2010 Report specific to the North Platte Basin. Key sections of that report that contributed to evaluation of M&I water needs include Section 4 (North Platte Basin Consumptive Needs Assessment) and Appendix H (State of Colorado 2050 Municipal and Industrial Water Use Projections).

Appendix J (Technical Memorandum 2050 Municipal and Industrial Gap Analysis) of the SWSI 2010 Report extended the M&I and SSI gap analysis analyses from the year 2030 to 2050. It also incorporated updated information on Identified Projects and Processes (IPPs) that the CWCB collected through coordination with the basin roundtables and water providers. In addition, Appendix L (SWSI 2010 Municipal and Industrial Water Conservation Strategies) of the SWSI 2010 Report represents the latest effort by the CWCB to date to integrate water conservation into overall water supply planning. This effort also estimated statewide water conservation potential out to the year 2050.

The SWSI 2010 reports estimated M&I water demand forecasts by using county and statewide population projections as predictors of future growth. Future water needs were estimated by multiplying county population projections by aggregated data on per capita water use (gallons per capita per day). Low, medium, and high scenario population projections were developed using the forecasting process and models of the Colorado State Demographer's Office (SDO). It is important to note that water use data includes demands from transient and permanent populations, and for commercial and light industrial uses. Information was gathered from municipal water providers and reviewed with each basin roundtable. Estimated water savings from projected passive water conservation projections (i.e. water demand reductions associated with state and federal policy measures) were subtracted from the baseline water use estimates.

Summary of Needs

The North Platte Basin has only one municipal water provider, the Town of Walden, serving a population of about 600. Limitations to the town’s water supply were identified in the original SWSI report, and subsequently addressed through a CWCB-funded study and multi-alternative project, eliminating the only municipal water supply gap in the basin. The Walden Water Supply Project is discussed in Section 4. A small amount of ongoing and future needs to support commercial and light industrial uses were identified in the basin.

Where to find more information:

- Statewide Water Supply Initiative Phase 1 Study, CWCB 2004
  - Section 5 – Projected Water Use
  - Section 6 – Water Needs Assessment
  - Appendix A – State of Colorado Population Projections 2000 to 2030
  - Appendix E – Statewide M&I and SSI Water Demand Projections
- Water Supply and Needs Report for the North Platte Basin, CWCB 2006
  - Section 5 – Consumptive Water Supply Needs in the North Platte Basin
- State of Colorado 2050 Municipal and Industrial Water Use Projections, CWCB 2009
- Statewide Water Supply Initiative 2010, CWCB 2011
  - Section 4 – Consumptive Needs Assessments
  - Appendix H – State of Colorado 2050 Municipal and Industrial Water Use Projections
  - Appendix J – Technical Memorandum 2050 Municipal and Industrial Gap Analysis
  - Appendix L – SWSI 2010 Municipal and Industrial Water Conservation Strategies
- North Platte Basin Needs Assessment Report, CWCB 2011
  - Section 4 – North Platte Basin Consumptive Needs Assessment

2.4 Environmental and Recreational Water Needs

Summary of Process

The first statewide effort to comprehensively catalog environmental and recreational needs was conducted in 2007 as part of the Statewide Water Supply Initiative – Phase 2 (not to be confused with the Phase 2 Nonconsumptive Projects and Methods Assessment of the SWSI 2010). This report was structured to build on the work of the 2003 Statewide Water Supply Initiative by summarizing the work of Technical Roundtables that were formed to provide a more detailed analysis of four key topics, Delineating and Prioritizing Colorado's Environmental and Recreational Resources and Needs; Water Conservation and Efficiency; Alternative Agricultural Water Transfer Methods to Traditional Purchase and Transfer; and Addressing the Water Supply Gap.

The 2007 SWSI Phase 2 effort summarized initial environmental and recreational data and programs to serve as the technical platform for the roundtable-specific work of the Phase 1 Nonconsumptive Needs Assessment (NCNA). The NCNA was rolled out to fulfill the legislative requirement to identify environmental and recreational needs in each basin. This process allowed the NPBRT to use detailed mapping of environmental and recreational attributes to identify environmental and recreational focus areas where future studies and projects can be targeted. The NCNA process is described in more detail in SWSI 2010 and its appendices.

For the North Platte Basin the environmental and recreational focus area mapping resulted in a unique map detailing environmental and recreational subcategory counts per stream segment. The map was published as a Geospatial PDF file on the CWCB website, in order to allow access via free Adobe software to detailed spatial attribute information for each segment.

As part of the NCNA process the NPBRT was the only basin to rank their nonconsumptive attributes through a formal roundtable voting exercise, summarized in Section 2 and Appendix B of the 2011 Report. The resulting prioritized list of nonconsumptive attributes includes:

1. Important Stream Fishing
2. Important Lake Fishing
3. Waterfowl hunting/riparian and wetland wildlife viewing
4. Waterfowl/Shorebird and Crane Habitat
5. Amphibians
6. Significant Wetland Plant Communities
7. Whitewater and Flatwater Boating
8. River Otter
9. Bald Eagle and Osprey
10. CWCB minimum Instream Flows, Minimum Lake Levels
11. Class 1 Waters + Wild and Scenic Eligible
12. Lake Chub

In 2010, Phase 2 of the SWSI NCNA process involved the identification of projects and methods that help address the environmental and recreational needs detailed in the basin-specific attributes of the NCNA. This analysis included the identification of projects through a detailed outreach and survey process. The following data was collected for each of the projects: name, location, type (project, information and flow protection), status (completed, ongoing, planned, or proposed), BRT attributes, project protections, and reach ID. All identified projects were documented and mapped.

The NPBRT identified 42 proposed, planned, and completed nonconsumptive projects as documented in the 2011 Report. The Phase 2 NCNA process is described in more detail in SWSI 2010 and its appendices.

The resulting identified projects and methods contained:

- Projects identified by CWCB surveys and workshops
- CWCB watershed restoration projects
- Projects funded by CWCB's Water Supply Reserve Account grant program
- CWCB Instream Flows
- Information from the USGS study, Southwest Regional Gap Analysis Project
- Projects identified by the Colorado Division Wildlife (now Colorado Parks and Wildlife)

The next step in the Phase 2 NCNA process involved a simple initial analysis of the extent of protection provided by the listed projects. Projects were identified as providing direct protections (designed intentionally to improve a specific attribute) or indirect protections (not designed to directly improve the specific attribute but may still provide protection).

The final step in the Phase 2 NCNA process involved the creation of an initial map of environmental and recreational gaps. This map was prepared by overlaying the focus areas with the listed projects to determine where focus areas are located without corresponding projects (Figure 7). These maps were not published at the time of the 2011 reports, but made available by the CWCB shortly thereafter.

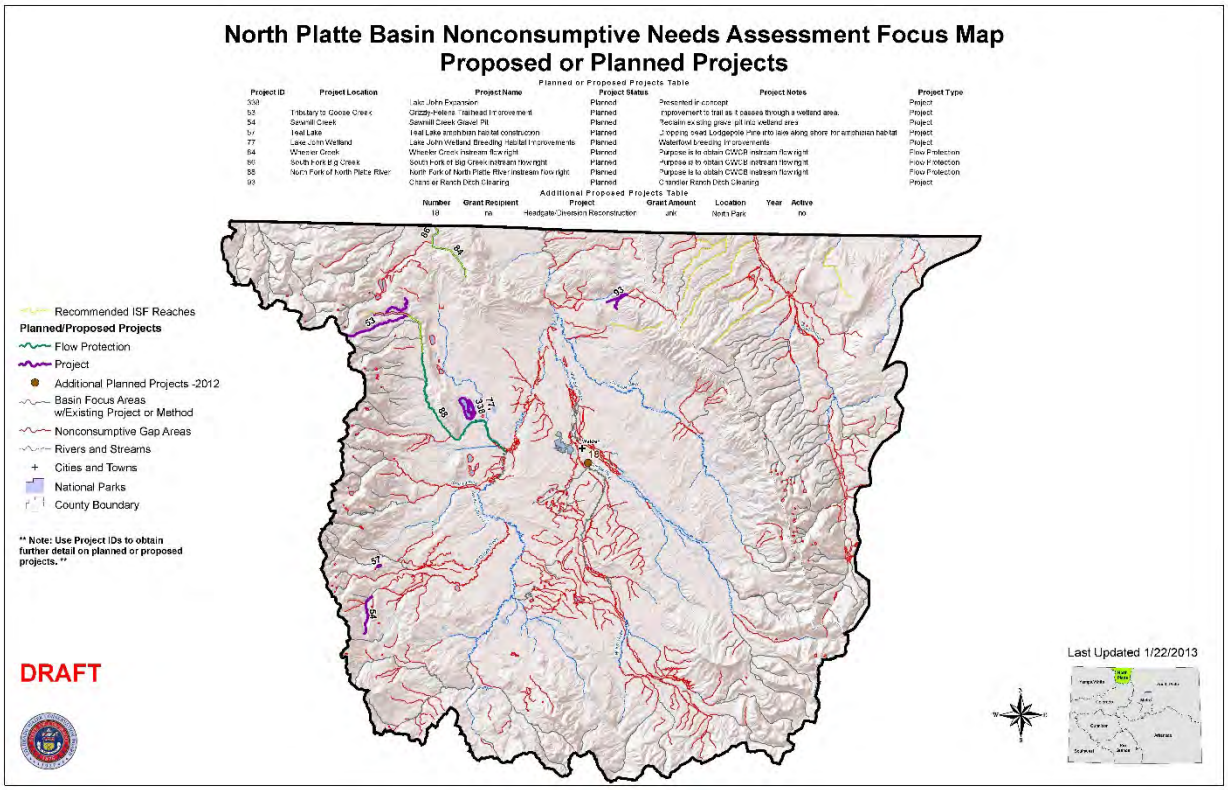


Figure 7. NCNA Phase 1 and Phase 2 Composite Focus Map

Recent Updates

To help with the Basin Implementation Plan process the CWCB created two interim work products since the Phase 1 and Phase 2 NCNA efforts of SWSI 2010. The first product was the Nonconsumptive Toolbox, published in July 2013. This document was designed as a resource for the Basin Implementation Plans by providing a tool to help plan, design, target, and execute nonconsumptive projects and methods. The Nonconsumptive Toolbox includes appendices detailing relevant scientific information, examples of measurable outcomes, tools and resources for project planning, updated basin nonconsumptive maps, funding opportunities, case studies, and existing programs.

The second interim work product from the CWCB was a preliminary environmental and recreational gap analysis delivered at the February 2014 BIP coordination meeting. This analysis provided a broad categorization of environmental and recreational gaps according to a three tier system: high priority projects gap, medium priority projects gap, and low priority projects gap. If any environmental and recreational attributes were identified in a segment, it was assigned to one of the three categories based on the existence of a project (e.g. no project = high priority) and the nature of the project (e.g. indirect protections = high priority; studies = medium priority; direct protections with no state listed species = low priority). Due to the wide variability in approach taken by the roundtables during Phase 1 and Phase 2 of the SWSI NCNA process, the CWCB preliminary gap analysis resulted in large differences between basins, and corresponding range of applicability to the BIP process.

As with agricultural use, environmental and recreational uses are vulnerable to severe droughts. CWCB's 2013 *Colorado Drought Mitigation and Response Plan* characterized environmental and recreational impacts, adaptive capacities, and vulnerability to recent droughts.

FISHING
Stream fishing was ranked as #1 and Lake fishing was ranked as #2 in the prioritization of nonconsumptive attributes by the NPBRT. Fishing, as well as waterfowl hunting, are important components to the outdoor recreation component of the local economy and is enjoyed by locals as well as many visitors to the Basin. The fishing attribute maps detailed in Figures 8 and 9 show streams and lakes accessible by the public with updates since the 2011 report labeled.

In addition to this public access fishing, many of the private ranches in the Basin have either developed their own guiding business for fishing and hunting, or lease their fishing and hunting access to private clubs or outfitters. In this way, outdoor recreation-based businesses add to the agricultural-based revenues for these ranches.

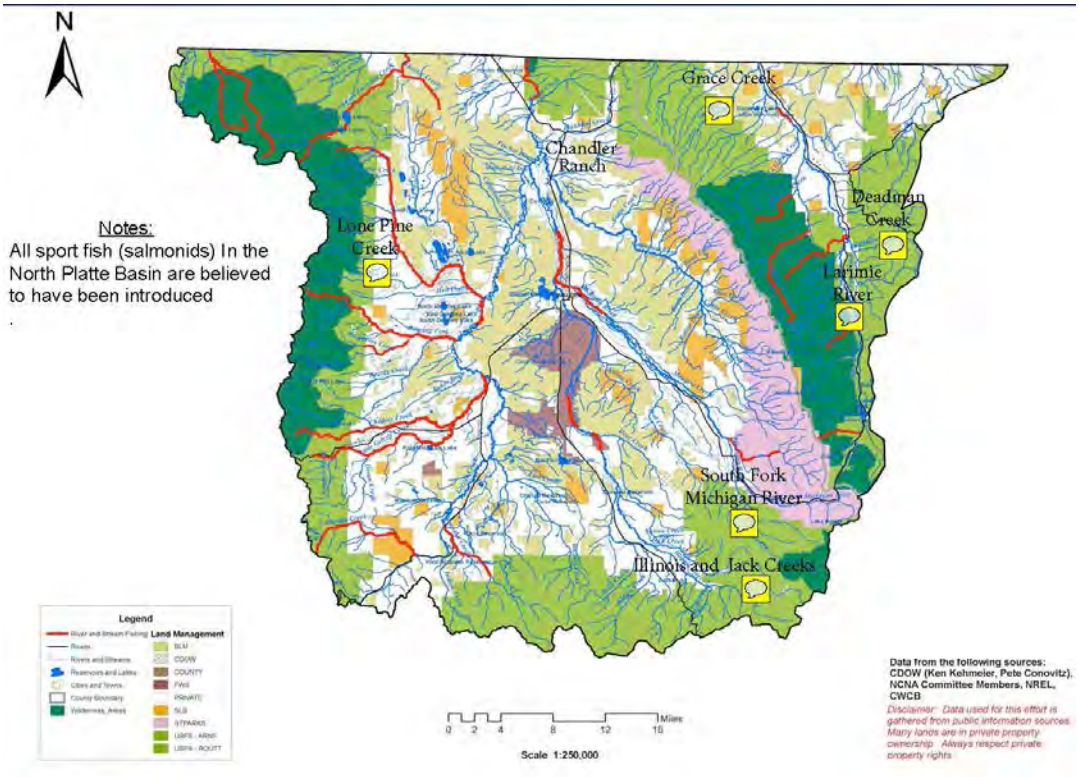


Figure 8: NCNA Important River/Stream Fishing with Public Access

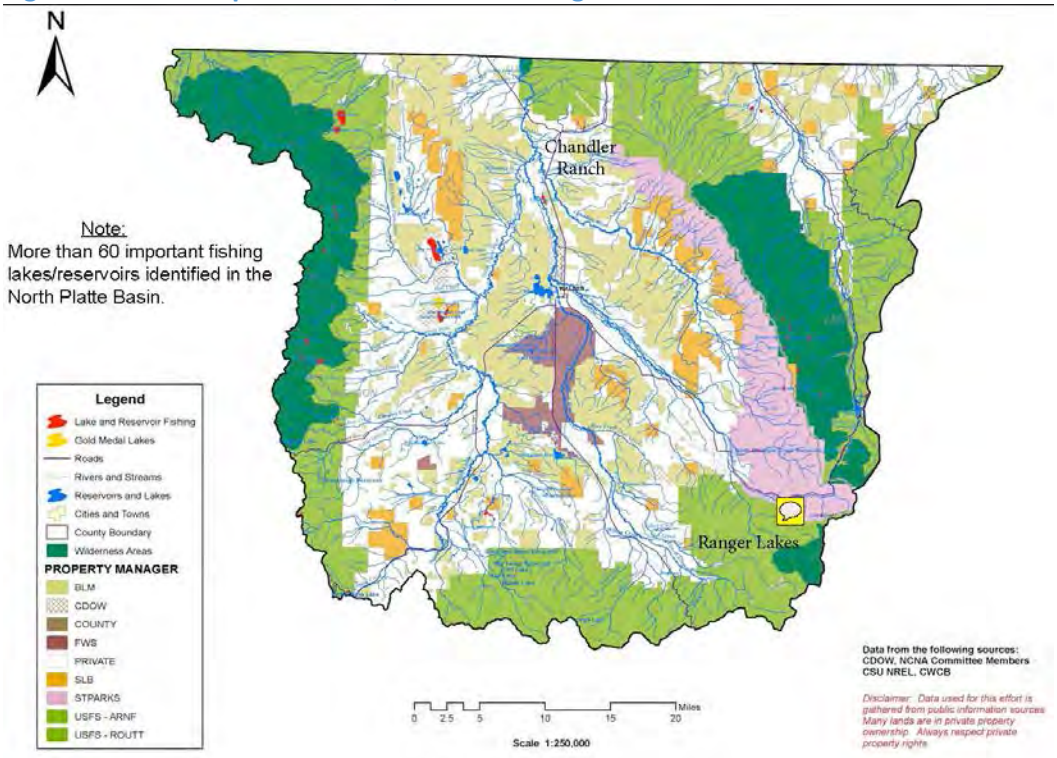


Figure 9: NCNA Lake and Reservoir Fishing with Public Access

WATERFOWL

Waterfowl hunting/riparian and wetland wildlife viewing was ranked as #3 and Waterfowl/Shorebird and Crane habitat was ranked as #4 in the prioritized nonconsumptive attribute list for the NPBRT. North Park (the lower elevations of Jackson County which represent a substantial fraction of the North Platte Basin) boasts the second most productive waterfowl habitat in Colorado. The USFWS developed the Arapaho National Wildlife Refuge in the heart of the basin to leverage this strength. One characteristic of North Park is that, due to the limited growing season (average of 45 frost-free-days), there is only one cutting of high mountain grass hay. For this reason, a natural synergy exists between irrigated hay meadows and waterfowl production. The hay cutting occurs late enough in the season that the young have fledged and therefore does not interfere with waterfowl production. North Park is the only part of Colorado where Ducks Unlimited works actively with private landowners to improve or increase hay meadows to the mutual benefit of consumptive and nonconsumptive attributes. A WSRA-funded study by Ducks Unlimited, the Irrigated Meadow Conservation Program Phase 1, identified potential projects to bring together potentially irrigable land with existing available water rights as indicated in the updated NCNA map in Figure 10.

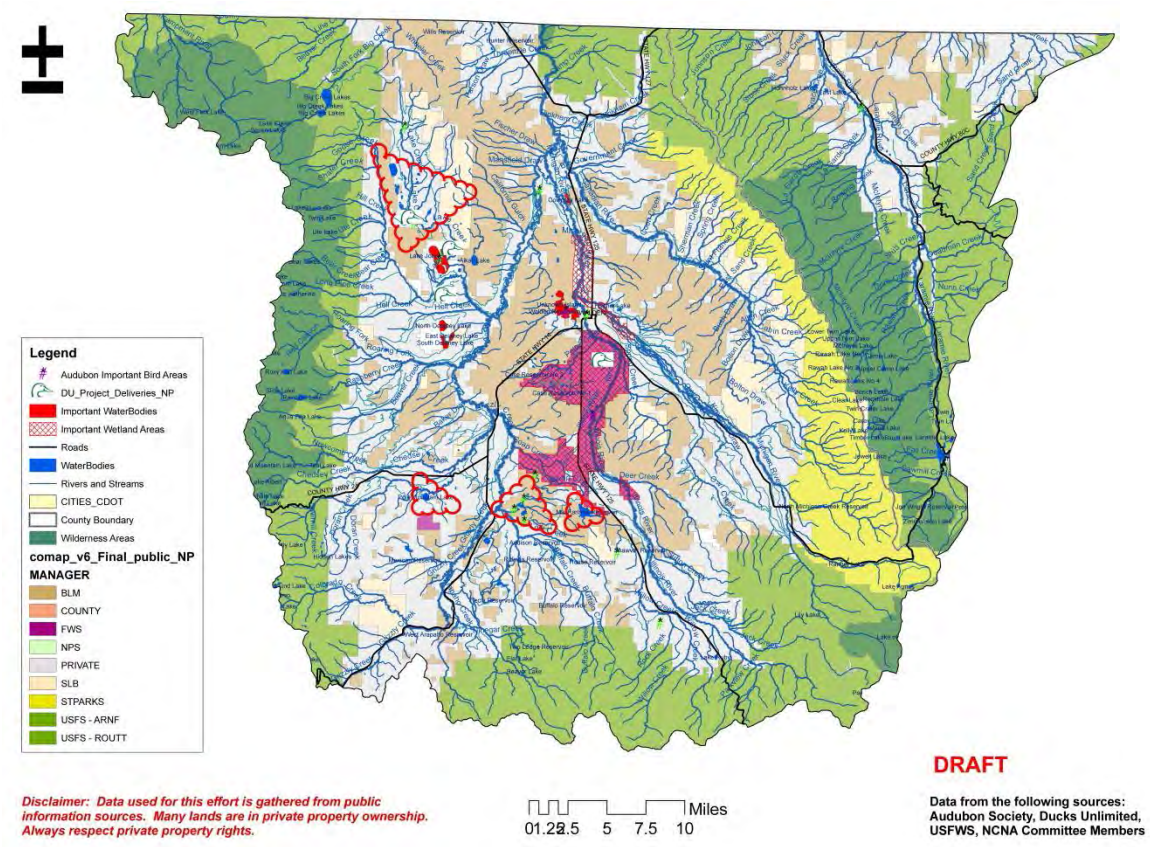


Figure 10: NCNA Important Waterfowl/Waterbird Habitat

WETLANDS

Although wetlands were ranked only in the 6th position by the NPBRT, these habitats provide the foundation for several of the other important attributes in the Basin including waterfowl/waterbird attributes (#3 and #4) and amphibians (#5). Wetlands have been the focus of previous studies, some of which have been funded by the North Platte Roundtable through the CWCB's Water Supply Reserve Account. WSRA funds supported the inventory of wetlands in the NP Basin by scientists from the Colorado Natural Heritage Program (CNHP) of Colorado State University. After studying the wetland plant communities and amphibians on sites predominantly on private lands (with express permission from landowners), the conclusions captured in the resulting report, "The Identification and Assessment of Important Wetlands in the North Platte River Watershed" (http://www.cnhp.colostate.edu/download/documents/2010/North_Platte_Report_may1.pdf), included:

- The existing paper National Wetlands Inventory maps for the North Platte Basin, which show that there are 138,043 acres of wetlands and water bodies, comprising 11% of the land area, were digitized. Only 6402 acres of the NWI total represent rivers or lakes. With lakes and rivers excluded, 77% of the wetland acres are herbaceous wetlands, 20% are shrub wetlands. Within the basin, almost 60% of the wetland acres are irrigated.
- The study team had access to 177,000 acres approved by private landowners in addition to wetlands on public lands.
- "The contiguous, relatively unaltered riparian corridors are the most significant asset of the watershed".
- The diversity of wetland and riparian communities in the North Platte Watershed afford the citizens of Colorado some of the most extensive habitat for waterfowl, shorebirds and aquatic mammals.
- They also noted that North Park is one of only two locations in Colorado where all three species of mountain amphibians of interest (the Boreal toad, an endangered species, the Wood Frog and the Northern Leopard Frog) are found.

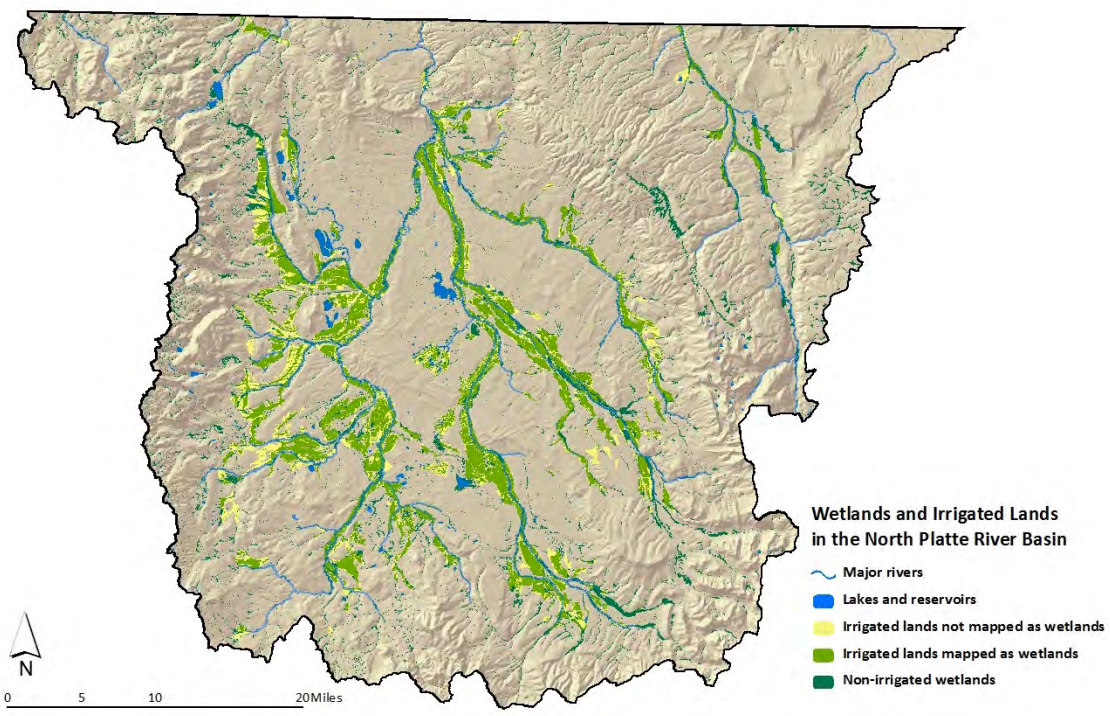


Figure 11. Colorado Natural Heritage Program Study Wetlands Map

However, due to the controversial designation of "potential conservation areas" that delineated private lands with and without permission for on-the-ground studies the study was not supported by the full roundtable.

The CNHP also conducted an assessment of the health of 95 randomly selected wetland sites in the NP Basin funded jointly by the EPA and CPW the following year. The resulting report: "North Platte Wetland Profile and Condition Assessment" contained a number of important observations and conclusions including:

- Over 600 plant species were identified in 95 sampling sites of about 1 acre each. Such wetland plant diversity is striking when compared to a total of about 3,000 plant species of from all types of plant cover found in Colorado.
- Across all methods, trends clearly indicate that wetlands in the North Platte River Basin are in very good condition.
- The landscape is less fragmented that in other parts of the state and the wetlands have good buffers.
- Continuing best management practices for cattle will maintain the healthy balance between cattle ranching and healthy wetland systems.
- Across the 138,043 acres of wetlands and water bodies mapped for the North Platte Basin, 90% (124,350) was identified as types important to waterfowl. This justifies continued emphasis on

wetland conservation in this basin by CPW and partner agencies and organizations with shared missions to conserve wetland dependent wildlife.

It is also clear from both the CNHP reports that protection and conservation of wetlands must involve collaborative partnerships with private landowners, since 73% of the wetland acres are privately owned and 70% of the privately owned wetland acres are irrigated.

It's important to recognize that water quality is important to both consumptive users downstream as well as for nonconsumptive (environmental & recreational) benefits in the Basin. The Water Quality Control Division (WQCD) of the Colorado Department of Health and Environment (CDPHE) for the first time included a section on wetlands for their state-wide assessment of water quality in 2012

The 2012 "Integrated Water Quality Monitoring and Assessment Report" introduced a new section on Wetlands with these comments:

- In Colorado, no single agency or organization oversees work on all four of the core elements, nor is there an official coalition or council that facilitates joint work on all four elements. Instead, individual state agencies or organizations focus on particular aspects.
- Inventory, monitoring and assessment of Colorado's wetlands (Core Element #1) has largely been led by the Colorado Natural Heritage Program (CNHP; www.cnhp.colostate.edu), a research unit of Colorado State University (CSU). Through partnerships with other agencies and organization, data generated through monitoring and assessment informs the other three elements."

The 2012 Report includes elements of the assessment of the wetlands in the North Platte Basin conducted by CNHP. It also includes information from and links to the new digital mapping tools for wetlands in Colorado, which include the North Platte Basin:

- "Digital wetland mapping is available to the public through two online mapping tools. USFWS supports the NWI Wetlands Mapper (www.fws.gov/wetlands/Data/Mapper.html), where users can view and download all official NWI data. In addition, CNHP and CPW recently developed the Colorado Wetlands Inventory (www.cnhp.colostate.edu/wetlandinventory), an online mapping tool that displays Colorado NWI data plus data from several non-NWI wetland mapping projects, such as playa wetlands mapped on the eastern plains or fen wetlands mapped in the mountains."

Summary of Needs

Due to the nature and extent of the various environmental and recreational attributes in the North Platte Basin, the CWCB preliminary gap analysis identified the majority of the stream segments in the basin as having a high projects gap. Since this exercise did not result in useful information to help target environmental and recreational projects in the basin, the roundtable chose to create a weighted environmental and recreational focus map based on the NPBRT's prioritization of attributes. This map uses the relative priority and concentration of environmental and recreational attributes to create a heat map that better indicates the concentration and relative importance of attributes per roundtable

consensus. This map will be used to help target projects to address identified environmental and recreational attributes in the basin, including both multi-purpose projects and specific environmental and recreational projects. The resulting map is detailed in Figure 12.

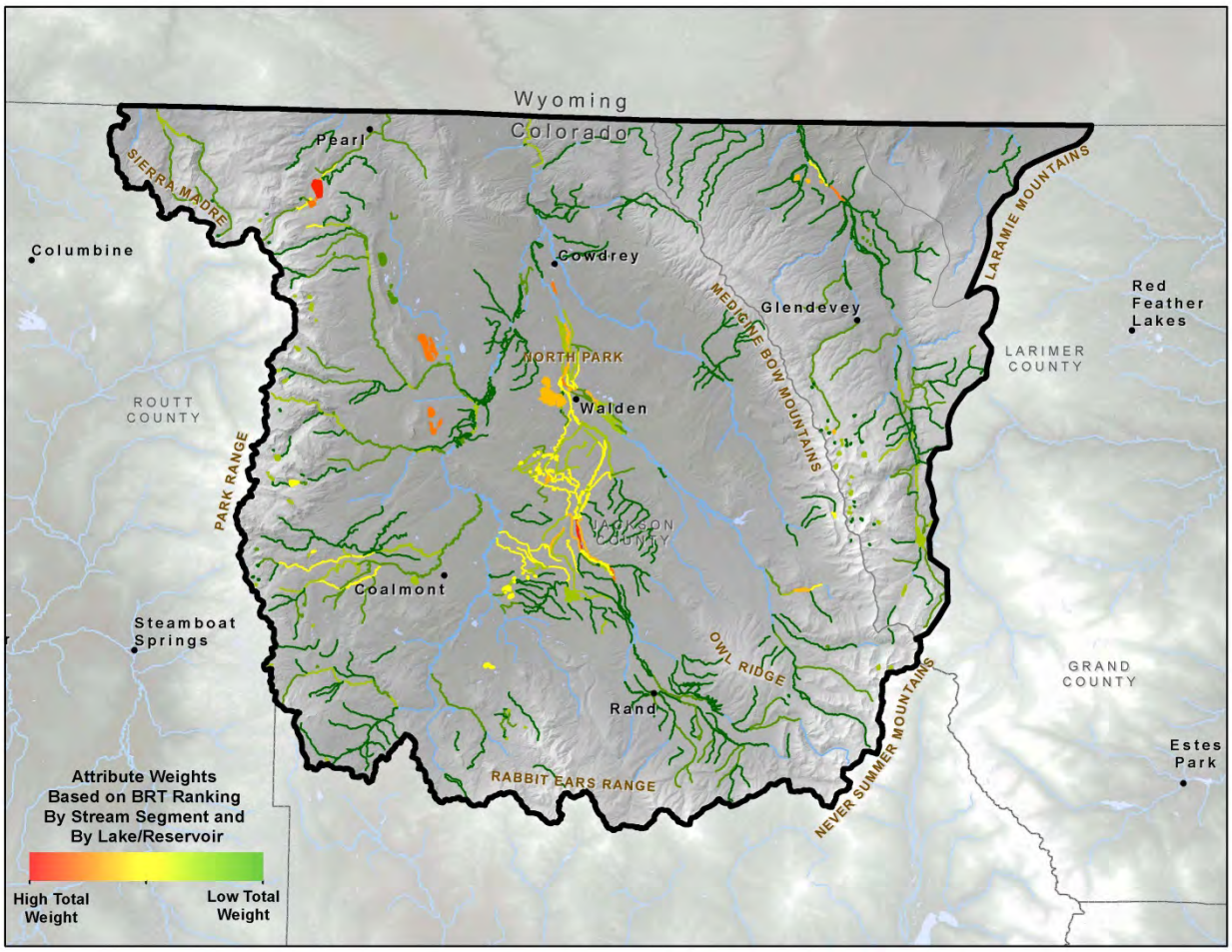


Figure 12: Weighted Environmental and Recreational Attribute Focus Map

Where to find more information:

- Statewide Water Supply Initiative 2010, CWCB 2011
  - Section 2 – Nonconsumptive Needs Assessment
  - Section 3 – North Platte Basin Nonconsumptive Projects and Methods
- North Platte Basin Needs Assessment Report, CWCB 2011
  - Section 2 – North Platte Basin Nonconsumptive Needs Assessment
  - Section 3 – North Platte Basin Nonconsumptive Projects and Methods
- Nonconsumptive Toolbox, CWCB 2013
- Identification and Assessment of Important Wetlands within the North Platte River Watershed, Colorado Natural Heritage Program
- North Platte River Basin Wetland Profile and Condition Assessment, Colorado Natural Heritage Program
- 2012 Colorado Integrated Water Quality Monitoring Report, Colorado Department of Public Health and Environment

Section 3: Basin Evaluations

3.1 Introduction

There are many tools available to help assess opportunities and constraints to meeting the water needs of the North Platte River Basin. The primary tool used to evaluate hydrologic opportunities and constraints is the North Platte River Basin Water Resources Allocation Model, developed by CWCB. Since the water allocation modeling effort for the Laramie River watershed has not yet been completed, this model reflects only the North Platte River watershed (Water District 47). In addition to the North Platte Model, mapping overlays are a useful tool to identify trends in irrigated acreage, highlight opportunities for multi-use projects, and identify projects that may be competing for the available water.

In this section, case studies are presented to illustrate examples of how available tools can be used to identify opportunities and projects, and to investigate constraints basin-wide and at specific locations. The types of tools and analyses presented in this section support the project specific analyses summarized in Section 4.

3.2 North Platte River Basin Water Resources Allocation Model

The North Platte River Basin Water Resources Planning Model (North Platte Model) is a water allocation model developed as part of the Colorado Decision Support System (CDSS) process. It is designed to assess the availability of water to individual users and projects, based on hydrology, water rights, and operating rules and practices. The model is implemented in "StateMod", a program developed by the State of Colorado for application in the CDSS project. The North Platte Model "Baseline" data set extends from 1956 to 2007. It simulates current demands, current infrastructure, and the current administrative environment as though they had been in place throughout the hydrologic modeled period.

The North Platte Model was developed as a tool to test the impacts of proposed diversions, reservoirs, water rights and/or changes in operations and management strategies. The model simulates proposed changes based on the highly variable hydrology of the historic data set as constrained by the administration of existing water rights. The Baseline data serves as the starting point for analyzing potential future changes in the basin. Model variations can include changes in current demands, new or enlarged storage projects, changes in current irrigation practices, changes to water rights or operating criteria, and changes in hydrology. The model changes can then be compared to the Baseline simulation results to determine their performance and effects.

The North Platte Model was used to identify flow-based issues and make preliminary estimates of water

available for projects in the NPBIP. The model can also be revised to include new projects (e.g. to investigate the yield of a proposed reservoir); assess the impacts of changes to irrigation efficiencies; or determine how changed reservoir operations could improve streamflows through critical reaches.

3.2 Spatial Data

Spatial data has been developed for the North Platte River Basin through several efforts. Assembling, overlaying, and analyzing the available data is an important step in both identifying and evaluating projects to meet consumptive, environmental, and recreational needs. Key data assembled and used for the NPBIP includes:

- *Irrigated Acreage Coverages:* Irrigated acreage assessments were completed for 1956, 1976, 1987, 2001, 2005, and 2010 through the CDSS modeling efforts, and for 2011, 2012, and 2013 by DWR for the Equitable Apportionment Decree annual accounting. Additionally, irrigated and irrigable acreage was mapped in 1940. The original map has been digitized to create an additional historical irrigated/irrigable acreage coverage as shown in Figure 13.
- *Environmental and Recreational Attributes and Projects:* Coverages were developed through the SWSI 2010 NCNA process as described in Section 2.
- *Landowner Coverage:* Coverages reflecting private land ownership in the basin were obtained from Jackson County Water Conservancy District (JCWCD). A coverage delineating Federal and State ownership was obtained from the Bureau of Land Management (BLM).

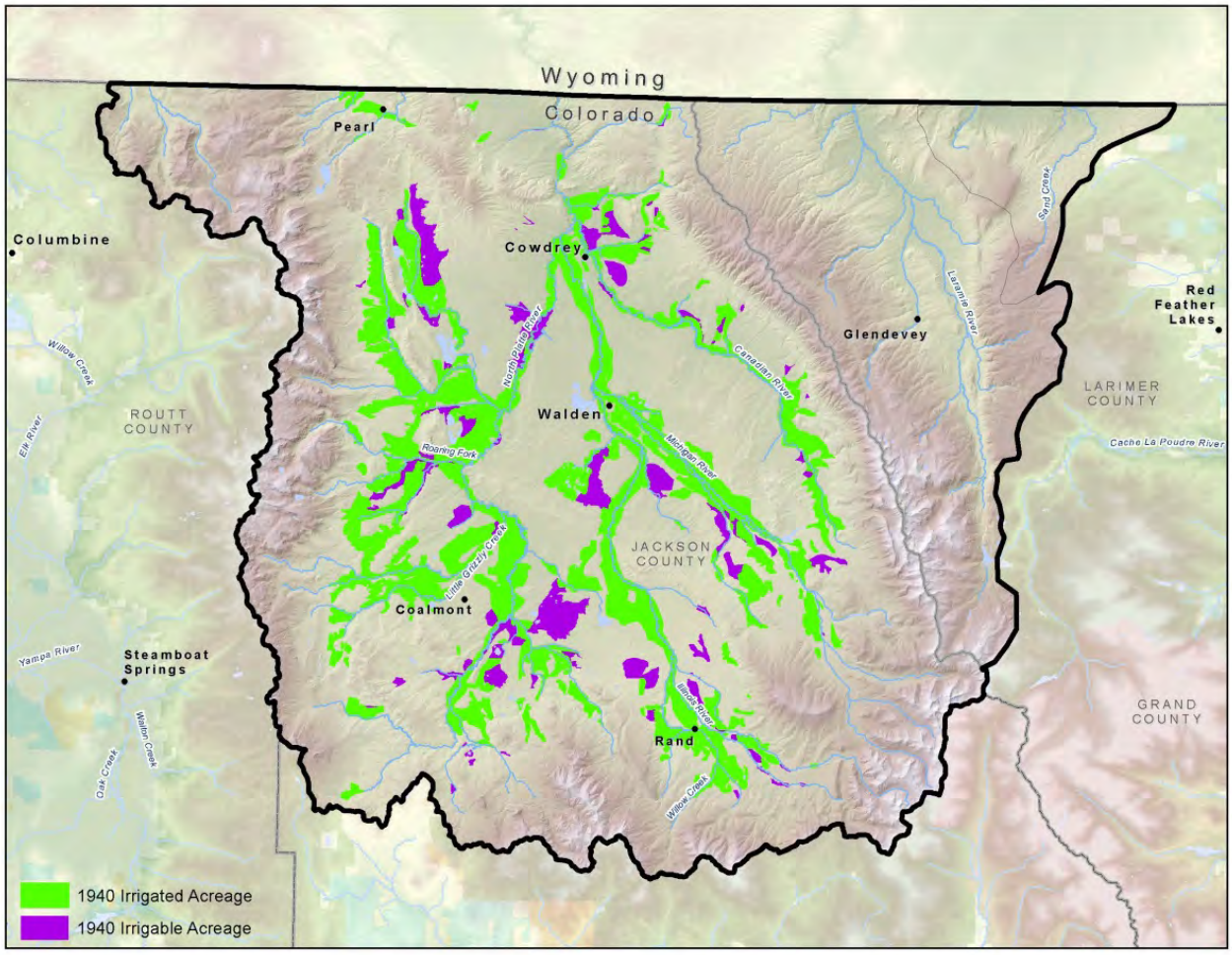


Figure 13: 1940 Irrigated/Irrigable Acreage Coverage

All spatial data was overlaid and reviewed in order to identify irrigation projects and/or project demands; assess high-concentration areas of environmental and recreational needs; investigate areas with potential opportunities for multi-purpose projects; and determine projects that may benefit from more detailed flow analysis.

Where to find more information:

- The North Platte River Basin Water Resources Planning Model User's Manual (rev. 2009) report and the StateMod Surface Water Allocation Model for the North Platte Basin can be found on the CDSS website (cdss.state.co.us)
- Spatial data developed through the CDSS modeling effort can be found on the CDSS website (cdss.state.co.us/GIS/Pages/DataByCategory.aspx)
- Land ownership developed by the Bureau of Land Management can be found on the Colorado BLM website (www.blm.gov/co/st/en/BLM_Programs/geographical_sciences/gis/GeospatialData.html)

3.4 Case Studies

Case Study: Irrigated Acreage Analysis

Identification and evaluation of irrigation projects through the NPBIP process was important in addressing the primary goal in the North Platte Basin: *maintain and maximize the consumptive use of water in the basin*. Since no agricultural projects were identified during the SWSI 2010 process, NPBRT discussions and a technical meeting with local landowners were used during the NPBIP process to identify potential projects. Recent irrigated acreage assessments were overlaid with the historical 1940 acreage delineation to identify potential opportunities to put historically irrigated acreage back into production. Once identified, discussion with local landowners provided anecdotal information as to potential feasibility and constraints on serving this irrigated acreage, including infrastructure issues, limited water availability, land ownership, or land conditions. These discussions guided whether the parcel of land would be included as a potential project and what additional analysis could be performed to better understand the feasibility. Irrigated acreage on the Cumberland Ditch serves as an example of this process.

Cumberland Ditch diverts from the Michigan River to serve acreage bounded by the Michigan River on the west and the Canadian River on the east. The analysis prepared to support the technical outreach meeting overlaid the current acreage with the 1940 acreage, limited to only privately owned lands. This overlay revealed a large parcel of potentially irrigable land attributed to the Cumberland Ditch. Figure 14 reflects the current irrigated acreage (2013) served by Cumberland Ditch with respect to the potentially irrigable parcel from the 1940 coverage.

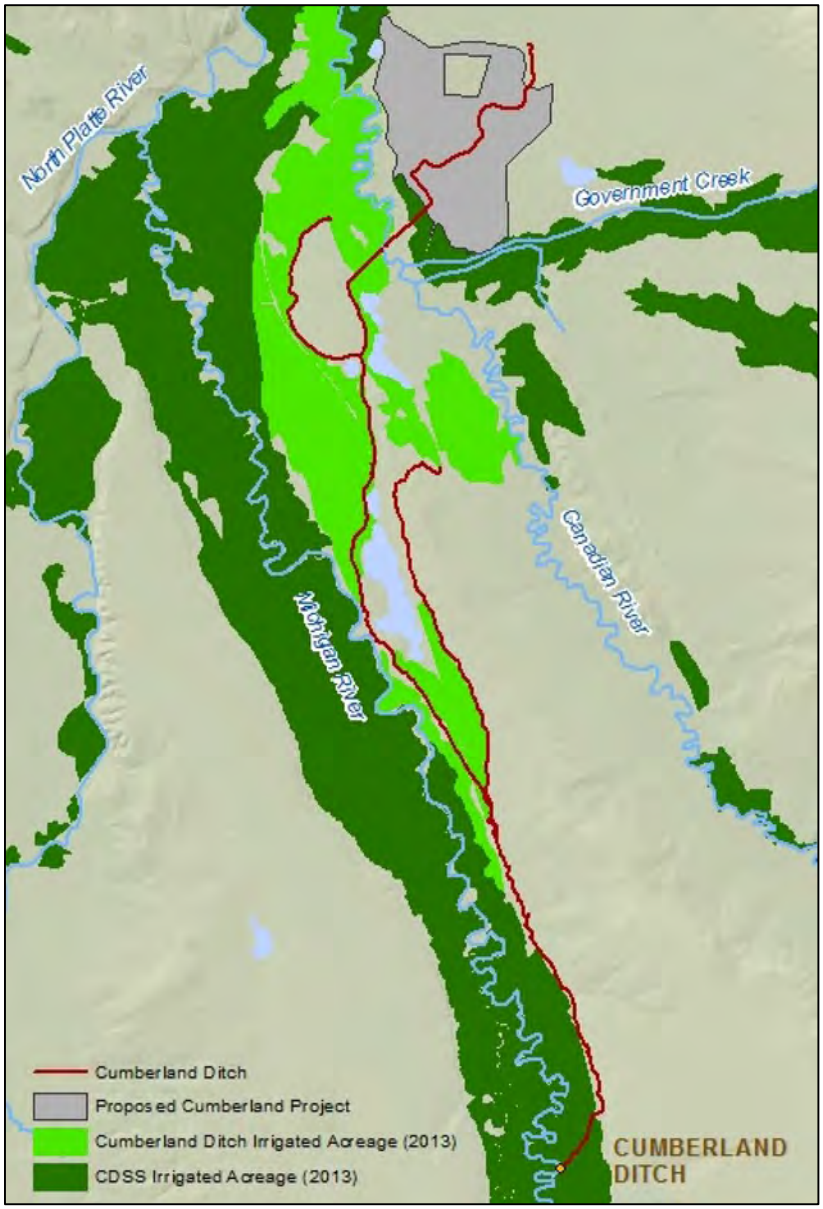


Figure 14. Cumberland Ditch Irrigated Acreage Analysis Case Study

This potentially irrigable acreage consisting of approximately 540 acres was identified as a possible opportunity. Additional discussion at the technical meeting vetted potential constraints. Discussions with the land operator revealed that there was historically a siphon under the Canadian River that served the acreage. The siphon fell into disrepair and would need to be restored to serve this acreage. After identifying the initial opportunity and constraints, the NPBRT chose to include the parcel as a consumptive use project.

This approach resulted in six consumptive use projects focusing on irrigated acreage for inclusion in the NPBIP, totaling more than 10,500 acres. Consumptive use projects ultimately selected by the NPBRT are summarized in Section 4, with additional analysis provided for select projects.

Case Study: Legally Available Flow

The North Platte Model has the capability to estimate the amount of water that is physically and legally available at a given location for potential development. This capability is useful in estimating the amount of water that would be available to a new consumptive or environmental and recreational project in the basin, and to examine the impacts to water availability and streamflow throughout the remainder of the basin. Legally available flow varies widely from one tributary to the next and from one year to the next, and is generally less than the physical streamflow. The differences between physical streamflow and the amount of water that is available for future use reflects water that must be bypassed to meet downstream uses with senior water rights.

In continuing with the previous case study, this variability and comparison to physical streamflow can be seen for the Cumberland Ditch irrigated acreage as shown in Figures 15 and 16. These figures, reflecting data extracted directly from model results, show physical streamflow and legally available flow on the Michigan River at the Cumberland Ditch diversion point for the period of 1975 through 2007.

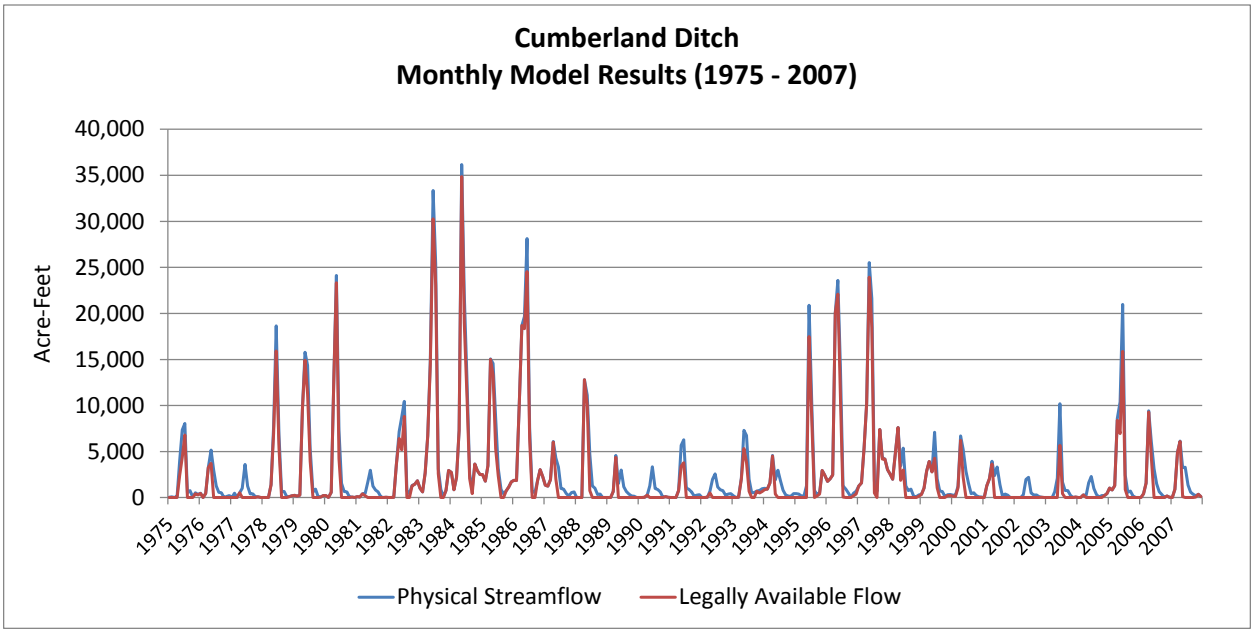


Figure 15. Cumberland Ditch Legally Available Flow Case Study – Monthly Model Results

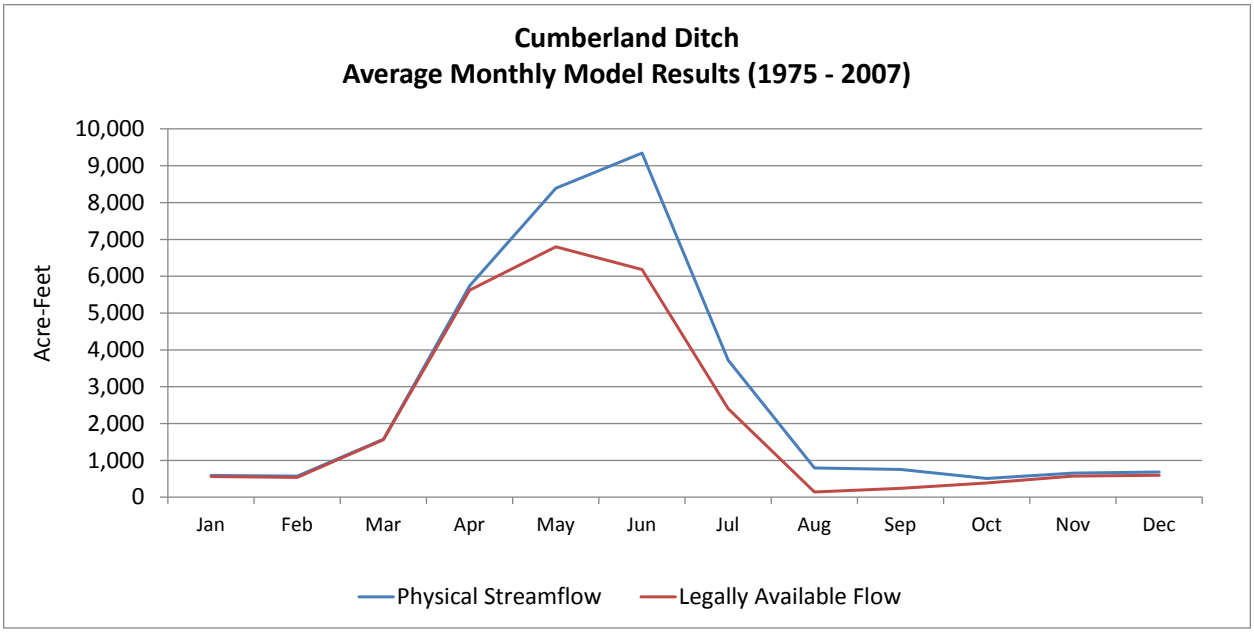


Figure 16. Cumberland Ditch Legally Available Flow Case Study – Average Monthly Model Results

As the graphs illustrate, in dry years there is no legally available flow at the Cumberland Ditch diversion point. However in many years there is sufficient legally available flow in the early irrigation season to supply a portion of the additional Cumberland Ditch acreage without injury to existing water rights. As is typical in the basin, the average monthly results indicate that both physical and legally available streamflow drops significantly in the late irrigation season resulting in late season shortages.

Additional applications of this type of analysis may include:

- Evaluation of available supply for reservoir enlargements or new projects
- Evaluation of estimated reservoir supply and yield to support reservoir sizing
- Evaluation of monthly flows for environmental and recreational projects

Legally available flow analyses were performed for select projects as described in Section 4.

Case Study: Analysis of Agricultural Impacts on Streamflows

The streamflow regimes of the major tributaries in the North Platte River Basin are dominated by agricultural use. Land owners divert to irrigate large ranches through open channels, consumptively using a portion of the supply, while the remaining unconsumed portion is returned back to the river or stored in soil moisture for later use. This case study examines the interplay of these components at the parcel level and basin-wide.

The North Platte Model serves as a tool to explore each of these components individually, as well as to evaluate what natural flow would look like in the basin absent of man's influence. This case study includes a discussion of:

- Natural flow compared to actual physical streamflow in the basin
- Consumptive use of irrigation supplies
- Irrigation practices
- Reservoir operations

Comparison of Natural Flow to Streamflow in the Basin

The North Platte Model provides a platform for looking at natural conditions in the basin, without the presence of man and agricultural use in the basin. The model has the functionality to estimate natural flows whereby the impact of diversions, CU, and return flows are removed from streamflow gage records, resulting in natural flow. The comparison of natural flows to recorded streamflow shows how agricultural use in the basin has affected the natural flow conditions, both in quantity and timing. Figures 17 and 18 illustrate the natural flow compared to the recorded streamflow at the North Platte River at Northgate gage and the Grizzly Creek near Hebron gage, shown with two different modeling periods to view annual and monthly differences.

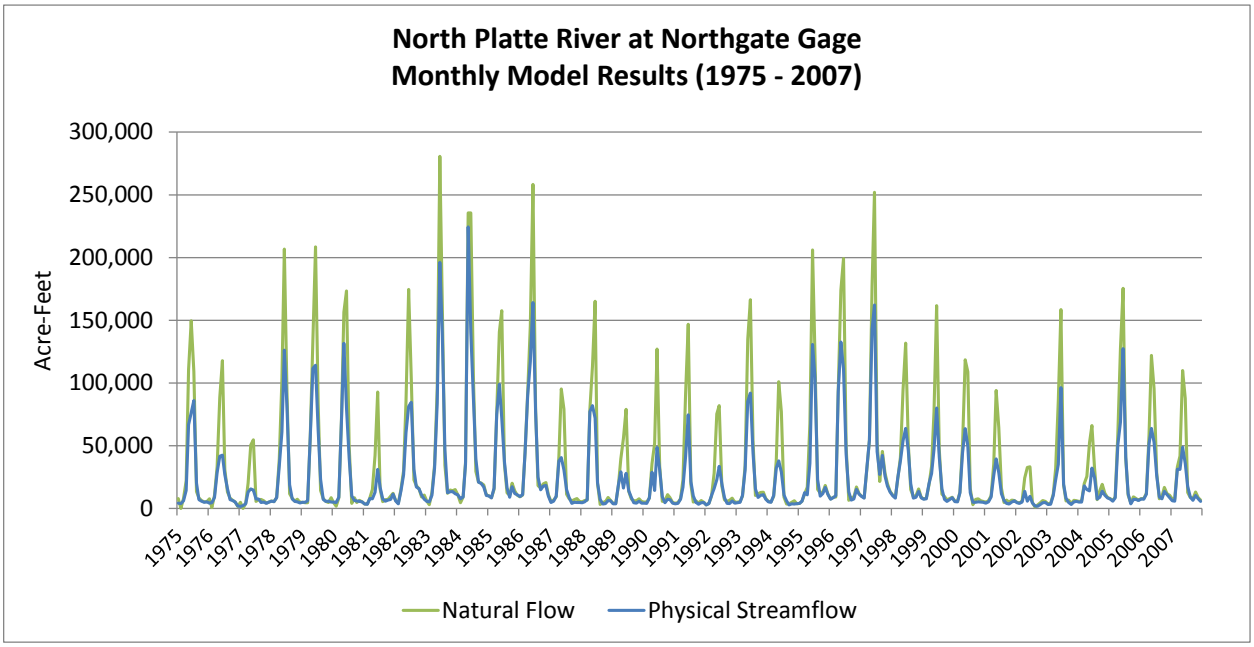


Figure 17. Natural Flow vs. Streamflow Case Study – North Platte River at Northgate gage

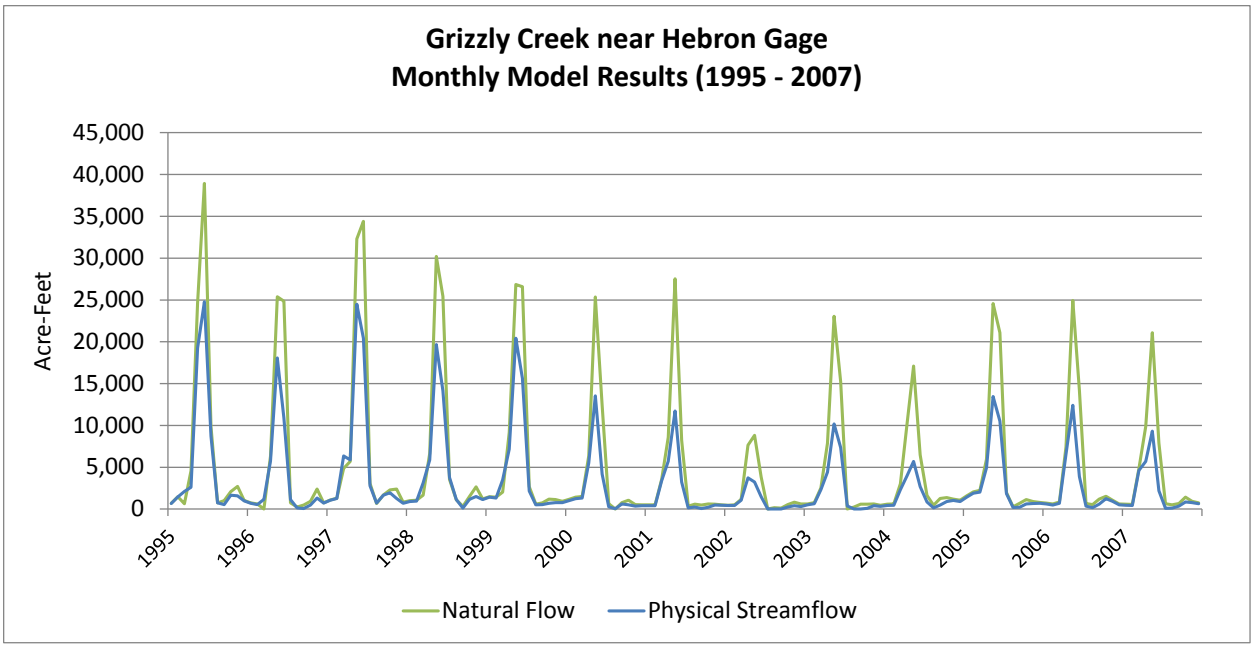


Figure 18. Natural Flow vs. Streamflow Case Study – Grizzly Creek near Hebron gage

There are two key observations that can be drawn from the graphs. First, the large differences between natural flow and streamflow shown in the graphs reflect that stream depletions are occurring in the early irrigation season (i.e. May and June). Second, agricultural use is not significantly altering the natural streamflow conditions during periods outside of the early irrigation season, during periods of lower flows. These observations both point to the fact that significant depletions are not occurring during late season months, which would further exacerbate low flow conditions for fish and amphibian species. Additionally, the results indicate that low flow conditions exist naturally in the basin and are generally not the result of agricultural development in the basin. The graphs reflect an accumulated impact of all diversions, consumptive use, return flows, and storage occurring upstream of the gage location. The effects on natural flow conditions for a specific stream reach may show a greater impact, particularly in stream reaches with storage operations. However, in general, consumptive use from direct diversions in the early irrigation season has the largest impact on streamflow in the basin.

Consumptive Use of Irrigation Supplies

There are close to 390,000 acre-feet of diversions to irrigation and storage on average annually in the North Platte River watershed, with an additional 21,000 acre-feet of diversions in the Laramie River watershed. This is compared to 195,000 acre-feet and 6,300 acre-feet of CIR average annually in the North Platte River and Laramie River watersheds, respectively. Although the diversions appear to be sufficient to meet the CIR on an annual basis, the supply does not coincide directly with the demand as shown in Figure 19.

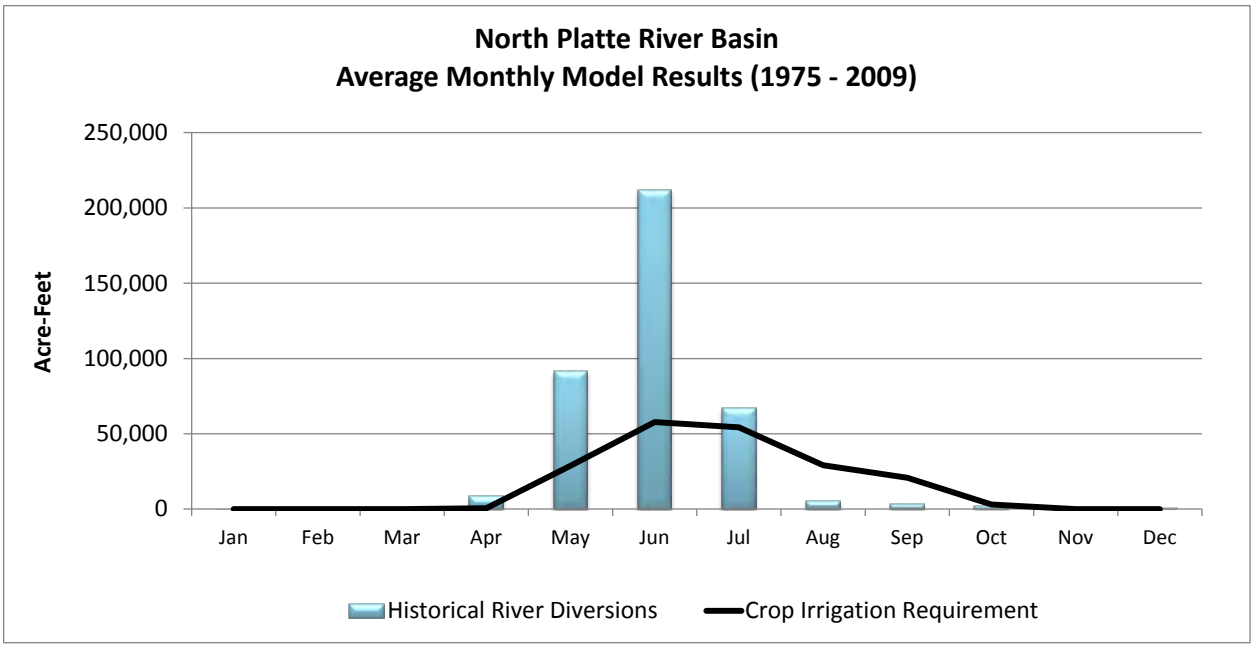


Figure 19. Irrigation Supply Case Study – Average Monthly Model Results

Large diversions do not necessarily result in higher consumptive use or "wasting" water, as the unused portion is stored in the soil moisture reservoir and consumed later in the season, or seeps back to the river and is re-diverted downstream. Ground water studies of the alluvium have not been completed in the North Platte River Basin; however the North Platte Model was calibrated using a relatively quick return flow rate whereby the majority of the return flows reach the river within the same month they are diverted. A small portion, approximately 15 percent of the non-consumed portion of the diversion, reaches the river in the month following the initial diversion resulting in a small stream gain. As depicted in Figure 19 above, the diversions are minimal in the late irrigation season when the stream would most benefit from this stream gain, limiting the significance of this benefit. An irrigation practice that is widely used in the basin does however result in a positive stream benefit, as discussed in the following case study.

Irrigation Practices

Throughout the CDSS modeling efforts, the different types of shortages summarized in Section 2.3 were discussed with local landowners in the North Platte River Basin. As the case study analyses of streamflow and diversions support, there are significant physical and legal shortages in the basin, generally later in the irrigation season. Discussions also indicated that land owners use irrigation practices that result in additional late season shortages, situations when an irrigator may have physically and legally available supply but chooses not to irrigate. Land owners indicated that they stop irrigating before the growing season is complete because they will not have sufficient supply to get an additional cutting. The North Platte Model can be used to understand the impact to the stream resulting from these irrigation practices.

The "Baseline" scenario reflects the full irrigation demand and allocates water based on water rights and water availability. This scenario does not limit diversions based on historical diversions or irrigation practices, rather the Baseline scenario continues to simulate diversions to meet the CIR as long as water is physically and legally available. The difference between the Baseline scenario diversions and the historical diversions is the amount of water that was left in the stream even though irrigators were entitled to divert the water for irrigation. This amount is a direct nonconsumptive benefit to the stream, as it represents diversions that irrigators are physically and legally entitled to but choose not to divert leaving this water in the stream.

This difference can be reviewed for any diversion structure in the basin; Figure 20 illustrates this difference between the Baseline scenario diversions and historical diversions for the Peterson Ditch. This ditch was selected for use in this case study because it has two of the more senior water rights in the basin. Areas in the graph shown in red reflect months when the Baseline scenario diversions are greater than the historical river diversions; the period of results selected for the figure better illustrates these monthly differences.

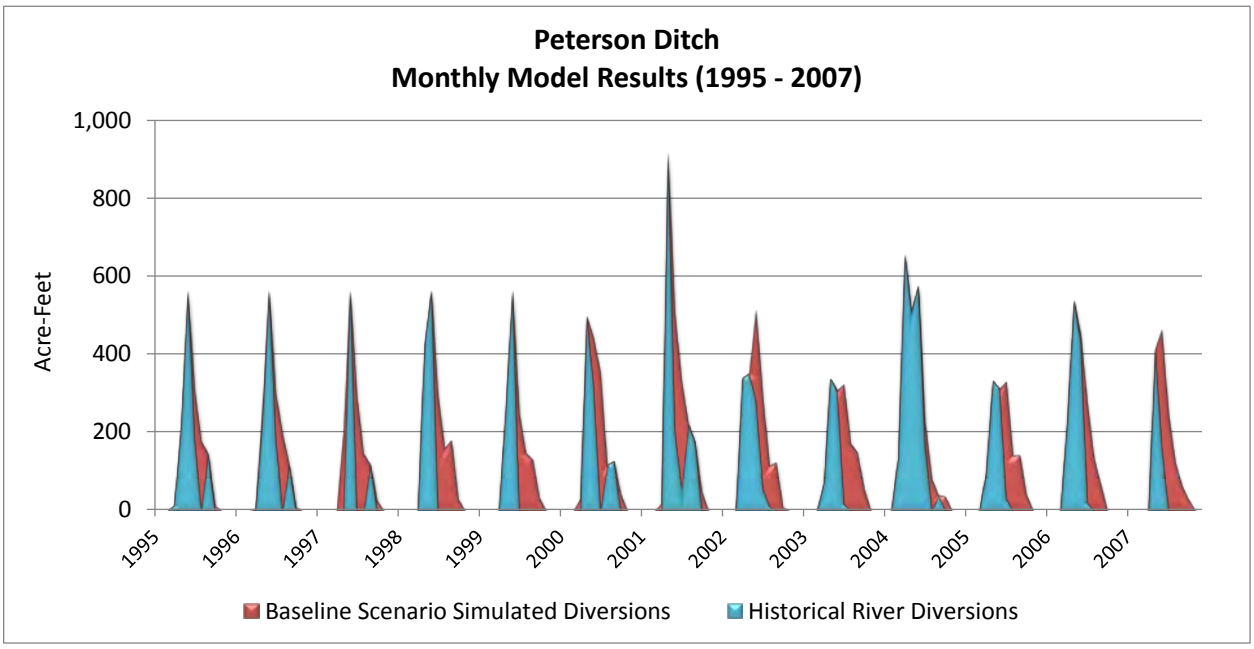


Figure 20. Irrigation Practice Case Study – Average Monthly Model Results

Baseline scenario diversions exceed historical diversions by more than 25,000 acre-feet on average in July and more than 20,000 acre-feet in August over the 1975 to 2007 period for the North Platte River watershed as a whole. These amounts, although a small portion of the almost 400,000 acre-feet of annual diversions in the basin, constitute a large nonconsumptive benefit to the river and have a large impact to the local streamflow in those low-flow months.

Reservoir Operations

Many of the smaller reservoirs in the basin provide supplemental irrigation supplies to lands in close proximity to the reservoir. Larger reservoirs however use the river to convey releases to downstream users and via exchange to upstream users. The North Platte Model is able to simulate reservoir operations, including on-channel storage or via carriers, evaporation, and direct or exchanged releases. In this case study, the operations for Meadow Creek Reservoir are illustrated spatially to understand the extent of the reservoir's impact, and the timing of the reservoir storage as compared to releases.

Meadow Creek Reservoir is an off-channel reservoir constructed in the early 1980's and is primarily filled from Squibob Ditch diverting from the Michigan River. Reservoir releases serve irrigated acreage either through direct release or via exchange, and also serves as the supply for transbasin diversions via exchange through Michigan Ditch. The extent of the reservoir's operations is illustrated in Figure 21.

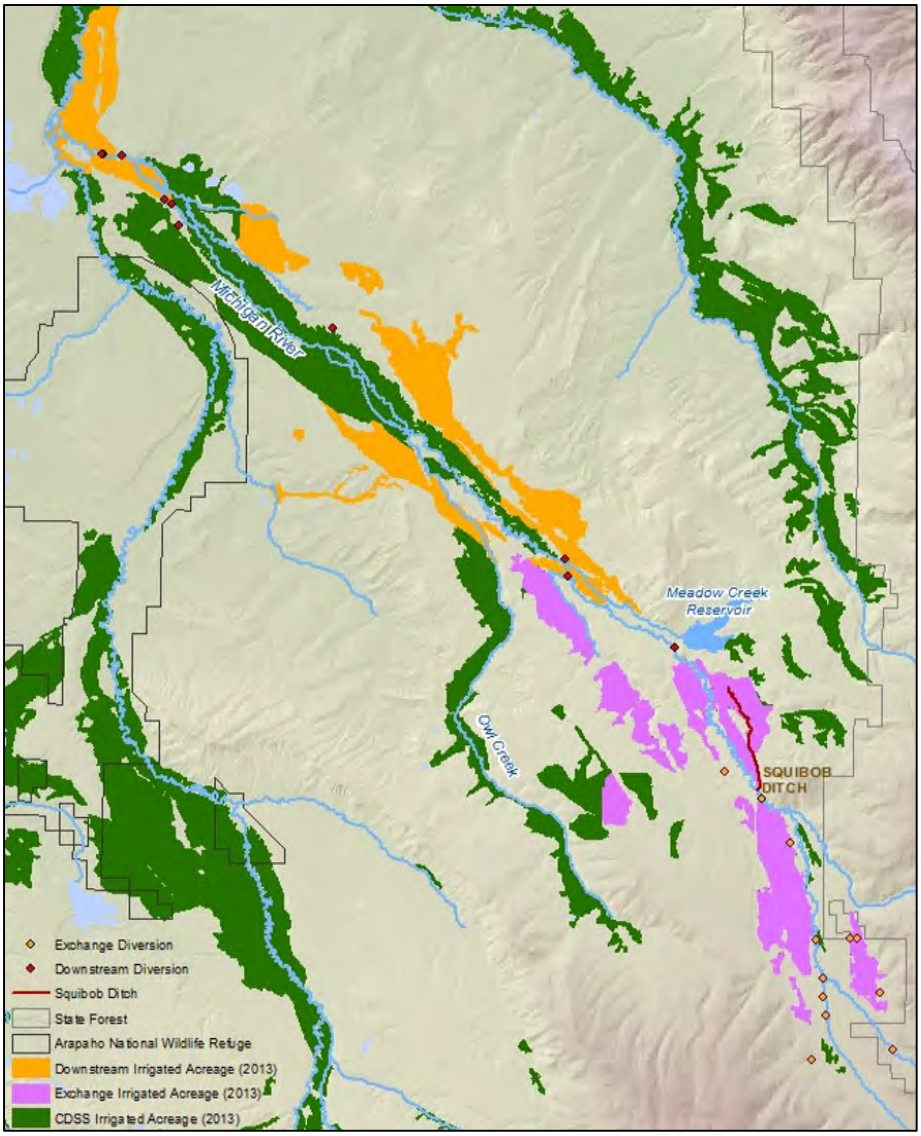


Figure 21. Reservoir Operations Case Study – Meadow Creek Reservoir Extent

For the acreage located downstream, the stream benefits from the released water en route to the downstream diversion point. For Meadow Creek Reservoir, nine downstream ditches have historically been supplied by releases from the reservoir, ranging from 0.19 miles to 13.6 miles downstream of the reservoir.

For ditches and acreage located upstream, the exchange of reservoir releases can only occur as long as water rights within the exchange reach are not injured. This protects existing water rights but does create a depletion in the stream reach between the diverting ditch and the release from the reservoir. An additional nine ditches, including Michigan Ditch, have historically diverted reservoir releases via exchange from Meadow Creek Reservoir, ranging from 2.4 miles to 8.2 miles upstream of the reservoir.

The amount of stream benefits and depletions associated with the reservoir operations in any given month or year is highly dependent on the streamflow conditions and water availability within the stream reach, and the demand for storage and releases. A summary of the general timing of the reservoir storage and releases, shown in Figure 22 for Meadow Creek Reservoir, is useful in understanding the general timing and impact of existing reservoir operations and potential future reservoir operations in the basin.

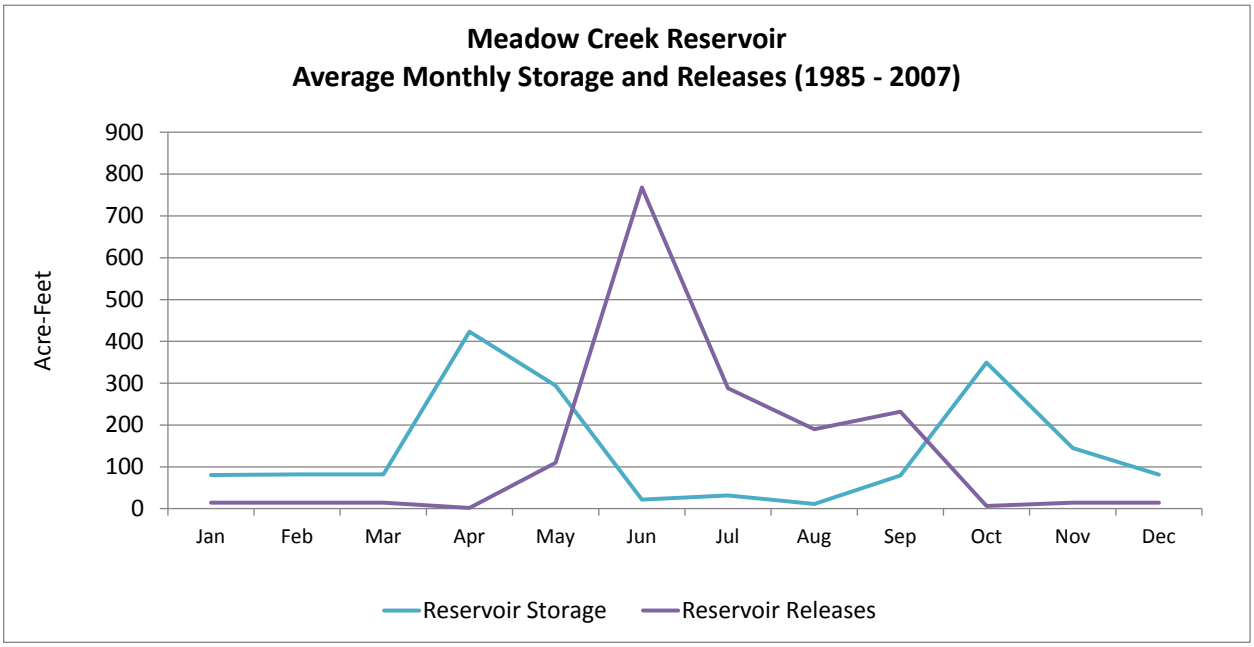


Figure 22. Reservoir Operations Case Study – Average Monthly Storage and Releases

Section 4: Basin Projects

4.1 Introduction

Section 4 is the primary focus of the Basin Implementation Plan (BIP) that summarizes projects proposed to meet basin goals and present plans to guide their implementation. Projects are strategically selected to meet identified needs in the basin. The agricultural shortage analysis detailed in Section 2 was the background for technical outreach to agricultural stakeholders. This analysis was used to inform the selection of agricultural projects that most effectively address shortages and meet basin goals identified in Section 1. M&I and environmental/recreational needs detailed in Section 2 were also used to inform the selection of projects.

Developed in close coordination with the North Platte Basin Roundtable, the information contained in this section is considered a current 'snapshot' of potential basin solutions that is expected to be continually refined by project sponsors after publication of this NPBIP. Project information was collected through targeted technical outreach. Base project data from SWSI 2010 was refined through outreach to stakeholders and project proponents. Future refinements of the NPBIP may update project information and refine strategic implementation plans.

For simplicity, all items identified to meet water needs are referred to as projects. Projects include both structural solutions such as reservoirs and irrigation ditches, and nonstructural solutions such as protocols for the Colorado Division of Water Resources (storage, irrigated acreage, irrigation season). For the purposes of this report the term projects replaces the previous CWCB terminology for water solutions including identified projects and processes, proposed projects and methods, and actions. Projects may or may not have a committed sponsor, preliminary planning, design, conditional or absolute water rights, rights of way, and/or negotiations captured in writing with local governments or other water users.

Section 4.2 provides a list of proposed consumptive projects; Section 4.3 provides a standard project template used to summarize proposed projects; Section 4.4 provides a compilation of standard project summaries for proposed projects.

Other items that the guidance document included in Section 4, but that are not directly related to the implementation of projects, are included elsewhere in this report. The report Introduction includes a discussion of education, participation, and outreach (Section 4.1 of the guidance) and watershed health (Section 4.2 of the guidance). Note that the optional Section 4.8 of the guidance regarding Interbasin Projects and Methods is not applicable for the North Platte Basin and not included herein. For more information on how the structure of the NPBIP compares to the guidance refer to the comparison table in the report Introduction.

4.2 Updated Project List

Planned Projects

The planned projects listed in this section are the heart of the NPBIP. These consumptive, environmental, and recreational projects will serve to strategically meet important and diverse water needs identified in the North Platte Basin. Planned consumptive projects were developed through technical workshops and outreach are shown in Table 2 and 3, and Figure 23. Initial environmental and recreational projects identified during SWSI efforts were updated, as well as supplemented with additional projects developed through nonconsumptive outreach efforts, during the NPBIP process. Planned environmental and recreational projects are shown in Table 2 and 4, and Figure 24. Multi-purpose projects with consumptive, environmental, and recreational benefits are included in all three tables as noted in project summaries.

The following Table 2 lists select projects that received additional analysis during this NPBIP process. Project summaries, as discussed in Section 4.3 and included in Section 4.4, were developed specifically for these selected projects because:

- The project, and associated analysis herein, is representative of other projects on the list, such as the case with the Proposed Willow Creek Reservoir and the Hanson and Wattenberg Ditch Acreage;
- Implementation of the project is currently being pursued, such as the case with the Protocols and MacFarlane Reservoir; or
- Implementation of the project is potentially more feasible than projects on the following list due to limited constraints or challenges or more support from the BRT, as with the Canal Maintenance and Improvements project.

Projects not selected require further vetting with the NPBRT and landowners, along with high-level technical analysis, prior to being considered for implementation.

Table 2. List of Planned Projects Selected for Project Summaries

No.	Project	No.	Project
1	MacFarlane Reservoir**	8	Irrigation Season Protocol
2	Evapotranspiration Project	9	Irrigated Acreage Assessment Protocol
3	Walden Reservoir	10	Proposed Willow Creek Reservoir
4	Basinwide Augmentation Plan	11	Dam Ditch Headgate Improvement**
5	Hanson and Wattenberg Ditch Acreage	12	Canal Maintenance and Improvements
6	Proposed Streamgage Installation	13	Instream Diversion Structure Identification**
7	Storage Protocol	14	Verner SWA, North Platte River Restoration
**Denotes multi-purpose projects with consumptive, environmental, and recreational benefits			

Planned Projects Selected for Project Summaries

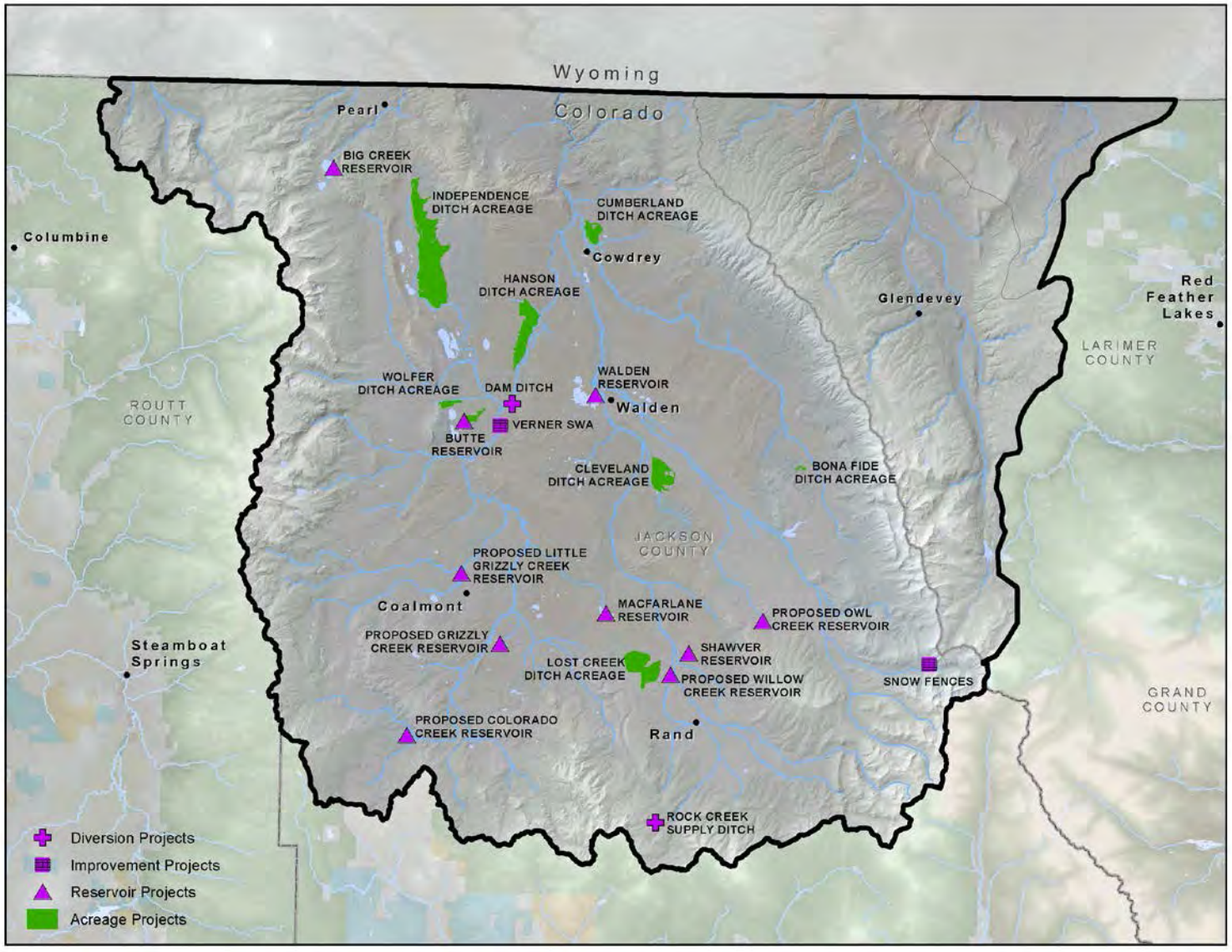


Figure 23. Planned Projects Selected for Project Summaries

Table 3. Planned Consumptive Project List

No.	Project	Project Description
1	**MacFarlane Reservoir ****	Outlet work and toe drain improvements to existing reservoir (WDID 4703614)
2	**Evapotranspiration Project**	Continued support of climate station operation and lysimeter data collection to develop high altitude ET coefficients
3	**Walden Reservoir**	Dredge reservoir bottom to increase capacity for new use (WDID 4703627)
4	**Basinwide Augmentation Plan**	Develop basinwide plan to augment various uses, potentially including augmenting depletions from livestock, industrial or municipal development in the basin
5	**Hanson and Wattenberg Ditch Acreage**	Irrigable acreage (1,612 acres) potentially served by rehabilitated Hanson and Wattenberg Ditch or new North Platte diversion
6	**Proposed Streamgage Installation**	Identify and potentially install new streamflow gages at key locations
7	**Storage Protocol**	Protocol for storage under the Equitable Apport. Decree
8	**Irrigation Season Protocol**	Protocol to define irrigation season in the basin
9	**Irrigated Acreage Assessment Protocol**	Protocol for delineating irrigation acreage under the Equitable Apport. Decree
10	**Proposed Willow Creek Reservoir**	New reservoir near Willow Creek crossing of Highway 125, potentially filled from Willow Creek or Illinois River
11	**Dam Ditch Headgate Improvement ****	Redesign/replace existing headgate to increase capacity, ease maintenance issues and improve fish connectivity (WDID 4700582)
12	**Canal Maintenance and Improvements**	Process to easily identify and fund needed canal maintenance and improvements
13	**Instream Diversion Structure Identification ****	Process to easily identify, prioritize, and fund the redesign of existing diversion structures whose instream infrastructure impacts fish connectivity
14	**Lost Creek Ditch Acreage**	Irrigable acreage (1,646 acres) potentially served by existing or enlarged Darcy Reservoir or new Willow Creek pipeline (WDID 4700737)
15	**Cumberland Ditch Acreage**	Irrigable acreage (544 acres) potentially served by rehabilitation of existing Cumberland Ditch siphon under Canadian River (WDID 4700577)
16	**Independence Ditch Acreage**	Irrigable acreage (5,215 acres) potentially served by enlarged Independence Ditch and/or rehabilitated Big Creek Reservoir (WDID 4700683)
17	**Cleveland Ditch**	Irrigable acreage (1,097 acres) potentially served by rehabilitated Cleveland Ditch or new Spring Creek diversion (WDID 4700559)
18	**Wolfer Ditch**	Irrigable acreage (431 acres) potentially served by existing Wolfer Ditch (WDID 4700961) or existing or enlarged Butte Reservoir (WDID 4703598)
19	**Bona Fide Ditch Acreage**	Historically irrigated acreage (31 acres) served by rehabilitated Bona Fide Ditch (WDID 4700515)
20	**Butte Reservoir**	Enlargement or repurposing of existing reservoir (WDID 4703598), South and East reservoir sites

No.	Project	Project Description
21	**Proposed Colorado Creek Reservoir**	New reservoir near confluence of Colorado Creek and Grizzly Creek (CR 1B and Hwy 14)
22	**Proposed Grizzly Creek Reservoir**	New reservoir site near CR 28 and Hwy 14 on the land of John Rich. Site would inundate prime pasture land and may be affected by pending conservation easement. Same location as Richland Reservoir (WDID 4703500) water right. Adjacent to, and may back water up on BLM land.
23	**Proposed Little Grizzly Creek Reservoir**	New reservoir near Little Grizzly Creek crossing of County Road 24
24	**Snow Fences**	Construction of new snow fences to increase snow deposition, specific locations TBD
25	**Rock Creek Supply Ditch**	Transbasin diversion from Willow Creek to Rock Creek; potentially use historical structure (WDID 4702082) for 10 cfs, abandoned in 1992
26	**Shawver Reservoir**	Enlargement of existing reservoir (WDID 4703620), potentially use new capacity to supply augmentation plan
27	**Proposed Owl Creek Reservoir**	New reservoir on Owl Creek, or potentially enlarge small existing reservoir in area
	****** Denotes multi-purpose projects with consumptive, environmental, and recreational benefits	

Planned Environmental and Recreational Projects

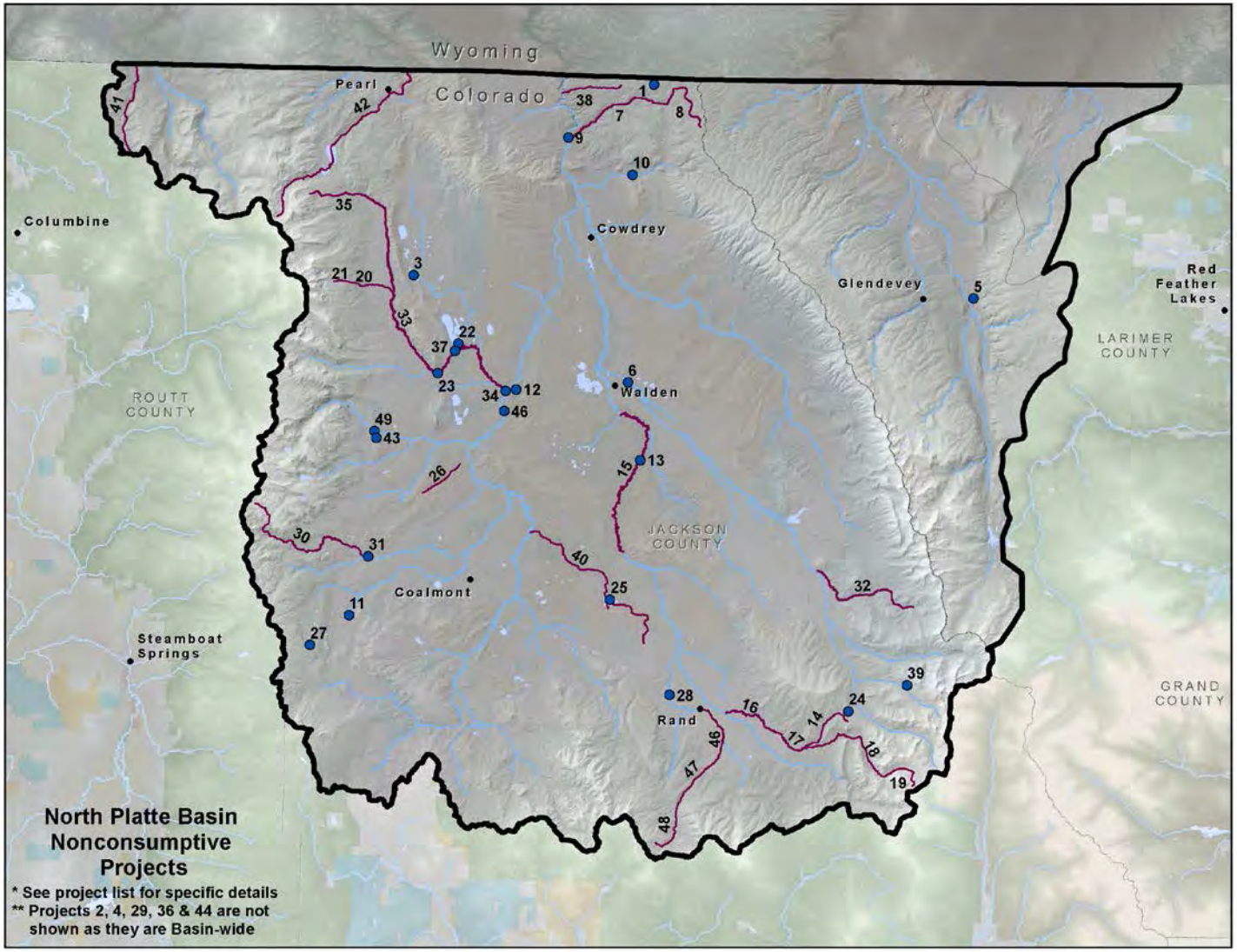


Figure 24. Planned Environmental and Recreational Projects

Table 4. Planned Environmental and Recreational Project List

No.	Project or Segment	Project or method	Primary focus	To benefit:	Contact
1	Bear Draw	Relocate trail out of wetland	Wetlands	Fishery, wetlands, amphibians	USFS
2	BLM Water quality/quantity: Various reaches in North Platte Basin	Monitor water quality/quantity	Water quality/quantity	Fishery, wildlife, livestock, water quality	BLM
3	Boettcher Lake Rehabilitation	Rehabilitate/replace irrigation infrastructure	Improve/increase irrigated meadows	Waterfowl habitat	DU, Private Owner
4	Boreal Toad Studies - Twisty Park/County Wide	Boreal Toad Studies	Species of concern	Amphibians	CPW
5	Brown Creek Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
6	Brownlee SWA- North Platte River	Brownlee SWA river channel/riparian corridor habitat/water quality improvements	Improve fishery habitat, water quality, erosion control	Fishery, riparian plant community	CPW
7	Camp Creek	Remove fill & culverts from wetland	Wetlands, water quality, aquatic passage, stream function	Fishery, wetlands, amphibians	USFS
8	Camp Creek	Replace double culverts	Stream function, aquatic passage	Fishery	USFS
9	Camp Creek Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
10	Chandler Ranch (ANWR)	Rehabilitate/replace infrastructure to resume irrigation practice	Restore irrigated meadows	Waterfowl, amphibians	ANWR

No.	Project or Segment	Project or method	Primary focus	To benefit:	Contact
11	Crosby Creek Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
12	Dam Ditch Headgate Improvement **	Redesign/replace existing headgate to increase capacity, ease maintenance issues and improve fish connectivity	Aquatic passage	Fishery	USFS
13	Dryer Ditch	Rehabilitate/replace irrigation infrastructure	Improve/increase irrigated meadows	Waterfowl, amphibians	DU, ANWR
14	Elk Creek Tributary	Harden crossing to reduce wetland damage	Wetlands	Fishery, wetlands, amphibians	USFS
15	Illinois River on ANWR	Willow enclosures and riparian corridor rehabilitation	Riparian habitat health	Wetland plants	ANWR
16	Jack Creek	Create low-water road-crossing after culvert failure	Stream function, aquatic passage, water quality	Fishery, wetlands, amphibians	USFS
17	Jack Creek	Decommission and rehabilitate user-created road in fen	Water quality, wetlands	Fishery, wetlands, amphibians	USFS
18	Jack Creek	Relocate road out of wetland	Wetlands	Fishery, wetlands, amphibians	USFS
19	Jack Creek Tributary	Decommission road-stream crossing	Water quality, restore wetlands	Fishery, wetlands, amphibians	USFS
20	Lake Creek	Wetland habitat improvement	Waterfowl Production/Hunting	Waterfowl, wetlands	CPW
21	Lake Creek SWA Improvement	Enhance existing wetland	Wetland habitat enhancement, waterfowl production	Wetlands, waterfowl viewing/hunting, amphibians	CPW, DU
22	Lake John outlet relocation	Move outlet to create more circulation in lake	Improve water quality, fish habitat	Fishery	CPW
23	Legal Tender Ditch - NF N. Platte	Legal Tender Ditch diversion modification	Improve aquatic passage	Fishery, riparian plant community	CPW

No.	Project or Segment	Project or method	Primary focus	To benefit:	Contact
24	Lily Lake	Improve water quality and riparian habitat from improved grazing management through fencing	Wetlands	Fishery, wetlands, amphibians	USFS
25	MacFarlane Dam Project **	Dam rehabilitation	Preserve existing storage for NC and Consumptive Uses	Wildlife, waterfowl (ANWR & BLM Tourism)	ANWR, BLM
26	Manville SWA-Roaring Fork	Manville SWA river channel/riparian corridor habitat/water quality improvements	Improve fishery habitat, water quality, erosion control	Fishery, riparian plant community	CPW
27	McGee Fen	Improve water quality and riparian habitat from improved grazing management through fencing	Rare plant habitat, Wood Frog, Leopard Frog	Wetland plants, amphibians	USFS
28	McKinnon Creek fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
29	NC Projects on private lands	Various	Bring willing landowners together with project organization to collaborate on NC projects on private lands	Fish/amphibian/ waterfowl habitat, wetlands protection	TBD
30	Newcomb Creek	Newcomb Creek grazing management project	Water quality, erosion control, fishery, Wood Frog, Northern Leopard Frog	Fishery, wetlands, Wood Frog, Northern Leopard Frog	USFS
31	Newcomb Creek Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
32	North Fork Michigan River	Stream channel and riparian habitat improvements	Fishery habitat	Fishery, riparian plant community	CPW
33	North Fork North Platte (Richard Conservation Easement)	Stream habitat improvement on Richard Conservation Easement	Water quality, fishery habitat, erosion control	Fishery	CPW

No.	Project or Segment	Project or method	Primary focus	To benefit:	Contact
34	North Fork North Platte Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
35	North Fork North Platte Tributary	Decommission road-stream crossing before dead-ends at private land	Water quality, restore wetlands, stream function	Fishery, wetlands, amphibians	USFS
36	Instream Diversion Structure Identification **	Improvement fishery habitat/connectivity	Improve aquatic passage	Fishery	CPW
37	Richards Ranch Conservation Easement	Ulrich Ditch Rehabilitation	Improve irrigation capabilities/waterfowl habitat	Waterfowl habitat	DU, CPW
38	Salt Creek	Decommission, re-contour to improve drainage	Water quality, wetlands	Fishery, wetlands, amphibians	USFS
39	Silver Creek	Silver Creek culvert project	Wetlands, water quality at crossing	Fishery, wetlands, amphibians	USFS
40	Soap Creek Restoration	Rehabilitate stream channel/riparian corridor vegetation	Stream habitat improvement	Fishery, riparian plant community	ANWR, BLM
41	South Fork Hog Park Creek	Relocate road out of wetland	Wetlands, water quality at crossing	Fishery, wetlands, amphibians	USFS
42	South Fork of Big Creek	South Fork of Big Creek measurements	Stream flows, maintenance flows, amphibians	Fishery, amphibians	USFS
43	Sunday Creek Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS
44	Various ditch diversions/headgates on USFS	1) Survey ditch diversions & headgates for their potential to impact water quality & aquatic habitat; 2) create cooperative projects with ditch owners, NRCS, FS; 3) improve/replace diversions	Water quality, aquatic habitat	Fishery, wetlands, amphibians	USFS

No.	Project or Segment	Project or method	Primary focus	To benefit:	Contact
		with fish passage/water quality issues			
45	Verner SWA, North Platte River Stream Restoration	Verner SWA river channel/riparian corridor habitat/water quality improvements	Improve fishery habitat, water quality, erosion control	Fishery, riparian plant community	CPW
46	Willow Creek	Replace culvert	Stream function, aquatic passage	Fishery, travel	USFS
47	Willow Creek Tributary	Remove culvert & fill, restore wetland	Water quality, restore wetlands, stream function, aquatic passage	Fishery, travel	USFS
48	Willow Creek Tributary	Replace culvert	Stream function, aquatic passage	Fishery, travel	USFS
49	Wolfer Ditch on Roaring Fork	Wolfer Ditch diversion modification	Irrigation capabilities, fishery habitat	Fishery, riparian plant community	CPW
** Denotes multi-purpose projects with consumptive, environmental, and recreational benefits					

4.3 Standard Project Summary Template

To systematically present detailed project information, a standard project summary template was developed. The template enables the review and comparison of projects through a concise summary of project information, including projects constraints, implementation strategies and how well the project meets the Basin Goals. Planned projects are highlighted in Section 4.4 with separate summary sheets. The standard project summary template is shown below. Where applicable, projects also include a write-up of background information and technical support performed during the NPBIP process.

Project Name	
Project Sponsor	
Category	Classification of the proposed project by: **Sponsor Type:** ☐ Single Entity ☐ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☐ Structural ☐ Non-Structural
Volume Water Gained/Saved	
Purpose	Brief description of project purpose. Typically 1-2 sentences.
Constraints and Challenges	Issues or circumstances limiting project implementation. May include: • **Acceptance (conflicts, adverse impacts, disincentives)** • **Feasibility (cost, land ownership, hydrology, water rights administration)** • **Regulations (permitting, limitations, restrictions)**
Implementation Steps and Project Scope	Systematic plan to implement the proposed project. May include: • **Public Education, Outreach, and Acceptance** • **Partnerships and Cooperative Strategies** • **Technical and Feasibility-Level Analysis** • **Permitting, Design, and Construction** • **Funding Mechanisms**
Effectiveness at Meeting Basin Goals	Description of how well the Implementation Plan meets basin Goals measured against benchmarks set as Measurable Outcomes.

4.4 Proposed Project Summaries

MacFarlane Reservoir Rehabilitation

Background

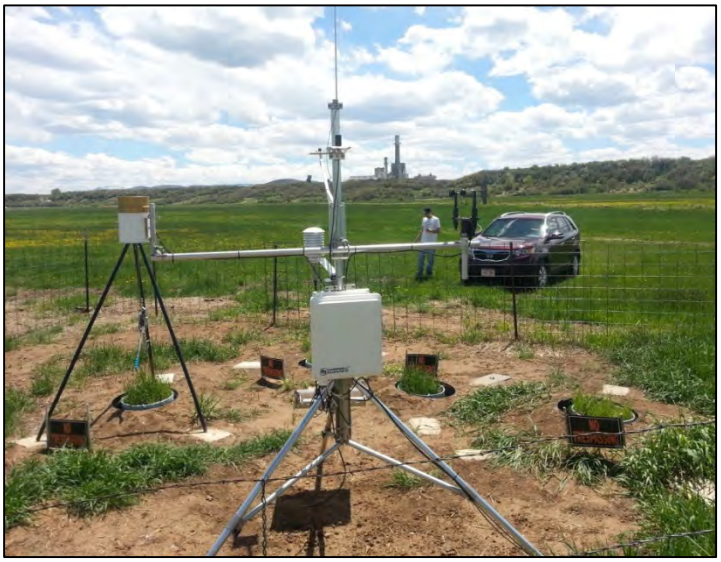
The MacFarlane Reservoir is a multiple purpose reservoir jointly owned by a local rancher (Blaine Evans), the U.S. Fish and Wildlife Service, and the U.S. Bureau of Land Management. The Colorado Division of Water Resources (DWR) has issued a notice that a storage restriction will be placed on the reservoir if the outlet pipe and toe drains are not repaired within the next five years. The reservoir is used for irrigation of private and public land as well as supporting waterfowl habitat in ponds and wetlands within the Arapahoe National Wildlife Refuge. This project to preserve existing storage in the basin has been identified and discussed at NPBRT meetings prior to during the NPBIP process.

Project Name	MacFarlane Reservoir Rehabilitation
Project Sponsor	Blaine Evans (50%), U.S. Fish and Wildlife (42.5%), BLM (7.5%)
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural
Volume Water Gained/Saved	Current capacity would be preserved: 6,507 AF (absolute, irrigation) with refill rights of 6,833 AF (1,208 AF absolute, and 5,626 conditional; multiple uses).
Purpose	Reline outlet and reconstruct toe drains to preserve existing reservoir uses of irrigation and waterfowl habitat.
Constraints and Challenges	- *Funding.* Costs for engineering and project implementation are extensive. - *Partnerships*. Due to the joint ownership of the reservoir, project execution and funding includes the private and federal owners. This makes coordination, funding, timing, and approval more complicated. - *Cost/Benefit Analysis*. Estimated costs to design and construct the necessary improvements are large compared with the economic returns.

Implementation Steps and Project Scope	- *Engineering Design*. The USFW is helping to fund and coordinate the design work of the outlet lining and toe drain reconstruction. - *Funding Mechanisms*. Costs associated with the repairs will likely need significant cost sharing among the private and federal partners. Grant and/or loan assistance may be necessary to assist the private water user. Potential funding sources and loan options from entities such as the CWCB are being investigated.
Effectiveness at Meeting Basin Goals	This project excels at meeting the basin goals 1, 3, 4, and 5. The preserved storage helps to maintain and maximize the consumptive use of water in the basin (Goal 1), while helping to maintain important existing infrastructure (Goal 3). In addition, the multiple purpose uses of the reservoir help to directly maintain healthy wetlands (Goal 4), while showcasing the beneficial relationship between agricultural and environmental and recreational water use (Goal 5).

Evapotranspiration Project

Background



In 2009, the NPBRT approved $100,818 of WSRA funding for Colorado Climate Center (CCC) at Colorado State University (CSU) to conduct a study titled: Monitoring the Effects of Weather Conditions on Evapotranspiration North Platte River Basin. The study was a data collection effort designed to provide more information on how the weather conditions of the basin affect evapotranspiration (ET) from irrigated hay meadow grasses. The study established a network of complete year round weather stations to continuously monitor and report weather conditions from three distinctly different locations in the basin (Cowdrey, Hebron, and Larand) to better estimate reference ET. The study also intended to use lysimeters at the Arapahoe National Wildlife Refuge to calculate crop coefficients for the high altitude hay meadows of North Park. The results were compared and posted continuously on a crop water use website managed and maintained by the Colorado Climate Center at CSU. The resulting data are also archived and fed directly into the CDSS via HydroBase, as used in other NPBIP analyses.

This 5-year study was completed in 2014. Though the study resulted in valuable and easily accessible climate data, technical difficulties with the lysimeters prevented the derivation of a local crop coefficient to enable the more accurate calculation of actual crop water use in the basin. Technical problems with the lysimeters included: location/siting issues, too much time between watering, flooding, and leakage.

The proposed phase 2 of this project was discussed and favorably received at NPBRT meetings during the NPBIP process. Phase 2 would involve the installment of new lysimeters with better design and operational accommodations to ensure the collection of adequate data to enable the calculation of a crop coefficient for high altitude hay meadows specific to the North Platte Basin.

Project Name	Re-Establishment of Lysimeters in North Park to Determine High Altitude, Hay Meadow Crop Coefficients
Project Sponsor	Colorado Climate Center (CCC) at Colorado State University
Category	**Sponsor Type:** ☒ Single Entity ☐ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural
Volume Water Gained/Saved	N/A
Purpose	Install lysimeters to accurately measure actual evapotranspiration (ET) and enable the calculation of a crop coefficient for high altitude hay meadows specific to the North Platte Basin.
Constraints and Challenges	- *Technical Difficulties.* Previous lysimeter problems must be addressed, including: location/siting issues, too much time between watering, flooding, and leakage. - *Partnerships*. The CCC would need to work with landowners willing to accommodate water station equipment. - *Staffing*: Reliable and continuous staffing is essential for ongoing operation of the lysimeters and the collection of data sufficient to enable the derivation of a local crop coefficient. - *Funding*. The CCC does not have adequate funds to perform the project without assistance from the NPBRT's WSRA funding or other sources.
Implementation Steps and Project Scope	- *Design*. The CCC is working on developing appropriate lysimeter design and siting to accommodate data collection in the North Platte. - *Staffing*. Staffing arrangements will be made to ensure continuous and accurate data collection. - *Funding Mechanisms*. Grant assistance will likely be pursued through the NPBRT.
Effectiveness at Meeting Basin Goals	The more accurate calculation of agricultural CU in the basin enabled by this project will ultimately help to maintain and maximize the consumptive use of water in the basin (Goal 1).

Walden Reservoir Dredging Project

Background

Walden Reservoir, constructed in 1954, is an off-channel reservoir located west of the Town of Walden. The reservoir can store diversions from both the Michigan and Illinois Rivers, and primarily serves as a supplemental irrigation supply for ranches along the Michigan River. Additionally, the Town of Walden owns six shares (out of 300 total shares) in the reservoir, and a portion of the reservoir is also owned by U.S. Fish and Wildlife. The reservoir has a current active capacity of approximately 5,204 acre-feet based on recent content records from DWR, which is equal to the reservoir's senior absolute storage rights. Additionally, the reservoir has an absolute right of 1,747 acre-feet for refill; conditional rights totaling 2,773 acre-feet for refill; and a junior absolute right for 1,259 acre-feet for irrigation, fish, and wildlife uses.

The Town of Walden recently investigated several options associated with better use of their shares in the reservoir for the Town's water supply. These options, summarized in *Town of Walden Water Supply Evaluation* in March of 2008 by CDM, included potentially:

1. Changing the use of the Town's shares to include municipal and/or augmentation uses and either exchanging the shares to the existing water treatment plant (WTP) diversion point or delivering the shares to the WTP via pipeline,
2. Potentially trading their shares for water rights already decreed for municipal and/or augmentation rights in Meadow Creek Reservoir on the Michigan River, and
3. Using reservoir water directly via pipeline to irrigate the Town's cemetery and parks.

Ultimately this report, and the subsequent report to the CWCB summarizing the results of the study, indicated the Town of Walden did not proceed with discussions with the Walden Reservoir Company to change the Town's shares in the reservoir, citing both concerns of water quality and opening up the reservoir's water rights in Water Court. The report also noted concerns with exchange potential from Walden Reservoir releases due to senior rights on Queen Ditch. Further feasibility of trading shares was not recommended due to substantial river losses to Meadow Creek Reservoir releases in transit to the WTP diversion. Lastly, the CWCB report proposed three potential routes to convey releases of the Town's shares via pipeline to the Town's park, cemetery, and the Courthouse landscaping, however it did not include cost estimates for the pipeline options.

Although specific to the Town of Walden's shares, the investigations in the study provide information that guided discussions regarding Walden Reservoir during this BIP effort. Dredging of the reservoir was ultimately identified as a potential project during the technical outreach meeting, with several options proposed for the use of the additional capacity. This potential project's main benefit is that it protects the existing storage rights and capacity, while creating new capacity for a new use.

In addition to the dredging project, any work on Walden reservoir should include the installation of concrete on the spillway where the county road crosses. Hard surfacing of this area would alleviate

ongoing damage caused by plowing and maintenance of the road. At the same time the two corrugated metal pipes under the county road in the feeder ditch should be evaluated for potential replacement or repair. The Colorado Department of Transportation (CDOT) is currently replacing culverts for this feeder ditch under the state highway that are currently collapsing.

Project Name	Walden Reservoir Dredging Project
Project Sponsor	TBD
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural
Volume Water Gained/Saved	Conservative estimate of 100 acre-feet additional capacity, requires feasibility study to identify maximum potential.
Purpose	Dredge silted material from reservoir bottom to increase reservoir capacity for new use; apply for a junior water right for additional storage. New uses may include: - Basin-wide Augmentation Plan Supply - Supplemental Irrigation Supply - Supply for Industrial Oil and Gas Operations - Recreational and/or Environmental In-Reservoir Uses or Releases
Constraints and Challenges	Limited feasibility has been completed for this project, however the following potential constraints and challenges were identified: - *Acceptance by Walden Reservoir Company shareholders on project plan*. Many of the alternatives previously investigated for Walden Reservoir risked opening the water rights in Water Court to include additional uses, or involved costly infrastructure improvements, which were both perceived as disincentives to the shareholders. This project protects existing water rights and capacity, and may lead to additional storage capacity for irrigation uses, which shareholders may be more inclined to support. - *Division 6 Office Review*. Filing for a new storage right at the reservoir would impact the current administration and operation of the reservoir, including revised reservoir accounting to track the current and new uses and integration into the basin-wide storage accounting for the Equitable Apportionment Decree. Additionally, if the new use is in part used to supply a basin-wide augmentation plan, the Division 6 Office would need to be involved with approving the reservoir as a supply for specific depletions. The project would benefit greatly by involving the Division 6 Office early in feasibility process. - *Environmental Impacts.* Investigation of required permitting and environmental impact studies would be required prior to project scoping to understand these requirements as they pertain to dredging operations. Temporary water quality issues may be seen during dredging operations as debris is disturbed and

	removed, and impacts to the reservoir banks from dredging equipment would need to be mitigated. Additionally, disposal sites for the dredged material would need to be identified. - *Reservoir Outlet Control.* Review of the minimum and incremental measureable release from the reservoir would be required; outlet works may need improvement to provide more control of releases, depending on the new use. - *Equitable Apportionment Decree Storage Limitation.* The decree limits the amount of storage for irrigation to 17,000 acre-feet annually. This constraint needs to be considered if additional capacity is allotted for irrigation uses.

Implementation Steps and Project Scope	- *Feasibility Study*. Selection of a contractor to thoroughly vet the constraints and challenges discussed above and develop a study. Walden Reservoir Company shareholders would need to evaluate and vote on acceptance of the project. Components of the study may include:
	  - evaluate amount of viable material for dredging and potential disposal sites
	  - investigate environmental impact or permitting requirements
	  - perform water availability for new storage water right
	  - evaluate funding mechanisms for dredging project
	  - identify potential markets or partnerships to lease or purchase the new supply
	  - develop initial cost estimates; identify and schedule dredging contractors
	- *Implementation Steps*. Depending on the recommendations and acceptance of the Feasibility Study, implementation steps would likely include:
	  - develop draft reservoir operational protocol, usage and lessee agreements, and accounting
	  - assist with Division 6 Office discussions and filing for a new water right
	  - comply with environmental permitting requirements, as necessary, for dredging operations and material disposal
	  - retain a dredging contractor to complete dredging operation
	  - install concrete on the spillway where the county rood crosses and evaluate necessity to replace two CMP's under county road in feeder ditch
	- *Funding Mechanisms*. Although not as costly as other reservoir expansion efforts, this proposed project has significant up-front costs. Potential funding sources, loan options, and short-term revenue opportunities would need to be investigated during a feasibility study. For example, revenue could be generated for the dredging project through the short-term leasing of existing storage space to other users.

Effectiveness at Meeting Basin Goals	This project could excel at meeting the first four basin goals. Storage in the reservoir preserved through dredging would help maintain and maximize the consumptive use of water in the basin (Goal 1), while restoring and maintaining important existing infrastructure (Goal 3). A potential augmentation plan could help strategic economic water development by providing a water supply for future development (Goal 2). Finally, enhanced recreational and/or environmental in-reservoir uses or releases would help maintain healthy rivers and wetlands (Goal 4).

Technical Support

The North Platte Model Baseline scenario results can be used to look at the water available to a junior storage right, from both the Illinois River and the Michigan River. Figure 25 shows the amount of legally available flow at the reservoir feeder canal on the Illinois River and at the Old SC Ditch headgate on the Michigan River. Based on the results, it appears that in many of the years, there is more water available than the 100 acre-feet of additional capacity discussed during this planning effort. The limiting factor on the additional capacity of this potential project would likely be the amount of material that could be safely and economically dredged, or the demand for additional supply in the basin.

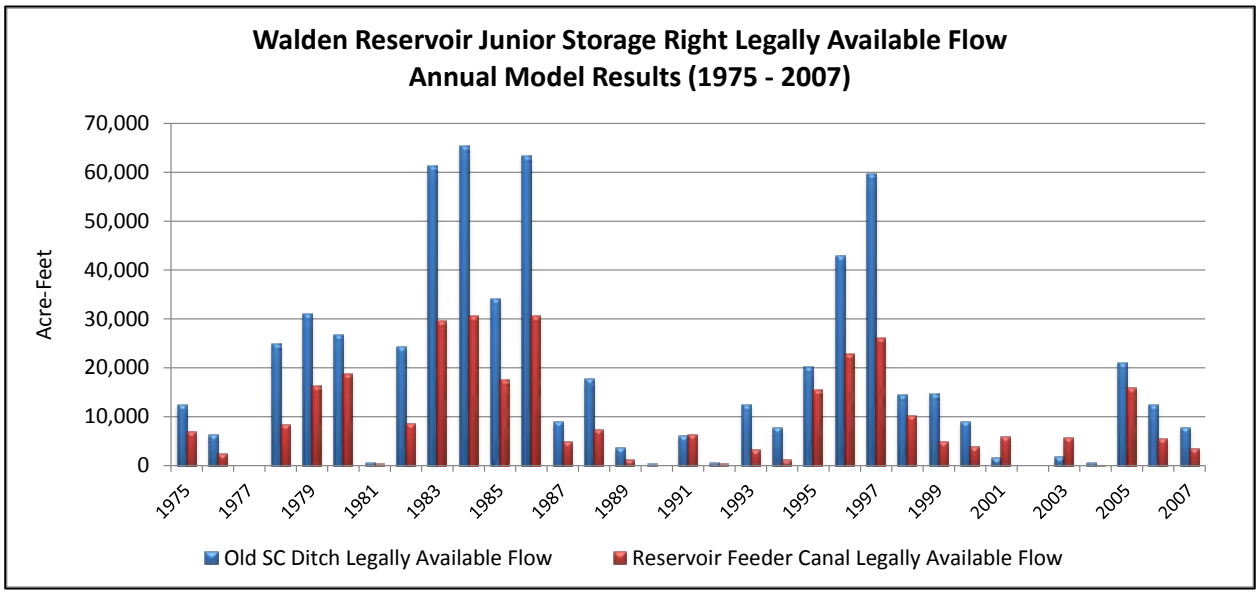


Figure 25. Walden Reservoir Dredging Project – Legally Available Flow

The North Platte Model can be used to further analyze the additional capacity and reservoir operations during a feasibility effort to understand how much water would be available for use each year, the amount carried-over each year, and the firm yield of the additional capacity during dry years.

Basinwide Augmentation Plan

Background

An augmentation plan, as defined by CDWR, is a court-approved document designed to protect existing water rights by replacing water depleted by a new project. "Augmentation" is the process of providing water to the river to prevent reductions in streamflow caused by the new project depletions, which would otherwise affect senior water rights. This allows the new project, which would be junior to all other existing water rights, to continue to deplete the river even when a senior right has placed a "call" on the river. Augmentation plans are generally used to augment depletions from well pumping under junior water rights, although they can also be used to augment other junior depletions (e.g. reservoir evaporation). The key to a successful augmentation plan is the location and seniority of the replacement

supplies; the depletion must be augmented in quantity and location and with a water supply with sufficient seniority so that it would not be called out by other senior rights.

The Division 6 Office has received inquiries into the availability of augmentation water in the North Platte Basin to augment a variety of new projects in the basin. These augmentation plan requests have included augmentation of evaporation from a small pond, augmentation of well depletions for a new livestock processing facility, and augmentation of water used at a pellet plant. To date, there is neither an existing augmentation plan in the basin, nor any water rights that have been changed in Water Court to include augmentation as a use.

Augmentation plans can be filed by individual users or by a larger entity that will augment depletions from a number of new projects. Based on the recent inquiries, the amount of augmentation water requested for new projects has been relatively small. If the amount requested for future projects in the basin is similar, it would benefit the individual users to be a part of a larger augmentation plan in which users could share augmentation plan supplies and not incur the legal and engineering costs of developing individual augmentation plans. Additionally, if an entity such as JCWCD developed and managed a basinwide augmentation plan, the District would be in a good position to manage new projects and growth in the basin.

Project Name	Basinwide Augmentation Plan
Project Sponsor	TBD
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☐ Ag ☒ M&I ☒ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural
Volume Water Gained/Saved	TBD
Purpose	Develop a basinwide augmentation plan and multiple augmentation supplies to support new project depletions and promote economic growth.
Constraints and Challenges	- *Availability of Augmentation Supplies*. There are currently no senior water rights in the basin that have been changed in Water Court to include augmentation as a use type. Due to the basin's goal to maintain, and increase irrigated acreage, the roundtable does not support the dry up of acreage and changing senior irrigation rights (direct and storage) for augmentation use. Therefore, potential augmentation supplies would include junior direct or storage rights in new or enlarged storage facilities. Additional capacity made availability in Walden Reservoir may be one source of augmentation water. Additional supplies would need to be investigated, potentially with the construction of new storage facilities to augment new project depletions on multiple tributaries.

	- *New Project Depletions*. JCWCD and users in the basin need to discuss the new project depletions that would be included under the plan, specifically the location and types of projects (e.g. commercial, industrial, domestic). Explicit language in the augmentation plan can include desired project depletions and exclude non-desirable depletion types. - *Equitable Apportionment Decree and Three-States Agreement.* The limitations this decree and agreement place on water usage in the basin must be considered during the development of the augmentation plan, including storage limitations and depletion allowances.

Implementation Steps and Project Scope	- In order to develop a basinwide augmentation plan, JCWCD may consider retaining legal counsel and engineering consultants to assist with:
	  - Developing the augmentation plan application including descriptions on the quantity and availability of augmentation supplies; extent of where supplies will be used; what project depletions will be included; how much augmentation water will be used; when, where and how much augmentation water will be required; and how the augmentation plan will be operated.
	  - Developing an engineering analysis showing how project depletions impact the river and how the augmentation supplies will protect existing water rights.
	  - Developing appropriate plan accounting forms for submittal to the Division 6 Office.
	- *Plan Rules and Regulations.* Consider developing rules and regulations governing participation in the basinwide augmentation plan, which may include applicant processes, initial and annual fee assessments, agreements with operators of augmentation supplies, liability limitations, measuring/reporting requirements, and notification requirements.
	- *Funding Mechanisms*. There are significant costs associated with developing the augmentation plan, including legal and engineering fees as well as potential construction costs for new storage facilities. Potential partnerships with end users (e.g. industrial, commercial, and environmental) and/or a proactive marketing program should be explored, as well as loan options from entities such as the CWCB would need to be investigated.

Effectiveness at Meeting Basin Goals	This project could excel at meeting the basin goals 1 and 2. A potential augmentation plan could help maintain and maximize the consumptive use of water in the basin (Goal 1) and could help strategic economic water development by providing a water supply for future development (Goal 2).

Hanson and Wattenberg Ditch Acreage

Background

Parcels of historically irrigated or potentially irrigable land that may be irrigated in the future were identified based on spatial analysis of historical and current irrigated acreage coverages, as discussed in the Irrigated Acreage Analysis Case Study. One of these parcels, historically served by Hanson and Wattenberg Ditch, was identified as potentially irrigable in the 1940 mapping but not irrigated in more recent assessments. Therefore, it was presented as a potential Irrigated Acreage Project at the technical

outreach meeting. The parcel shown in Figure 26 is approximately 1,600 acres in size and is located downstream of the confluence of the North Fork of the North Platte River and the mainstem, primarily on land owned by the Silver Spur Land and Cattle Company.

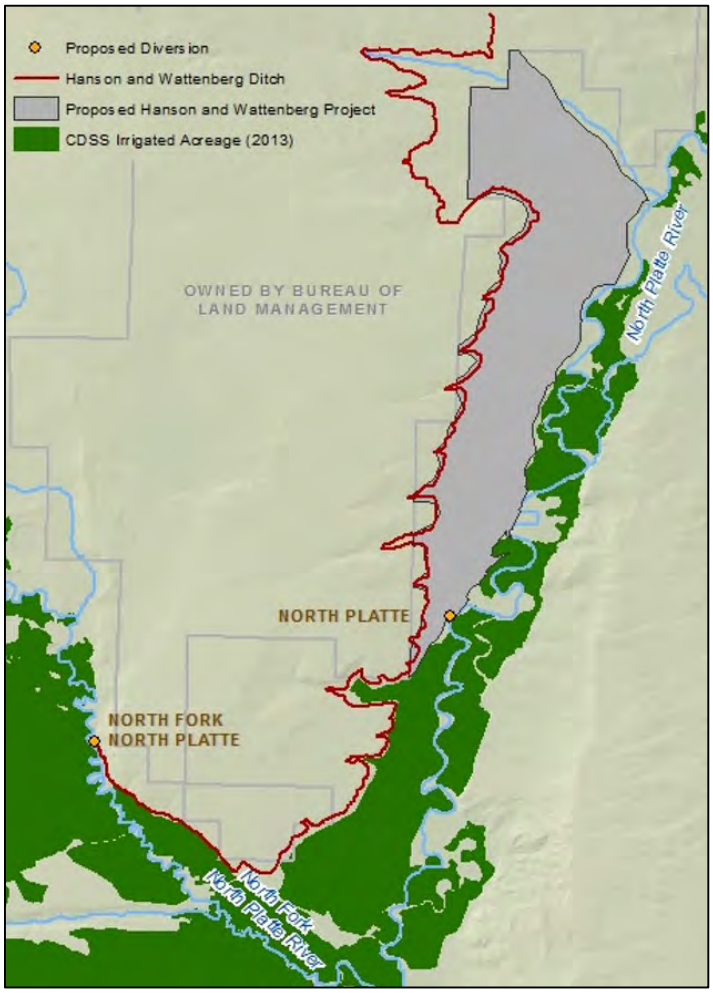


Figure 26. Proposed Hanson and Wattenberg Ditch Project

Discussion at the technical meeting regarding this parcel identified both opportunities and constraints:

- There is an existing ditch, although in disrepair, that runs over eight miles from the historical diversion point on the North Fork of the North Platte River to the Hanson and Wattenberg Ditch parcel.
- The existing ditch crosses several drainages through land owned by the BLM. Land owners cited maintenance issues with wash-outs and access to ditch segments on BLM land.
- The parcel could potentially be irrigated using the existing ditch alignment with a junior water right, or using a new ditch alignment and water right from the North Platte River.
- Water availability on the North Fork for a junior water right would likely be limiting in dry years, but water availability would not be an issue on the mainstem.

Although the constraints and challenges for putting this parcel under irrigation are significant obstacles, the opportunity to increase acreage within a stream reach that has ample water availability led to the inclusion of this parcel as an Irrigated Acreage Project.

Project Name	Hanson and Wattenberg Ditch Acreage
Project Sponsor	TBD
Category	**Sponsor Type:** ☒ Single Entity ☐ Partnership **Use Type:** ☐ NC ☒ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural
Volume Water Gained/Saved	1,612 acre parcel with an estimated 2,750 acre-feet of irrigation water requirement
Purpose	Irrigate the Hanson and Wattenberg Ditch parcel under a junior water right from either the North Fork of the North Platte River or the North Platte River mainstem.
Constraints and Challenges	- *Water Availability*. The existing ditch alignment reflects a diversion point on the North Fork, however technical analysis of legally available flow at that historical diversion point yielded water availability issues in dry years and later in the irrigation season. Water availability at a diversion point on the mainstem yielded more reliable supplies throughout the season. - *Ditch Alignment and Improvements*. A diversion point on the mainstem would ideally be selected to allow for a gravity-fed delivery system, topological analyses would be required to identify that diversion point and ditch alignment. Pumps may be required for a diversion from the mainstem. Additionally, portions of the existing ditch would need to be relocated onto private land to eliminate access issues on BLM land. The ditch would also need to be improved at the multiple drainage crossings to reduce maintenance costs due to washout issues.

Implementation Steps and Project Scope	- In order to put the parcel under irrigation, the land owner may consider retaining contractors to:
	  - assist with surveying the parcel and potential ditch alignments
	  - construct new portions and improve existing portions of the ditch, as well as construct a new headgate and measuring device
	  - assist with filing for a new water right for multiple uses so as not to preclude future development opportunities on the parcel
	  - clearing and seeding the new parcel
	- *Funding Mechanisms*. Construction of a new headgate, ditch realignment and/or rehabilitation, clearing the parcel of sagebrush, and Water Court proceedings/filings for a new water right associated with putting this parcel under production add up to significant up-front costs. Potential funding sources

	and loan options from entities such as the CWCB would need to be investigated by the landowners.
Effectiveness at Meeting Basin Goals	This project could excel at meeting the basin goals 1 and 3. The additional irrigated acreage would help maintain and maximize the consumptive use of water in the basin (Goal 1), while restoring and maintaining important existing infrastructure (Goal 3).

Technical Support

The North Platte Model Baseline scenario and the Historical CU Analysis can be used to determine the amount of water that would be physically and legally available to a junior water right from both the North Fork and the mainstem for irrigation of the Hanson and Wattenberg Ditch Acreage, as compared to the estimated CIR associated with the 1,612 acres of grass pasture. Figures 27 and 28 illustrate these comparisons on a monthly basis. As shown, there are limitations to water availability during dry years and late in the irrigation season for the North Fork diversion point. The senior calling rights on the North Fork are located just downstream of the historical diversion point, therefore much of the flow in the river would need to be bypassed to meet the senior water rights. The model results on the mainstem however do not indicate such limitations, and instead there appears to be a much more reliable and consistent supply. The primary challenge for a diversion on the mainstem would be infrastructure, potentially requiring a lengthy gravity-fed ditch or pumped diversions.

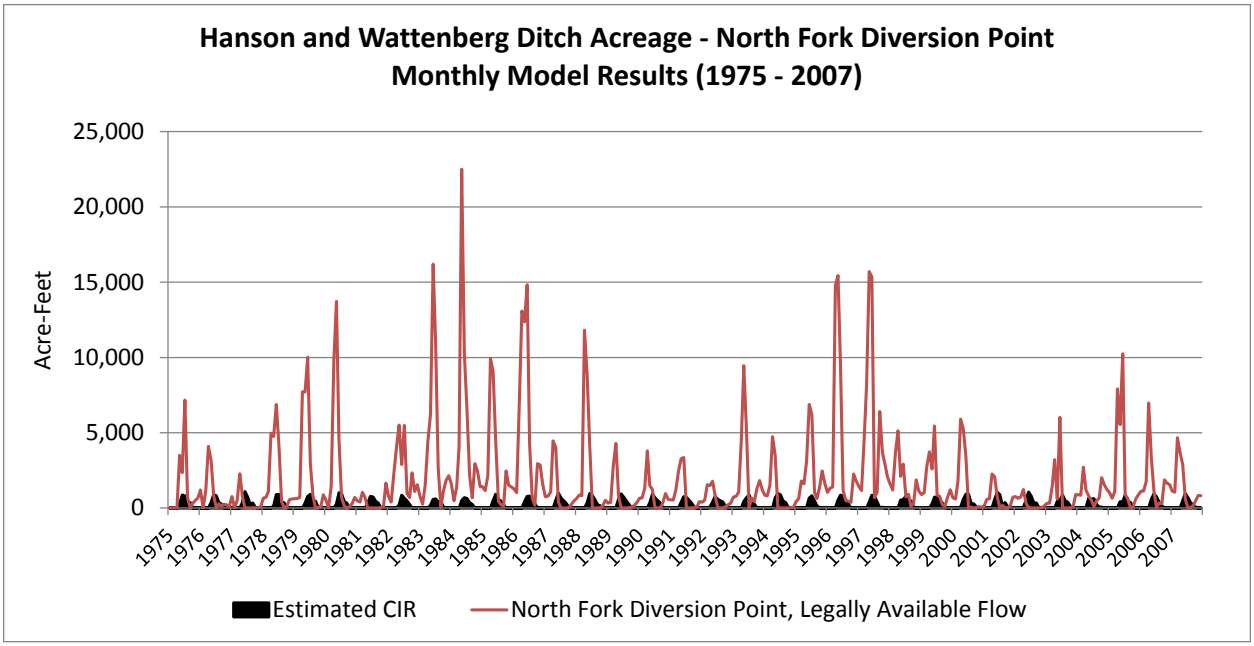


Figure 27. Hanson and Wattenberg Ditch Ac, Legally Available Flow at North Fork Diversion Pt

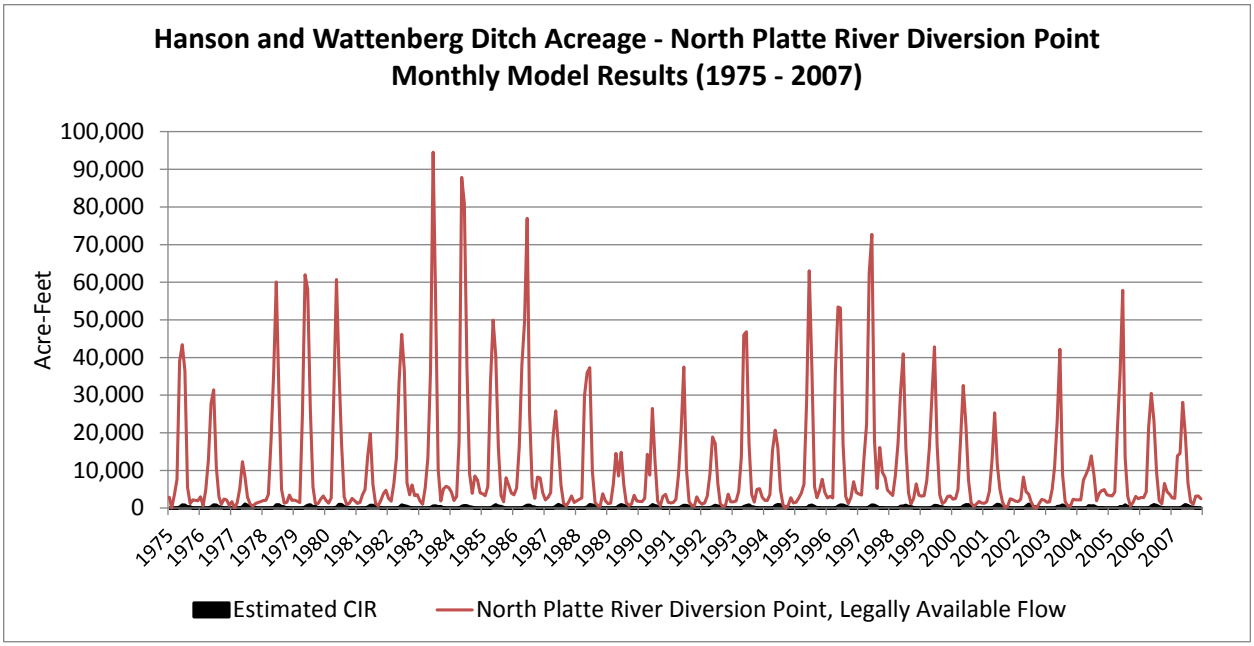


Figure 28. Hanson and Wattenberg Ditch Ac, Legally Available Flow at North Platte River Diversion Pt

Proposed Streamgage Installation

Background

Long-term continuous streamflow gage records for major tributaries are critical to administration, water resource management, and planning/modeling efforts in a watershed. Unfortunately, the North Platte River Basin does not have many of these streamflow gages.

- Of the more than 30 USGS or DWR streamflow gages in the North Platte River watershed (Water District 47) with records available in HydroBase:
  - Five gages are currently active (i.e. have records in 2012 or more recent) reflecting streamflow conditions on only three rivers; the Illinois River, Michigan River, and the North Platte River.
  - Nine have more than 15 years of records, four of which have not been active since 1948.
  - Thirteen have five or fewer years of records, primarily in the late 1970's and early 1980's
- Of the eleven USGS or DWR streamflow gages in the Laramie River watershed (Water Districts 48 and 76) with records available in HydroBase:
  - Three are currently active with records in 2014; Joe Wright Creek Above and Below Joe Wright Reservoir (06746095 and 06746110), and Sand Creek at Colorado-Wyoming State Line (06659580).

During the North Platte Modeling effort, a "wish list" of streamflow measurement locations was developed. The selected locations, summarized in Table 5, represent areas with significant current irrigation or irrigated acreage identified in the Equitable Apportionment Decree and a minimal amount of important streamflow data. In addition, at these locations downstream tributary measurements are

insufficient or do not have similar characteristics to "extrapolate" streamflow information to upstream locations. Locations where streamflow gages had historical measurements were given higher priority, providing for a longer period of hydrologic record at the same location.

Table 5. Proposed Streamgage Installation List

Location Description	*Historical Gage ID (Period of Record)*	*Drainage Area*	*Approximate Current Tributary Irrigated Acreage*
North Fork North Platte near Walden, CO	06614000 (1924 - 1945)	101,500 acres	13,000 acres (plus an additional 5,000 acres of irrigable land in Decree)
Roaring Fork near Walden, CO	06612500 (1924 - 1945)	50,350 acres	10,200 acres
Grizzly Creek near Hebron, CO	06611300 (1977 - 1980)	141,700 acres	16,000 acres
Canadian River near Brownlee	06619450 (1978 - 1983)	100,900 acres	7,500 acres
Illinois River at Walden, CO	06618500 (1923 - 1947)	163,400 acres	21,000 acres
Michigan River at Walden, CO	06617100 (1923 – 1947)	116,500 acres	20,000 acres
Michigan River near Cowdrey, CO	06619000 (1937 – 1947)	304,600 acres	24,000 acres

Project Name	Proposed Streamgage Installation
Project Sponsor	TBD
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural
Volume Water Gained/Saved	N/A
Purpose	Install and maintain streamflow gages in the basin
Constraints and Challenges	The quality of a streamflow record is directly correlated with the quality of construction and rating of instrumentation, and long term maintenance of the site and instrumentation. Challenges associated with siting, installing and maintaining a streamflow gage include: - cross section uniformity - site accessibility - appropriate gage type selection

	- long-term maintenance including site visits, instrumentation calibration and maintenance, and repairs as necessary - telemetry and processing of records - funding for installation and ongoing operation
Implementation Steps and Project Scope	- The USGS has developed standards in order to reliably and accurately measure streamflow; these standards should be reviewed and incorporated into any gage designs. - As the gage would likely be used by DWR for administration purposes, it is recommended the Division 6 Office be consulted prior to any final siting decisions to maximize the benefit and use of the records. - *Funding Mechanisms*. The initial cost of installing the streamflow gage, although not nominal, is generally not the major limiting factor. Instead, the long-term maintenance, site visits, and record processing for quality control are the main financial limitation in creating a reliable and accurate long-term record. Many historical streamflow gages in the basin, owned and operated by either DWR or USGS, are no longer in operation due to funding cuts at the State and Federal level. It is important to identify and maintain a long-term funding supply, including potential partnerships with DWR or USGS, to keep the gage in operation. A variable amount of matching funds from the USGS may be available to help with operations and maintenance coast, depending on USGS priorities, history of record, stream size, and water quality issues. Total annual operations and maintenance costs for a gage are currently estimated to be about $17,000 per year.
Effectiveness at Meeting Basin Goals	This project is designed to meet the NPBIP basin goal 6: to "Promote water rights protection and management through improved streamflow gaging." In addition, this project would help maintain and maximize the consumptive use of water in the basin (Goal 1), while eventually enabling the successful implementation of projects designed to meet other basin goals.

Storage Protocol

Background

The Equitable Apportionment Decree states that the North Platte River basin in Colorado is limited to 17,000 acre-feet of storage for irrigation uses each Water Year. This limitation is generally most restrictive in "wet" years immediately following drought years, whereby the reservoirs in the basin have been drawn down and have sufficient space and water available to fill. This limitation was exceeded in Water Year 2013, prompting the Division 6 Office to document how total storage was calculated, and how evaporation and storage associated with non-irrigation uses was accounted for in a draft Storage Protocol (*Protocol for Determining Storage for Irrigation in North Platte River Basin*, October 21, 2013). Water users and the JCWCD were not involved in the development of the initial draft protocol, therefore through this NPBIP process, they requested to review and provide input to the protocol language.

More robust protocol language will:

- Protect and maximize storage rights in the basin.
- Prevent exceedance of the storage limit in the future.
- Clearly define the storage calculations, including collection of records, comparison of "diversion-to-storage" records to "end-of-month" reservoir records, and more explicit accounting of evaporation and non-irrigation uses in multi-use reservoirs.
- Define options to manage reservoir storage and procedures to notify water users and JCWCD during years when storage curtailment is required or anticipated.
- Define approach to identify and mitigate the situation if "over-storage" occurs within the Water Year, including how and/or which reservoirs would potentially make a release.

Project Name	Storage Protocol
Project Sponsor	JCWCD and DWR
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☒ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural
Volume Water Gained/Saved	N/A
Purpose	Develop a Final Storage Protocol that protects and maximizes the use of storage rights in the basin and prevents exceedance of the Decree storage limitation.
Constraints and Challenges	- *Agreement of Protocol Language.* The Storage Protocol involves water users in the basin, JCWCD, CWCB Interstate and Federal Section[1], and Division 6 State Engineer and Water Commissioners. Final protocol language must address and protect the interests of all these entities.
Implementation Steps and Project Scope	- This project is currently underway; representatives from involved entities met in April of 2014 to discuss concerns with the draft protocol language. - The Division 6 Engineer is currently revising the draft protocol language based on feedback from the April meeting and will provide revised language to the JCWCD for their review.
Effectiveness at Meeting Basin Goals	This project will maintain and maximize the consumptive use of water in the basin (Goal 1), while eventually enabling the successful implementation of projects designed to meet other basin goals.

[1] The Equitable Apportionment Decree is silent on how storage for irrigation uses is calculated; therefore the North Platte Decree Committee representatives were not included in protocol language discussions during the BIP process.

Irrigated Acreage Protocol

Background

The Equitable Apportionment Decree (Nebraska v. Wyoming) states that the North Platte River watershed is limited to the irrigation of 145,000 acres each irrigation season. As discussed above, there are several incremental acreage assessments in the basin; however these have occurred in decadal or, more recently, semi-decadal increments. Annual acreage assessments are required for reporting under the Decree. Historically, acreage each year in the basin was estimated using the most recent acreage assessment available and adjusting these values based on recorded diversions to irrigation. Starting in 2011, DWR staff began producing an annual acreage assessment in the basin. The annual acreage assessment approach generally includes the following steps:

1. Obtain spatial imagery and coverages of the basin, including aerial imagery, National Agricultural Statistics Service (NASS) CropScape, and Landsat Imagery.
2. Process the Landsat Imagery into a Maximum Normalized Difference Vegetation Index (NDVI) Layer.
3. Using recent mapped irrigated lands, perform statistical analysis on the NDVI and CropScape coverages to produce mean NDVI values for each parcel.
4. Remove parcels with low NDVI values and attribute crop types to areas with high NDVI values.
5. Review irrigation diversion records for parcels with marginal NDVI values and revise final coverage.

This new approach is a technical improvement over the previous process and greatly improves the annual estimates of irrigated acreage in the basin. The new approach did not however include input or review from water users or JCWCD. Through the NPBIP process, JCWCD and water users have requested a period of annual review of the assessments with the opportunity to provide input on the final product.

This annual water user review will provide numerous benefits. It will enable the verification of parcel-specific irrigation with marginal NDVI values, and the identification of new acreage put into production that may not yet be reflected in the mapped irrigated lands. The review is especially important in drought years where a parcel may have only received irrigation early in the season that spatial imagery flown later in the season may not have identified.

Project Name	Irrigated Acreage Protocol
Project Sponsor	JCWCD and DWR
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☒ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural

Volume Water Gained/Saved	N/A
Purpose	Develop a Final Irrigated Acreage Protocol that includes review by local water users and JCWCD
Constraints and Challenges	- *Timeframe.* There is a limited timeframe that DWR operates to complete the annual acreage analysis, due to the time required to obtain spatial imagery and coverages and finalize diversion records. A majority of the effort is completed in March of each year with reporting to the North Platte Decree Committee (NPDC) by April 1st.
Implementation Steps and Project Scope	- Representatives from involved entities met in April of 2014 to discuss concerns with the draft protocol language. - During the meeting, DWR discussed the short timeframe and JCWCD agreed to complete their review and provide comment on the acreage within one week. - DWR is currently revising the draft protocol language based on feedback from the April meeting and will provide revised language to the JCWCD for review.
Effectiveness at Meeting Basin Goals	This project will maintain and maximize the consumptive use of water in the basin (Goal 1), while eventually enabling the successful implementation of projects designed to meet other basin goals.

Irrigation Season Protocol

Background

At the request of water users and JCWCD, the Division 6 Engineer developed a Draft Irrigation Season Protocol. The protocol defines the irrigation season, or the period of time each year the Division 6 Office will honor a river call of water rights for irrigation. Definition of the irrigation season provides "guidance to water right(s) holders for the use of their water but does not allow irrigators to expand the current use of their water right(s)". In defining an irrigation season, it limits the period that generally senior water rights may place a call on the river, and protects a period when other junior water rights may divert for storage or other uses.

The draft protocol language proposed an irrigation season from April 1st through October 31st, as well as the factors that the Division 6 Engineer may consider in modifying these dates, including:

- Daily average and minimum temperature related to growth triggers for grass pasture crops
- Crop demand and continued irrigation after harvest
- Potential damage caused by diverting water onto soil prior to hard freezes/winter

The selection of appropriate irrigation season dates is important to maximize the beneficial use of the diverted water, reduce wasteful irrigation practices, and protect the interests of senior and junior water right holders in the basin.

Project Name	Irrigated Season Protocol
Project Sponsor	JCWCD and DWR
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☒ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☐ Structural ☒ Non-Structural
Volume Water Gained/Saved	N/A
Purpose	Develop a Final Irrigation Season Protocol that reflects an appropriate and agreed upon irrigation season
Constraints and Challenges	- *Agreement of Irrigation Season.* Final protocol language regarding the irrigation season dates must address and protect the interests of senior irrigation and junior storage water right holders in the basin.
Implementation Steps and Project Scope	- Water users and representatives from the Division 6 Office and JCWCD met in April of 2014 to discuss the draft protocol language. - During the meeting, DWR and JCWCD requested that historical climate station data be analyzed with respect to the growing season of grass pasture, in order to understand historical beginning and ending growing season dates as they consider an appropriate irrigation season for the basin. - JCWCD is currently reviewing the draft protocol language revised per feedback from the April meeting and will provide comments to the Division 6 Office for their review.
Effectiveness at Meeting Basin Goals	This project will maintain and maximize the consumptive use of water in the basin (Goal 1), while eventually enabling the successful implementation of projects designed to meet other basin goals.

Technical Support

The North Platte Historical CU Analysis can be used to estimate the beginning (spring) and ending (fall) dates of the growing season for grass pasture based on historical climate data at various climate stations in the basin. Providing the range of growing season dates based on a long-term historical climate record allows the Division 6 Office and JCWCD to understand the variability and extremes of spring and fall dates during their consideration of protocol language.

A CU Analysis was simulated using available climate information at the Walden and Spicer climate stations using both a 42 and 45 degree growing season trigger in the Blaney-Criddle equation[2]. Note that climate stations with shorter periods of record (i.e. Gould, Pearl, and Rand) were not included in this summary analysis.

- The 42 degree temperature trigger is based on recommendations from the *Evapotranspiration and Agronomic Responses in Formerly Irrigated Mountain Meadows* developed by Ivan Walter, et al. for grass pasture in high mountain meadows.
- The 45 degree temperature trigger is based on recommendations from SCS TR-21 report for grass pasture.

Table 6 and 7 summarize the average, earliest, latest, and 80th percentile spring and fall growing season dates based on 42 degree and 45 degree temperature triggers. Figures 29 through 32 illustrate the spring and fall growing season dates for each climate station for each year there is available climate data. Walden sits at a lower elevation and generally has slightly warmer temperatures compared to Spicer station. The 45 degree trigger growing season is 20 days shorter on average compared to the 42 degree growing season, ten days later the spring and ten days earlier in the fall.

Table 6. Growing Season Summary, Walden Climate Station

Walden Climate Station Results	Spring Start Dates		Fall End Dates	
	42 Degree	45 Degree	42 Degree	45 Degree
Average	5-May	15-May	6-Oct	27-Sep
80th Percentile	13-May	22-May	11-Oct	3-Oct
Latest	20-May	27-May	19-Oct	12-Oct
Earliest	14-Apr	30-Apr	25-Sep	13-Sep

[2] The Original Blaney-Criddle Equation was used when analyzing the 42 degree temperature trigger, as the report outlined a calibrated crop coefficient for use with this temperature. The Modified Blaney-Criddle Equation was used when analyzing the 45 degree temperature trigger, as recommended in the SCS TR-21 report.

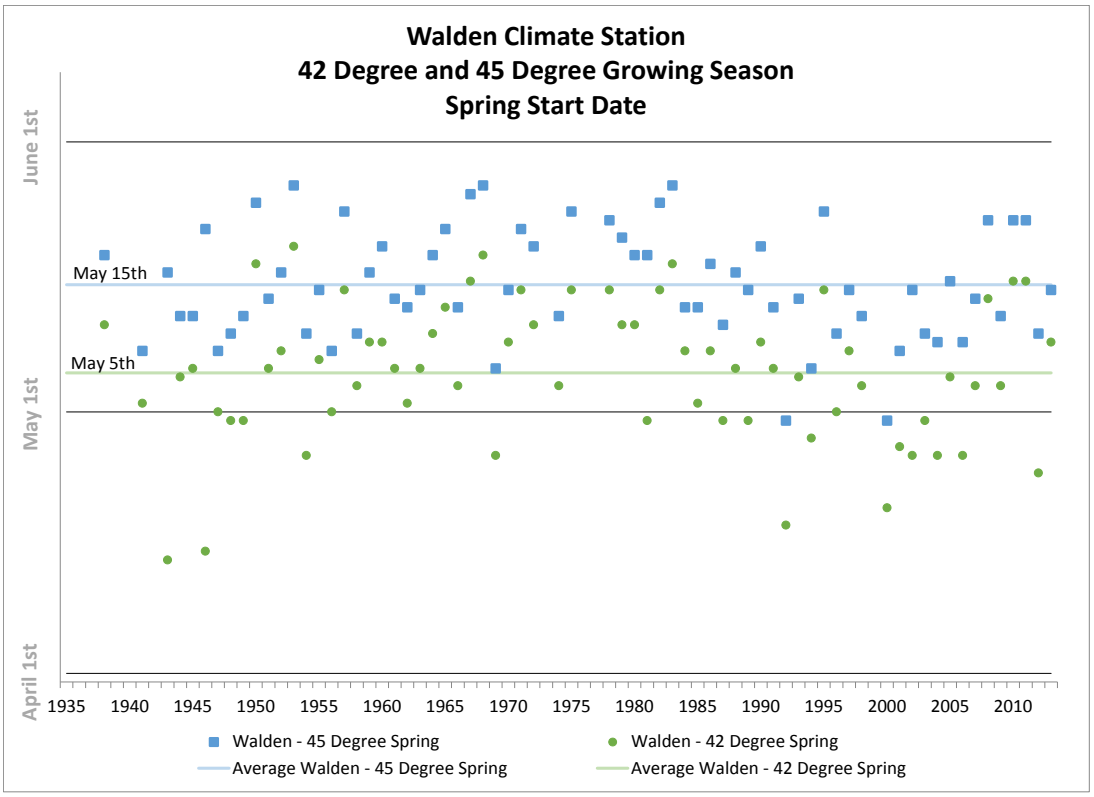


Figure 29. Annual Spring Growing Season Date, Walden Climate Station

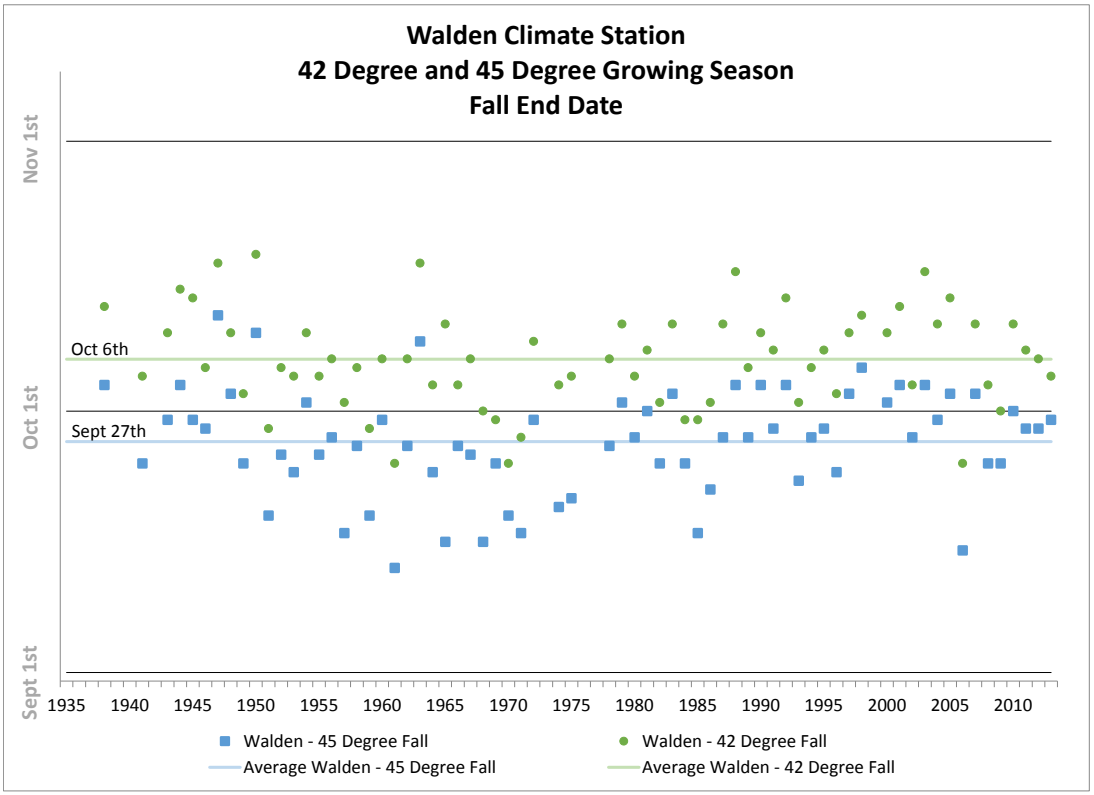


Figure 30. Annual Fall Growing Season Date, Walden Climate Station

Table 7. Growing Season Summary, Spicer Climate Station

Spicer Climate Station Results	Spring Start Dates		Fall End Dates	
	42 Degree	45 Degree	42 Degree	45 Degree
Average	7-May	17-May	7-Oct	28-Sep
80th Percentile	15-May	24-May	14-Oct	4-Oct
Latest	22-May	1-Jun	25-Oct	20-Oct
Earliest	13-Apr	27-Apr	21-Sep	11-Sep

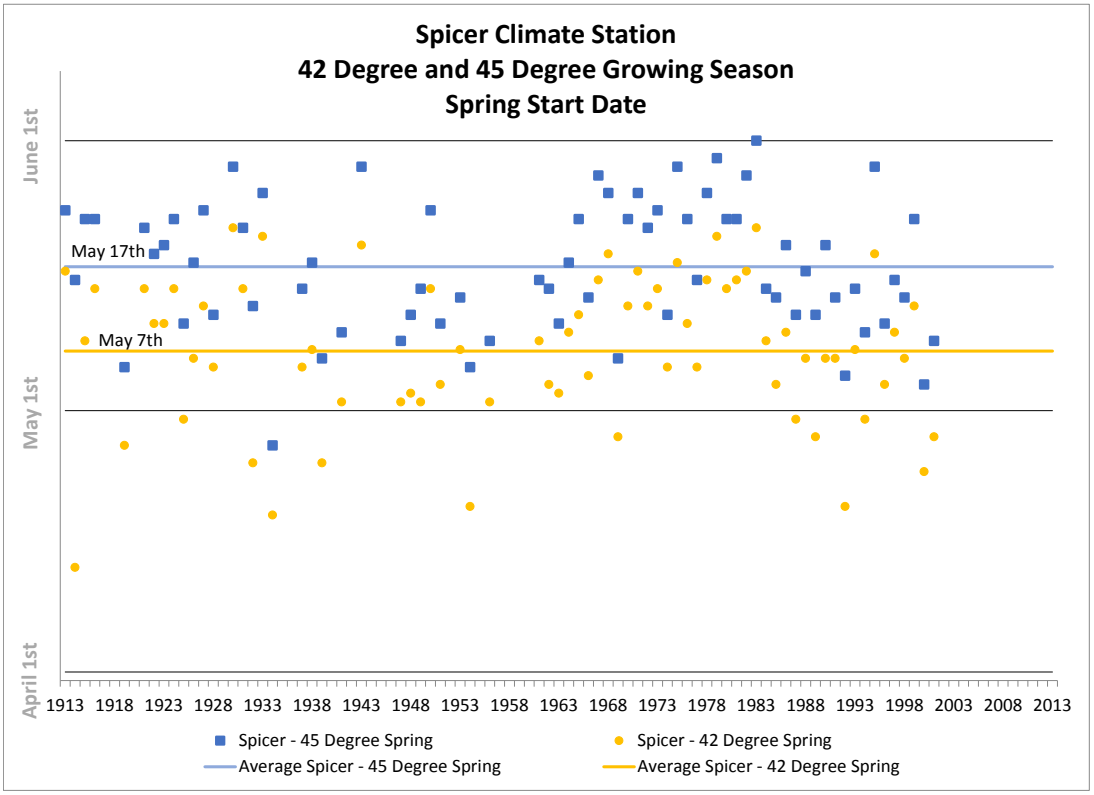


Figure 31. Annual Spring Growing Season Date, Spicer Climate Station

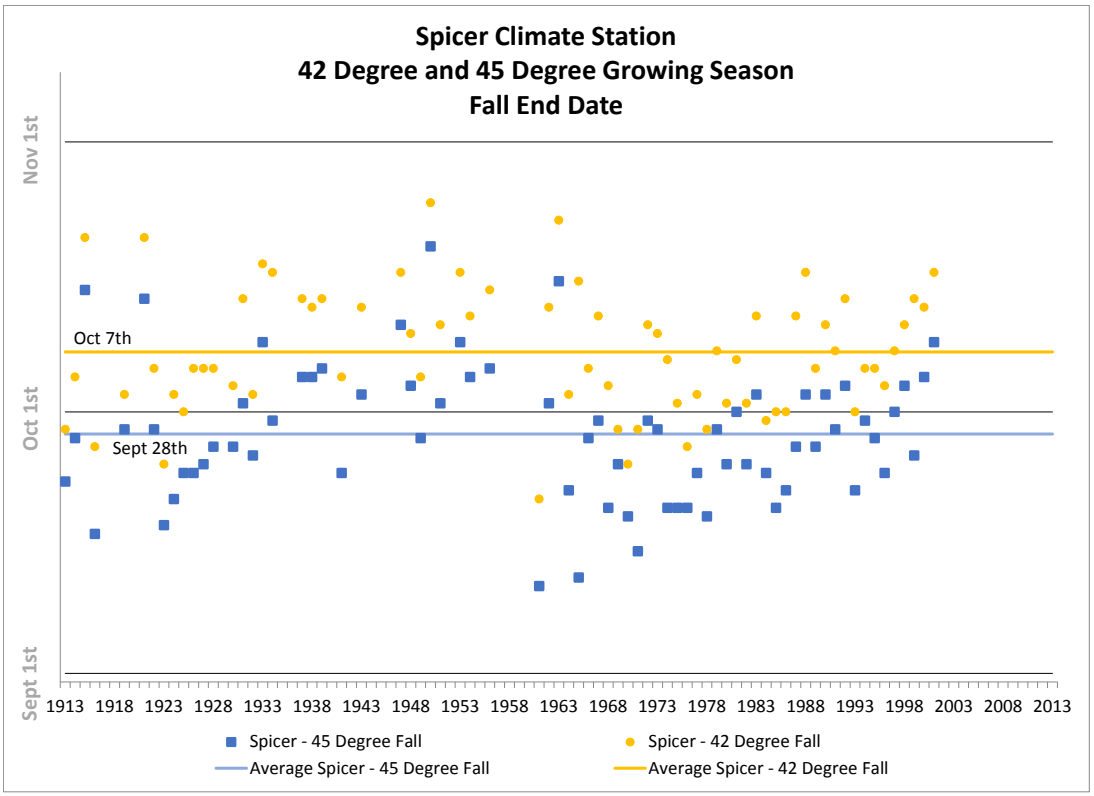


Figure 32. Annual Fall Growing Season Date, Spicer Climate Station

Proposed Willow Creek Reservoir

Background

New storage projects in the basin were identified during technical meeting discussions. Land owners discussed potential sites and the challenges faced in the design and construction of such a project. Discussion centered on small off-channel storage projects due to concerns over permitting and construction costs, water availability, and the Equitable Apportionment Decree storage limitation.

The Willow Creek Reservoir site was selected for inclusion in the project list because its location allowed for diversions from both Willow Creek and the Illinois River and its ability to serve existing and potentially new irrigated acreage. As shown in Figure 33, the proposed site is situated between Willow Creek and Illinois River near Highway 125, and could release directly to meet irrigation demands downstream on Illinois River or via exchange for upstream irrigation demands on Willow Creek or Illinois River. Additionally, the proposed reservoir may be able to serve the proposed Lost Creek Project irrigated acreage via pipeline and recreational or environmental needs lower in the basin during low flows.

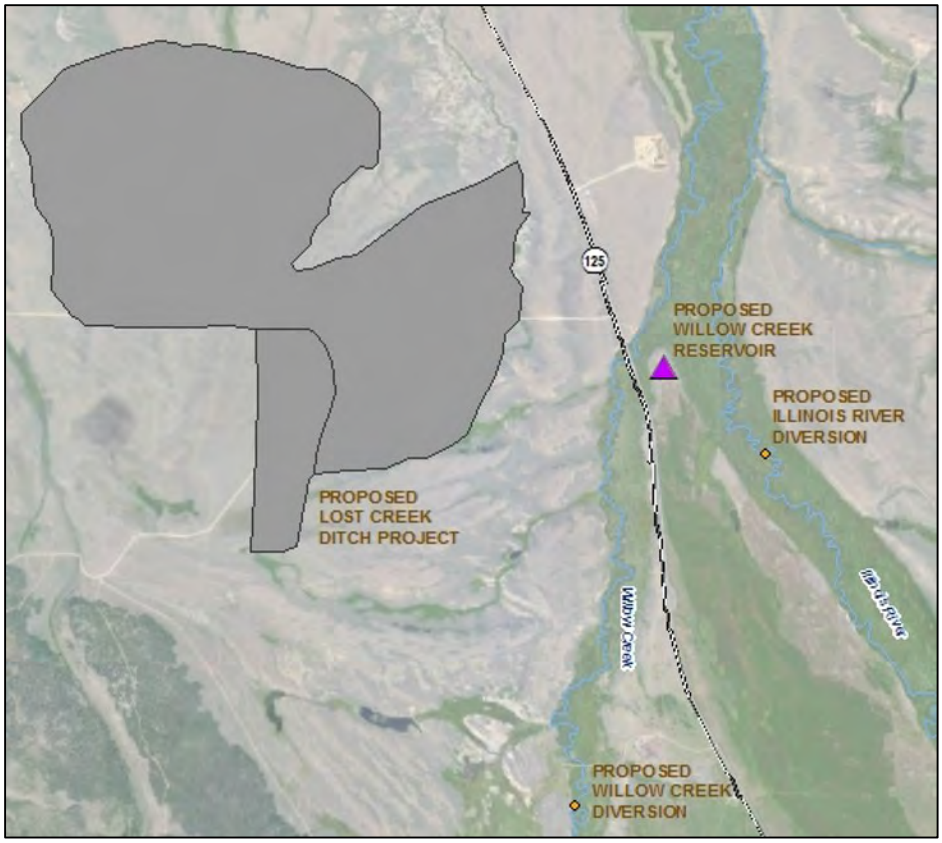


Figure 33. Annual Fall Growing Season Date, Spicer Climate Station

The proposed Lost Creek Ditch Acreage project encompasses approximately 1,650 acres and was originally considered in an irrigation/ranching plan in the early 1930's. Water availability issues in the Lost Creek drainage may have led to the plan not being developed, therefore new supplies, such as the proposed Willow Creek Reservoir, were considered under this NPBIP effort when selecting this parcel for inclusion in the proposed project list.

Project Name	Proposed Willow Creek Reservoir
Project Sponsor	TBD
Category	**Sponsor Type:** ☒ Single Entity ☐ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural
Volume Water Gained/Saved	Conservative estimate of 500 acre-feet capacity, requires feasibility study to identify maximum capacity.

Purpose	Construct Willow Creek Reservoir supplied by a junior water right from either Willow Creek or Illinois River for irrigation, environmental, and/or recreation purposes.
Constraints and Challenges	- *Water Availability*. A technical analysis of legally available flow was performed for proposed diversion points from both Willow Creek and the Illinois River. Legally available flow from both sources was limited in many years; in 13 of the 33 years legally available flow was less than the estimated reservoir capacity or zero. Additionally, the irrigation demand of the Lost Creek Ditch Acreage project is significantly greater than the proposed capacity of the reservoir, indicating an additional supply would be needed to serve the proposed acreage. - *Cost/Benefit Analysis*. Estimated initial capital and long operations and maintenance costs to construct and maintain the reservoir vs. the benefit of new supply to meet irrigation, environmental, recreational, or industrial demands. - *Site Conditions.* Significant feasibility analyses of the proposed site would be required to understand the structural constraints on the project (e.g. dam site foundation/materials, inundation mapping, highway crossings for canals) - *Permitting*. State and local environmental permitting requirements may require significant cost/effort to obtain and may require mitigation if sensitive species are located on the proposed site.

Implementation Steps and Project Scope	- *Feasibility Study*. A summary of work that would need to be completed, at a minimum, to evaluate the feasibility of the project:
	  - detailed water availability analysis
	  - site investigations including land ownership, right-of-way requirements, survey, geotechnical analysis, and sensitive species inventory/wetlands delineation.
	  - permitting and water rights requirements
	  - conveyance and reservoir design
	  - cost analyses
	- *Funding Mechanisms*. Costs associated with the feasibility study alone can be significant. Potential funding sources and loan options from entities such as the CWCB would need to be investigated.

Effectiveness at Meeting Basin Goals	This project could excel at meeting the basin goals 1 and 3. The additional storage and potential irrigated acreage would help maintain and maximize the consumptive use of water in the basin (Goal 1), while helping to maintain important existing infrastructure (Goal 3).

Technical Support

The North Platte Model Baseline scenario can be used to determine the amount of water that would be physically and legally available to a junior water right from both Willow Creek and the Illinois River for storage in the Proposed Willow Creek Reservoir and potential irrigation of Lost Creek Ditch Acreage. Two points were selected in the model that would be represent the location of potential diversion points, and the legally available flow at those points were obtained from the model. The results

reflected extreme variability in available flow, with 20 of the 33 years reflecting available flow greater than the estimated 500 af capacity of the proposed reservoir in a given year. The longest period with no available flow was six years. This percentage, as well as the legally available flow on average annually for the 1975 – 2007 period, is reflected in Figure 34. As shown, when there is legally available flow, it is significantly greater than the estimated capacity of the reservoir – a true flood vs. drought condition.

As the hydrological conditions in Willow Creek generally coincide with those seen on the Illinois River (i.e. dry conditions cause low flows in both rivers), and both rivers are subject to bypass water to the same downstream senior water rights, flow availability on both tributaries are limited at the same times. This lack of supply variability between the two tributaries limits the benefit of diversion points from both tributaries. The Illinois River generally has more legally available flow, although only by approximately five percent annually over the study period. In conclusion, reliable legally available flow from either tributary is a considerable constraint to the feasibility of this project.

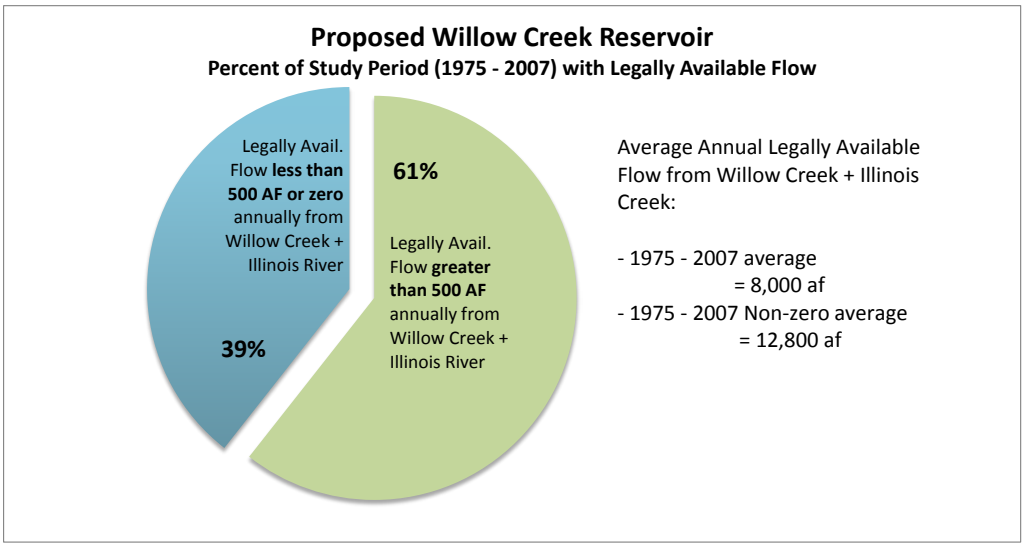


Figure 34. Proposed Willow Creek Reservoir, Legally Available Flow

Dam Ditch Headgate Improvement

Background

This structure was analyzed as a potential example of multipurpose projects in the basin that would improve fish connectivity and potentially improve operability and reliability of the diversion structure. Dam Ditch diverts 33.5 cfs of decreed absolute water rights from the North Platte River to irrigate over 130 acres of grass pasture on the east side of the river. The headgate, located downstream of the North Fork of the North Platte River and mainstem confluence, uses a rock pushup dam and a culvert under Highway 12 to divert water from the river, as shown in Figure 35. The current headgate design is difficult to maintain, is in need of repair, and causes fish connectivity issues on the mainstem during low flows. Additionally, maximum daily diversion rates for the ditch have been in decline since the mid-1980's, down from approximately 40 cfs to 22 cfs in recent years (HydroBase).

Figure 35. Ditch Dam Headgate Improvement Project

This culvert under County Road 12 was recently listed by Jackson County as requiring maintenance and/or full replacement. This listing, as well as discussions throughout this NPBIP process, resulted in this headgate being highlighted as a multi-purpose project. A potential redesign and replacement of this headgate could:

- Reduce maintenance efforts/expenses to both the landowner and Jackson County.
- Repair the culvert to prevent damage to or safety issues on County Road 12.
- Restore capacity of culvert to historical diversion rates, or greater.
- Improve fish connectivity in the North Platte River.

Project Name	Dam Ditch Headgate
Project Sponsor	TBD
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural

Volume Water Gained/Saved	Restore capacity of culvert to historical diversion rates or greater, potentially 18 cfs rate improvement.
Purpose	Redesign and replace current Dam Ditch headgate and culvert
Constraints and Challenges	- *Environmental Permitting.* Investigation of required environmental permitting would be necessary to understand these requirements as they pertain to design and construction. - *Coordination*. Coordination between the landowner and Jackson County is required for a mutually beneficial project design, access to the site, and potential cost sharing.
Implementation Steps and Project Scope	- *Design and Construction*. New headgate and culvert design should address irrigation operations, minimum road culvert design standards, ease of maintenance, stream bank improvements, and fish connectivity in the river. - *Funding Mechanisms*. Removal of existing infrastructure and construction of a new headgate and culvert add up to significant costs. Potential funding sources and loan options from entities such as the CWCB would need to be investigated by the landowners. Additionally, environmental advocacy groups may be interested in funding opportunities to expand stream and fish connectivity benefits in the stream reach.
Effectiveness at Meeting Basin Goals	This project could excel at meeting the basin goals 1, 3, and 4. The additional capacity would help maintain and maximize the consumptive use of water in the basin (Goal 1), restore and maintain important existing infrastructure (Goal 3), and maintain healthy rivers (Goal 4). In addition, this project exhibits a beneficial relationship between agricultural and environmental & recreational water use.

Canal Maintenance and Improvements

Background

Many of the headgates and ditches used for irrigation and ranching purposes in the North Platte River Basin have been in operation for several decades. Over time, ditches can erode or silt-in; headgates can migrate, settle, and crack; and floods can wreak havoc on all aspects of a ditch system. Landowners perform annual maintenance but generally lack the financial resources to replace deteriorating headgates or ditches. As discussed at the technical meeting, management of water resources in the basin is a challenge when headgates and ditches in poor condition cannot effectively or efficiently divert water supplies. Discussions focused on the benefits of identifying headgate structures and ditch systems in need of

substantial maintenance or replacement, and developing a mechanism to assist those landowners in obtaining funding for the proposed improvement.

JCWCD recently obtained WSRA funding to replace four old and deteriorating headgate structures with a new permanent diversion structure to measure and regulate diversions to over 12,000 acres of irrigated land. As cited in the Water Activity Summary Sheet associated with this project, the benefits of projects such as these extend beyond agricultural:

> *"The proposed new headgate structures will allow the water users to safely, effectively, and efficiently control and regulate the amount of water entering each of the associated ditches. The proposed diversion structure will serve as a permanent check structure, thus eliminating annual damage to the streambanks and reducing sediment discharge. Installing these improved structures will not only help to maintain the current agricultural economic base, but will also help meet the identified consumptive need of increasing irrigated acres within the county. Improved water efficiency is a benefit to all consumptive and associated non-consumptive uses of irrigation water.*
>
> *The structures will address both the agricultural and environmental water needs in a cost effective, collaborative way…In addition to irrigating highly valuable hay land, the irrigation water creates irrigation-induced wetlands and riparian areas that provide habitat for many species of big game, waterfowl and upland birds, including the Greater Sage Grouse. The ditches, wetlands, and riparian areas provide a variety of recreational opportunities as well."*

This project has clear consumptive and non-consumptive benefits with few challenges or constraints, leading to its selection for inclusion in the NPBIP Project List.

Project Name	Canal Maintenance and Improvements
Project Sponsor	Jackson County Water Conservancy District
Category	**Sponsor Type:** ☒ Single Entity ☐ Partnership **Use Type:** ☐ NC ☒ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural
Volume Water Gained/Saved	TBD based on the number and condition of the headgate structures and ditch systems identified for an improvement.
Purpose	Identify and prioritize projects to restore, rehabilitate, or improve agricultural water supply infrastructure in a manner that protects existing uses and improves stream or land conditions.
Constraints and Challenges	- *Identification and Prioritization of Projects.* Technical meeting discussion did not support systematic inventory of headgate structures or ditch systems, citing extensive costs for that level of effort. Rather, JCWCD may potentially request

	local landowners submit projects or sites in need. Due to the high-level of local water user involvement, this approach will likely result in several potential sites. Once identified, JCWCD would need to develop metrics (reflecting agricultural and environmental parameters) to evaluate and prioritize potential projects.
Implementation Steps and Project Scope	- *Funding Mechanisms*. Ideally multiple potential projects can be selected for construction under this effort and combined in a limited number of WSRA Grant Applications. Combining many potential sites under one WSRA Grant Request minimizes JCWCD administrative costs and potentially allows for cost sharing of design and construction.
Effectiveness at Meeting Basin Goals	This project could excel at meeting the basin goals 1, 3, and 4. More efficient headgate structures or ditch systems would help maintain and maximize the consumptive use of water in the basin (Goal 1), restore and maintain important existing infrastructure (Goal 3), and improvements to infrastructure would also help to revitalize affected river reaches (Goal 4), while showcasing the beneficial relationship between agricultural and environmental and recreational water use (Goal 5).

Instream Diversion Structure Identification

Background

Diversion structures in the North Platte Basin that operate using in-channel dams can cause fish connectivity (a.k.a. aquatic passage) issues within the stream reach, unless specifically equipped with fish ladders or other aquatic bypass structures. Such dams can create a fish passage barrier that prevents the movement of fish at the diversion point and disrupts habitat continuity on the river. Additionally, diversion dams can cause sediment build-up and lead to stagnation during low flow periods. Fish connectivity in stream reaches could be improved if these diversion structures (e.g. Dam Ditch discussed above) were identified and redesigned or replaced with structural designs more favorable to stream connectivity. Since many diversion structures are in need of repair, an opportunity exists to increase diversion accuracy and reliability, reduce O & M costs, and address fish connectivity at the same time.

The potential project initially involves the identification of these structures, and could ultimately include an evaluation of the current level of connectivity issues caused by diversion structures, an evaluation of the surrounding streambank, and an evaluation of current operational effectiveness of existing structures. These evaluations would allow for the prioritization of diversion structures whose redesign or replacement would be the most beneficial to the stream and increase the operational functionality of the diversion structure for irrigation. Additionally, this project could promote partnerships between individual land owners and environmental entities, such as the USFW or CPW, who could work together to design a diversion structure that could:

- Restore capacity and operational effectiveness of the structure for irrigation use.
- Reduce maintenance efforts/expenses to the landowner.

- Improve fish connectivity in the North Platte River.
- Improve the stream habitat within the affected reach.

Project Name	Instream Diversion Structure Identification
Project Sponsor	TBD
Category	**Sponsor Type:** ☐ Single Entity ☒ Partnership **Use Type:** ☐ NC ☐ Ag ☐ M&I ☒ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural
Volume Water Gained/Saved	TBD
Purpose	Identify diversion structures with in-channel dams that cause fish connectivity issues; evaluate and prioritize these structures in terms of operational effectiveness for irrigation use and overall impact of the structure on connectivity issues; and potentially redesign and replace these structures with more effective designs.
Constraints and Challenges	- *Identification and Evaluation.* Many structures with significant in-channel dams can be seen on aerial imagery of the basin. For those structures with less visible dams, an efficient and cost-effective method for identifying these types of structures must be determined. Consistent metrics need to be determined to evaluate and prioritize the structures. Accessing these sites in support of evaluating the structure and stream reach could be problematic due to remote locations on private property. Landowner support would be a prerequisite to any and all structures evaluated. - *Environmental Permitting.* Investigation of required environmental permitting would be necessary to understand these requirements as they pertain to design and construction. - *Coordination*. Coordination between the landowner and environmental entity is required for a mutually beneficial project design, access to the site, and potential cost sharing.
Implementation Steps and Project Scope	- *Design and Construction*. Any new headgate designs should address irrigation operations, ease of maintenance, stream bank improvements, and fish connectivity in the river. - *Funding Mechanisms*. Removal of existing infrastructure and construction of a new headgate add up to significant costs. Potential funding sources and loan options from entities such as the CWCB would need to be investigated by the landowners. Additionally, environmental advocacy groups may be interested in cost-sharing partnerships to expand stream and fish connectivity benefits in the stream reach. Ideally multiple potential projects can be selected for construction under this effort and combined in a limited number of WSRA Grant Applications.

	Combining many potential sites under one WSRA Grant Request minimizes costs and potentially allows for cost sharing of design and construction.
Effectiveness at Meeting Basin Goals	This project could excel at meeting the basin goals 1, 3, and 4. The additional operational functionality would help maintain and maximize the consumptive use of water in the basin (Goal 1), restore and maintain important existing infrastructure (Goal 3), and maintain healthy rivers (Goal 4), while showcasing the beneficial relationship between agricultural and environmental and recreational water use (Goal 5).

Verner State Wildlife Area (SWA) – North Platte River Stream Restoration

Background

The North Platte Stream Restoration in the Verner State Wildlife Area (SWA) is an effort to restore and enhance a popular public fishing area on the North Platte River. This one mile reach of the river is degraded from heavy historical grazing use, with poor riparian vegetation, eroding banks, a widening channel, and a silting in streambed. All of these factors decrease the river's ability to sustain healthy aquatic and riparian wildlife populations and have negative effects downstream in the form of increased velocities leading to further erosion, high levels of sediment in the water, and increasing temperatures. In partnership with the landowner, Colorado Parks and Wildlife (CPW) has recently made a strong effort to effectively fence off the riparian corridor, excluding cattle and beginning the recovery process. This will initially reduce further degradation, but additional work is necessary to eliminate the erosive conditions at work in the channel and restore bank vegetation. Therefore, CPW is pursuing a restoration project on this reach of the North Platte River.

Project Name	Verner State Wildlife Area – North Platte River Restoration SWA river channel/riparian corridor habitat/water quality improvements
Project Sponsor	Colorado Parks and Wildlife
Category	**Sponsor Type:** ☒ Single Entity ☐ Partnership **Use Type:** ☒ NC ☐ Ag ☐ M&I ☐ Multi-Purpose **Project Type:** ☒ Structural ☐ Non-Structural

Volume Water Gained/Saved	N/A
Purpose	Restore stream channel and riparian corridor to improve fishery habitat, water quality, erosion control.
Constraints and Challenges	- *Funding.* CPW doesn't currently have the funding available for project execution. Additional funds are necessary for the WSRA program or other sources. A previous WSRA application for this project was not approved by the NPBRT in 2013. However, future refinements to the project and level of funding pursued may help to achieve NPBRT support. CPW has already spent many hours in the preliminary investigation, assessment, and study of the project. CPW has developed a conceptual restoration plan to use as a basis for a final build design and intends to do the design work in-house as well as provide project oversight and supervision. - *Coordination*. Ongoing coordination between the landowner CPW is in place via an easement.
Implementation Steps and Project Scope	- Survey for final design. Use conceptual design and budget to create a build design to use for the on-site construction. - Collect, purchase, transport and store necessary materials for implementing the design. - Undertake open bid process to identify and contract entities to perform the physical ground work. - Implement plan design. - Conduct biological assessment of the treated river segment specifically isolating individual treatments for comparison. - *Funding Mechanisms*. This project may be reapply for WSRA grant funding after further discussion with the NPBRT.
Effectiveness at Meeting Basin Goals	This project would excel at meeting the basin goals 2 and 4. The restored stream channel and riparian corridor would improve fishery habitat and water quality. By improving an important and well-used public access fishing location, the project would help the local economy.

Section 5: Conclusions and Recommendations

5.1 Introduction

The North Platte Basin Implementation Plan (NPBIP) was created by the North Platte Basin Roundtable (NPBRT) for submittal to the Colorado Water Conservation Board (CWCB). It is designed to support regional water planning through the roundtable process established by the Colorado Water for the 21st Century Act. The NPBIP builds on previous roundtable work to propose and fund projects for meeting water needs. The NPBIP also provides critical grassroots input to the forthcoming Colorado Water Plan (CWP).

To encourage locally-driven and balanced solutions to water supply challenges, the plan identifies water projects through targeted analyses of water issues in the basin. The NPBIP includes analyses of water shortages, water availability under variable hydrologic conditions, opportunities for improving environmental and recreational attributes in the basin, and various site-specific water supply issues. The ultimate purpose of the plan is to better identify water priorities in the basin and highlight planned projects that will excel at meeting these priorities in the near future.

The NPBIP process continues the important public education, participation, and outreach work that the NPBRT has been engaged with for almost ten years. The creation of the NPBIP included targeted technical outreach to refine information on water needs and projects. It also included public outreach to gather input on key elements of the report. The NPBRT's ongoing outreach and education efforts will be critical throughout the development of the CWP.

Section 5.2 provides conclusions of key NPBIP information and how proposed projects meet basin goals; and Section 5.3 provides recommendations for project implementation strategies.

5.2 Conclusions

This section summarizes key information contained in major sections of this report and articulates how proposed Basin Projects (Section 4) will meet Basin Goals (Section 1). The structure of this document generally follows CWCB BIP guidelines with some modifications to better address local issues, streamline the report, and focus on planned projects.

- Section 1 defines basin goals and corresponding targets or measurable outcomes.
- Section 2 summarizes water supply needs in the basin.
- Section 3 describes options to analyze projects and case studies.
- Section 4 identifies proposed projects, related constraints, and strategies for implementation.
- Section 5 summarizes conclusions and recommendations.

Following are brief summary conclusions to Sections 1 through 4.

Basin Goals

The NPBRT identified eight Basin Goals to establish priorities for water development and maintain important historical water uses in the North Platte Basin. Each goal is paired with Measurable Outcomes and a process for their achievement to provide a more concrete measurement of success (Section 1).

North Platte Basin Goals

9. Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.
10. Increase economic development and diversification through strategic water use and development.
11. Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.
12. Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs.
13. Describe and quantify the nonconsumptive benefits of agricultural use.
14. Promote water rights protection and management through improved streamflow gaging data.
15. Enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health.
16. Support the equitable statewide application of municipal water conservation.

Basin Needs

The NPBRT identified water needs by summarizing corresponding information from existing relevant sources and updates secured through targeted technical outreach.

- **Agriculture:** Agricultural shortages are significant even in years with above average annual streamflow, and are more than 60 percent in drought years. Average annual agricultural shortages are currently 89,000 AF and projected to be 110,000 AF by 2050. Interviews with agricultural water users during outreach meetings and NPBRT meetings highlighted issues with aging or non-functional infrastructure, resulting in historically irrigated acreage that has not been irrigated in several years. Feedback also highlighted concerns over the amount of acreage currently irrigated and potential long-term implications of irrigating less than the maximum acreage allowed under the Equitable Apportionment Decree.

- **Municipal and Industrial:** The North Platte Basin has addressed its municipal needs through the Walden Water Supply Improvement Project. The very small amount of ongoing and future industrial needs in the basin are met with available supplies and accounted for by JCWCD through the Three States Agreement.

- **Environmental and Recreational:** Environmental and Recreational needs are summarized and targeted through a weighted focus map based on the NPBRT's prioritization of attributes. This

map uses the relative priority and concentration of environmental and recreational attributes to create a heat map that better indicates the concentration and relative importance of attributes per roundtable consensus. This map will be used in conjunction with an understanding of the individual environmental and recreational attributes to help target projects to address identified attributes in the basin, including both multi-purpose projects as well as specific environmental and recreational projects. The resulting map is detailed in Figure 12.

Basin Evaluations

The NPBRT used the North Platte River Basin Water Resources Allocation Model, case studies, and mapping overlays to evaluate projects and project constraints. Modeling tools allowed for the evaluation of water availability to individual projects based on variable hydrology, water rights, and operations (e.g. proposed diversions, reservoirs, and management strategies). The modeling tools helped to evaluate three case studies to investigate basin-wide issues and opportunities with specific projects (i.e. irrigated acreage analysis, legally available flow, and an analysis of agricultural impacts on streamflows). Mapping overlays of project data and basin needs were used to provide a consistent methodology to review potential projects, highlight options for multi-use projects, and identify projects that may compete for available water. Section 3 of this report provides details on how these evaluations were conducted.

Basin Projects

Projects are the primary focus of the NPBIP and the mechanism for addressing Basin Goals established in Section 1 of this report. This section summarizes projects that are highlighted for potential implementation, based on information presented in Section 4 of this report. Developed in close coordination with the NPBRT, the list of proposed projects is considered a current 'snapshot' of potential basin solutions that is expected to be continually refined by project sponsors. To strategically focus implementation these projects were determined to be the most effective at meeting basin goals and most likely to be feasible in the near future. Projects and the corresponding Basin Goals that they are designed to address are summarized in Table 8.

Table 8. Relationships between Basin Goals and Proposed Basin Projects

Project	Basin Goal							
	1	2	3	4	5	6	7	8
MacFarlane Reservoir	x		x	x	x			
Evapotranspiration Project	x							
Walden Reservoir	x	x	x					
Basinwide Augmentation Plan	x	x						
Hanson and Wattenberg Ditch Acreage	x		x					
Proposed Streamgage Installation	x					x		
Storage Protocol	x							
Irrigation Season Protocol	x							
Irrigated Acreage Assessment Protocol	x							
Proposed Willow Creek Reservoir	x		x					
Dam Ditch Headgate Improvement	x		x	x				
Canal Maintenance and Improvements	x		x	x	x			
Instream Diversion Structure Identification	x		x	x	x			
Verner State Wildlife Area – North Platte River Restoration		x		x				

Project Effectiveness in Meeting Goals and Measurable Outcomes

Table 9 provides brief narrative descriptions discussing general relationships between identified Basin Goals and proposed Basin Projects. In most case Basin Goals are fulfilled by a number of Basin Projects.

Table 9. Relationships between Basin Goals and Proposed Basin Projects

Goal 1: Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement – All highlighted projects are designed to fulfill this basin goal. Technical workshops and NPBRT meetings during the BRT process helped to identify potential acreage to maintain or restore, along with acreage delineation issues. The goal is being addressed through proposed structural improvements to new and existing infrastructure as well as nonstructural projects, such as administrative improvements developed in coordination with DWR.

Goal 2: Increase economic development and diversification through strategic water use and development – Two proposed projects related to the development of a potential augmentation plan could help fulfill this basin goal. A carefully crafted augmentation plan would enable new economic development in the basin without impacting current uses and historical water rights. In addition a project involving the restoration of an important public fishing location in a State Wildlife Area, would also help enhance the recreational economy.

Goal 3: Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies – Seven proposed projects would to directly address this basin goal through the restoration, maintenance, and modernization of existing water infrastructure. The projects include restoration of dam outlet works and toe drains, reservoir enlargement, reservoir dredging, ditch rehabilitation, headgate reconstruction, and inventories to efficiently focus future funding and improvements.

Goal 4: Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs – Five proposed projects would help address this basin goal with the intent to improve and maintain environmental and recreational focus areas in the basin. The projects include reservoir improvements on to preserve a major water supply for the maintenance of habitat at the Arapahoe National Wildlife Refuge, the improvement of a major diversion structure to address fish connectivity while addressing other water user needs, improvement of fisheries habitat at State Wildlife Areas (public access fishing), and two inventory projects that could help identity other multi-purpose project opportunities.

Goal 5: Describe and quantify the nonconsumptive benefits of agricultural use – Four projects help to address Goal 4 as well as this goal and also help to demonstrate direct multi-purpose benefits. These proposed projects include: include reservoir improvements on to preserve a major water supply for the maintenance of habitat at the Arapahoe National Wildlife Refuge, the improvement of a major diversion structure to address fish connectivity while addressing other water user needs, and two inventory projects that could help identity other multi-purpose project opportunities.

Goal 6: Promote water rights protection and management through improved streamflow gaging data – One proposed project would directly address this basin goal to improve streamflow gaging in the basin. The project builds on initial analyses included in the NPBIP and CDSS efforts. It involves the identification and installation of new gages at key locations in the basin.

Goal 7: Enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health – No proposed projects are currently identified to address this goal, however one ongoing project funded by the roundtable directly addressed this goal (USFS Pine-Beetle Study). Per recommendations in the goal's process and measurable outcome this ongoing study will be reviewed by the NPBRT with an effort to implement the findings and maintain communication on any further research or related projects.

Goal 8: Support the equitable statewide application of municipal water conservation – No proposed projects are currently identified to address this goal, however the NPBRT will remain involved in the ongoing processes of the IBCC and Colorado Water Plan to support the equitable statewide application of municipal water conservation measures.

5.3 Recommendations

Each project proposed for the North Platte Basin requires a unique and systematic plan for implementation that includes discrete steps to maneuver the project from conception to completion. These 'implementation strategies' typically involve two primary categories of action prior to completion of the project: *securing project acceptance* and *demonstrating project feasibility*. Each step in the project implementation process includes various challenges (constraints), or potential key issues or circumstances that may limit the ability of a project proponent to implement the proposed project. For each constraint, there exists a corresponding strategy to successfully complete the project. Table 10 summarizes strategies to overcome constraints related to securing project acceptance and demonstrating project feasibility to allow implementation of projects proposed for the North Platte Basin.

Table 10. Project Constraints and Implementation Strategies

Category	Constraint	Strategies
Project Acceptance	Conflict	Partnerships Cooperative Strategies
	Perception	Public Education and Outreach Incentive-Based Programs
	Regulations	Cooperative Strategies Regulatory Streamlining
Project Feasibility	Cost	Creative Funding Mechanisms Partnerships and Cooperative Strategies
	Water Availability	Water Availability Analyses Water Administration Strategies
	Constructability	Feasibility Analyses Engineering Design

Following are details of the strategies to implement proposed North Platte Basin projects, organized according to the implementation categories and constraints listed above in Table 10. This section is provided to help inform decision-makers on typical project challenges and guide future decision-making for effective implementation of proposed projects.

Project Acceptance

Conflict – Conflict can be a constraint to securing acceptance of a project. On one hand, the North Platte Basin has established a goal to "discourage the conversion of productive agricultural land to all other uses". An example for this type of constraint includes potential conflicting priorities between different water uses, such as agricultural, environmental, and recreational. Competition can generate conflict that may limit the ability of a project sponsor to implement a proposed project. Partnerships and cooperative strategies may effectively address conflicts as summarized in Table 11.

Table 11. Strategies to Address Conflict

Partnerships:

- Form beneficial relationships between agricultural and environmental/recreational water interests to identify appropriate land use policies and incentive-based measures:
  - Cooperative agreements can sustain agriculture and provide benefit to stream flows, including new storage projects which provide late season water for both environmental/recreational and agricultural uses.
  - Multiple purpose headgate reconstruction projects can improve fish connectivity while reducing the water user's O&M costs and improving diversion accuracy and reliability.
  - Increases in irrigated acreage will augment waterfowl habitat.
  - Managing wetlands and riparian corridors can improve water quality to benefit both consumptive and environmental & recreational users.
  - Delayed irrigation return flows and irrigation water stored in the "soil reservoir" provides benefits to stream flows and environmental/recreational water uses.

Cooperative Strategies:

- Maximize opportunities for recommended solutions to meet multiple objectives
- Combine water use purposes in collaboration with local water users
- Encourage dialogue, collaboration, and negotiations between NPBRT and water entities
- Form other incentive-based measures to encourage competing interests to collaborate

Perception – Perception can be a constraint to securing acceptance of a project. Representatives of competing water interests typically have a fair amount of knowledge on their own project needs, but may lack specific knowledge and/or have differing perspectives on the needs of competing water interests. Lack of knowledge and differing perspectives may generate an adverse perception of competing needs that may limit the ability of a project sponsor to implement a proposed project. Public education/outreach and incentive-based programs can effectively address adverse perceptions as summarized in Table 12.

Table 12. Strategies to Address Perception

Public Education and Outreach:

- Work closely with organizations that specialize in facilitation of public education and outreach programs (e.g. the Colorado Foundation for Water Education, CFWE).
- Increase public understanding and participation in important basin water issues through the NPBRT.
- Capitalize on previous educational efforts of the NPBRT and its education liaison (e.g. The North Platte River Basin Special Report magazine created by the CFWE).

Incentive-Based Programs:

- Form beneficial relationships between agricultural and environmental & recreational water interests to capitalize on available funding opportunities and identify other incentive-based measures that provide mutual benefits.

Regulations – Regulations can be a constraint to securing acceptance of a project. Since a large amount of the land in the North Platte Basin is under federal ownership, permitting issues can impact project feasibility, cost, and schedule. Federal lands are subject to restrictions (beyond those applied to non-Federal lands) to project development, construction, maintenance, and modernization; including USFS special use permit restrictions. Recent regulatory decisions (e.g. potential listing of the sage grouse, and EPA/ACE definitions of "waters of the United States") could pose additional challenges to the implementation of basin projects.

Regulatory bureaucracy and environmental impact requirements may significantly delay project timelines, increase costs and ultimately limit the ability of a project sponsor to implement a proposed project, regardless of the relative size of project scope. Regulatory streamlining and cooperative strategies may help to address regulatory constraints as summarized in Table 13.

Table 13. Strategies to Address Regulations

Cooperative Strategies:

- Use the NPBRT or a focus group raise the issue through state water planning processes and engage regulatory decision-makers.
- Engage elected representatives to understand regulatory challenges encountered on North Platte Basin projects.
- Engage Federal and State agency representatives to understand the multiple steps required for project implementation.
- Collaborate with local water users to proactively consider combining projects for multiple purposes.
- Collaborate with CWCB to identify technical support mechanisms for Federal permitting activities.

Regulatory Streamlining:

- Identify methods to proactively address potential regulatory pitfalls that generate excessive time delays and added costs.
- Identify methods to streamline regulatory processes between multiple agencies with proactive, time-dependent deadlines.
- Collaborate with CWCB to identify financial support mechanisms for Federal permitting activities.

Project Feasibility

Cost – Cost can be a major constraint to project feasibility. Water users must balance their water needs with the costs of maintenance and potential improvement projects. In addition, different water interests have different forms and amounts of revenue by which to finance projects. In some cases, regulatory requirements can add significant costs to a proposed project. The complex balance of water needs, technical challenges, types and amounts of revenue, and regulatory requirements generates costs that may limit the ability of a project sponsor to implement a proposed project. Creative funding mechanisms, partnerships, and cooperative strategies may help to address project costs as summarized in Table 14.

Table 14. Strategies to Address Cost

Creative Funding Mechanisms:

- Apply for CWCB financing (loan and grant) programs (Web Link), prioritizing multi-purpose water projects.
  - Water Project Loan Program
  - Water Efficiency Grants
  - Water Supply Reserve Account Grants
  - Colorado Healthy Rivers Fund Grants
  - Severance Tax Trust Fund Operational Account Grants
  - Colorado Watershed Restoration Grants
  - Agricultural Emergency Drought Response Program
  - Alternative Agricultural Water Transfer Methods Grants
  - Fish and Wildlife Resources Fund Grants
  - Weather Modification Grants
  - Non-Reimbursable Project Investment Grants
  - Invasive Phreatophyte Control Program
  - Wild and Scenic Rivers Fund
- Apply for other federal, state, or local funding opportunities.
- Investigate potential public-private partnerships to finance, build, and operate projects.
- Consider the addition of small hydropower generation capability to dam and reservoir projects to increase revenue.

Partnerships and Cooperative Strategies:

- Prioritize the most effective projects (cost/benefit analyses) to optimize cost savings.
- Facilitate regulatory streamlining and cooperative strategies.
- Collaborate with local water users to investigate opportunities for multi-purpose projects.

Water Availability – Limited water availability is often the primary constraint to project feasibility. Water users must constantly adjust to unpredictable hydrology. In addition, each type of water interest has different demand patterns, infrastructure, operating rules, and water rights available to use the variable hydrology. Water availability is therefore a product of both physical and legal water supplies that vary in both location and timing.

The complex balance of water supply and demand patterns, infrastructure operations, and water rights generates highly variable physical and legal water availability that may limit the ability of a project sponsor to implement a proposed project. Water availability analyses and water administration strategies can help to identify and address challenging availability issues as summarized in Table 15.

Table 15. Strategies to Address Water Availability

Water Availability Analyses:

- Use the Colorado Decision Support System (CDSS) to analyze timing, location, and conditions of limited water availability.
- Use the results of water availability analyses to identify issues, inform stakeholders, and guide decisions about optimal relationships between water operations and water administration regimes.
- Identify local projects with sufficient water available to recommend effective collaborative strategies.
- Identify hydrologic runoff patterns that are in excess of demands and can be strategically stored and beneficially used.
- Identify river dry-up points to ascertain strategic headgate improvements.
- Identify irrigation scheduling issues to improve diversion and delivery reliability and accuracy.

Water Administration Strategies:

- Protect private property rights that contribute to the successful operation of Colorado's long-standing water rights system.
- Facilitate effective water rights exchanges to optimize water availability.
- Facilitate water rights leasing programs for environmental and recreational uses.
- Identify important historical water rights at risk for abandonment.

Constructability – Numerous technical challenges affect the ease and efficiency of project construction or implementation and ultimately the feasibility of a project. These challenges surface throughout the concept phase and construction of a project. Proposed North Platte Basin projects include a variety of new construction, enlargements, upgrades, rehabilitation, restoration, maintenance, or modernization of reservoirs, dams, outlet works, headgates, canals, and piping. Constructability for these types of projects requires a highly technical demonstration that appropriate measures are taken to safely and effectively plan, design, and construct the project. An inadequate demonstration of constructability may limit the ability of a project sponsor to implement the proposed project. Adequate feasibility analyses and engineering design can effectively demonstrate constructability as summarized in Table 16.

Table 16. Strategies to Address Constructability

Feasibility Analyses:

- Hire a reputable engineering firm to analyze the feasibility of the project, demonstrating that:
  - The project can overcome previously identified constraints (see Table 11 through Table 15).
  - Required land, space, labor, equipment, and materials are accessible, suitable, and proven.

Engineering Design:

- Hire a reputable engineering firm to design the project with consideration for site conditions and feasibility results.

Appendix 1: Acronyms

BLM	Bureau of Land Management
BNDSS	Basin Needs Decision Support System
BOR	Bureau of Reclamation
CDPHE	Colorado Department of Public Health and Environment
CDSS	Colorado Decision Support System
CIR	Crop Irrigation Requirement
CRWAS	Colorado River Water Availability Study
CWCB	Colorado Water Conservation Board
CPW	Colorado Parks and Wildlife
CU	Consumptive Use
CWP	Colorado Water Plan
DWR	Division of Water Resources
EIS	Environmental Impact Statement
ESA	Endangered Species Act
GIS	Geographic Information System
HB	House Bill
IBCC	Interbasin Compact Committee
ISF	Instream Flow
IPP	Identified Project or Process
IWR	Irrigation Water Requirement
JCWCD	Jackson County Water Conservancy District
M&I	Municipal and Industrial
NC	Nonconsumptive
NCNA	Nonconsumptive Needs Assessment
NEPA	National Environmental Policy Act
NPBIP	North Platte Basin Implementation Plan
NPBRT	North Platte Basin Roundtable
NPS	National Park Service
PCU	Potential Consumptive Use
RICD	Recreational In-Channel Diversion
SB	Senate Bill
SSI	Self-Supplied Industrial
SWSI	Statewide Water Supply Initiative
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WSRA	Water Supply Reserve Account

Appendix 2: References and Inventory of Available Information

Water Supply and Demand

1. **Finding Common Ground on Water, Colorado Cattlemen's Association and Partners for Western Conservation, 2013.** *Provides recommendations for water solutions and multipurpose projects, vetted through a facilitated process involving members of Colorado's agricultural and environmental communities.* Report Link
2. **Town of Walden Water Supply Evaluation Report, CDM; Final Report, 2008; Project Summary, 2011.** *Evaluation of Walden's Water Supply Options, including planning level cost estimates.*
3. **North Platte Basin Fact Sheet, CWCB, February 2006**. *Summarizes compact information, major storage projects, water management issues, basin growth and water demands.* Report Link
4. **Water Supply Needs Report for the North Platte Basin, CWCB 2006.** *Inventories water supplies and demands in the basin; helpful reference for general basin information; looks at projected water supplies and demands out to the year 2030; catalogs consumptive IPPs.* Report Link
5. **Colorado's Water Supply Future Statewide Water Supply Initiative – Phase 2, CWCB (CDM), November 2007.** *Summarizes a range of solutions that will help meet future water supply needs through addressing water conservation and efficiency, alternative agricultural water transfer methods, delineating environmental and recreational resources and needs, and addressing the water gap.* Report Link [Username and password protected link]
6. **SWSI 2010, North Platte Basin Report Basin Wide Consumptive and Nonconsumptive Water Supply Needs Assessment, CWCB (CDM), 2011.** *Summarizes SWSI basin specific data and analysis of existing and projected consumptive and nonconsumptive water supply needs; and catalogs projects to meet needs (IPPs).* *Report* Link [Username and password protected link]
7. **North Platte River Basin Water Resources Planning Model User's Manual, CWCB, 2012.** *A reference manual that describes the CDSS model which can be used to understand basin operations and issues; evaluate the applicability to a planning or management issue; analyze a development or management scenario; or estimate conditions under current development over a range of hydrologic conditions.* Report Link
8. **Historical Crop Consumptive Use Analysis for the North Platte River Basin, CWCB, 2012**. *A reference manual providing approach and results to estimating historical crop consumptive use for the North Platte River watershed.* Report Link
9. **Historical Crop Consumptive Use Analysis for the South Platte Decision Support System, CWCB, 2010.** *.A reference manual providing approach and results to estimating historical crop consumptive use for the South Platte River Basin including the Laramie River watershed.* Report Link
10. **Technical Memorandum: Reconnaissance Level Cost Estimates for Agriculture and New Supply Strategy Concepts, CWCB (CDM), June 2010.** *Summary of evaluations for agricultural transfer and new supply development strategies.* Report Link
11. **Nonconsumptive Toolbox Report, CWCB, July 2013.** *Provides a compilation of information and tools for use to address nonconsumptive needs and implementation of projects and methods.* Report Link
12. **Evaporation and Agronomic Responses in Formerly Irrigated Mountain Meadows, Ivan Walter, et.al. 1990.** *Prepared for the Denver Board of Water Commissioners, the report presents technical*

approaches and procedures to quantify potential and actual evapotranspiration of irrigated meadow grass in high mountain meadows.

Water Quality and Watershed Health

13. **Statewide Water Quality Management Plan, CDPHE, June 2011.** *Summarizes current conditions of the state's surface waters on a basin scale; key water quality regulations and policies; and serves as an education tool for both current and future stakeholders.* Report Link [Statewide link]
14. **Integrated Water Quality Monitoring and Assessment Report, State of Colorado, 2012 Update.** *Summarizes water quality conditions and corresponding standards to assess attainment over the past five years.* Report Link *[statewide link]*
15. **Colorado Nonpoint Source Program 2012 Management Plan, CDPHE, February 2012.** *Identifies and prioritizes NPS issues; summarizes coordinating resources and partners to address issues and track progress in water quality improvement; and addresses the priorities through on-the-ground watershed restoration efforts.* Report Link
16. **Nonconsumptive Toolbo**x, CWCB, July 2013. *Provides a compilation of information for use by the BRT's others to help address nonconsumptive needs and implement nonconsumptive projects.* Report Link
17. **Identification and Assessment of Important Wetlands within the North Platte River Watershed**, Colorado Natural Heritage Program, January 2010. *Assists the NPBRT in meeting their overall goal of identifying important non-consumptive uses in the watershed.* Report Link
18. **North Platte River Basin Wetland Profile and Condition Assessment**, Colorado Natural Heritage Program, March 2012. *Summarizes findings from the basinwide wetland condition assessment, conducted in the North Platte River Basin.* Report Link
19. **GIS Map of Statewide Water Quality Data, CDPHE WQCD.** *GIS map portraying stream and lake segments with Outstanding Water (OW) use classifications, 303(d) impairments, and TMDL and Monitoring and Evaluation (M&E) designations.*
20. **Colorado State Forest Service Publications.** *Information related to forest health; forest management; forest insects, diseases, and disorders; and wildfire mitigation and education.* Web Link
21. **2013 Report on the Health of Colorado's Forests, Colorado State Forest Service, 2013.** *Updates on insect, disease, and wildfires and discussion on active forest management, forest restoration grant programs, effective use of beetle-kill trees, wildfire risk reduction, and community education programs.* Web Link
22. **Colorado Statewide Forest Resources Assessment, Colorado State Forest Service, 2010.** *A geospatial assessment of forest type and ownership including the data used to inform the assessment, the process followed, list of people engaged, and actions taken to address priority needs.* Report Link
23. **Colorado Statewide Forest Resources Strategy, Colorado State Forest Service, June 2010.** *The strategy provides a platform for CSFS and partners to focus efforts on important forest landscapes and leverage limited resources to achieve positive and significant results.* Report Link

24. **USDA, U.S. Forest Service, Rocky Mountain Region, Forest and Grassland Health.** *Information related to annual forest health reports, insects and disease, and forest health protection.* Web Link
25. **The Effect of Insect Mortality and Other Disturbances on Water Yield in the North Platte River Basin,** C.A. Troendle and J.M. Nankervis, January 2014. *A study evaluating the long-term impacts of the recent insect infestations on water yield from the North Platte River Basin.* Report Link

Climate and Drought

26. **The Colorado Drought Mitigation and Response Plan, CWCB, August 2013.** *Provides a blue print for how the State will monitor, mitigate and respond to drought.* Report Link

Public Outreach

27. **North Platte Basin Roundtable: 2012 Education Action Plan, February 2012.** *Summarizes the North Platte Basin's education action plan.* Report Link
28. **CWCB North Platte Basin Round Table.** *Contains information pertaining to the roundtable and various links.* Web Link
29. **CWCB Web Link.** *Contains links to relevant state documents.* Web Link

Appendix 3: North Platte Basin Roundtable Instream Flow Letter

North Platte Basin Round Table

December 19, 2006

Mr. Dan Merriman
Stream and Lake Protection
Colorado Water Conservation Board
1331 Sherman St., Rm 721
Denver, CO 80203

Dear Sir:

The North Park Basin Round Table has taken the position to support the Jackson County Water Conservation District in their opposition to instream flows in Jackson County below any existing diversions. Issues raised at the round table meeting are explained below.

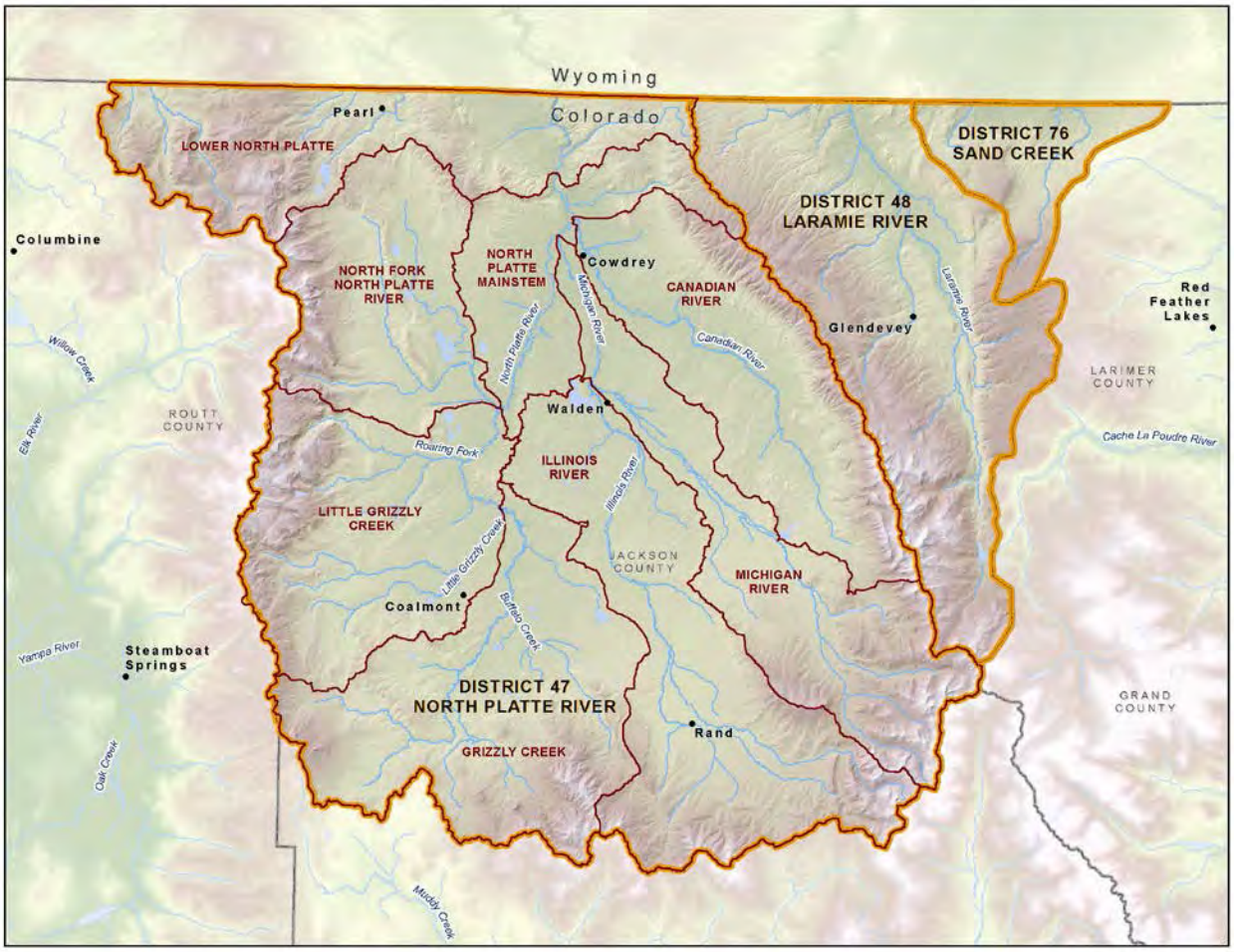
There already exists instream flows because of senior water right holders below the proposed instream flows on Indian Creek and the North Fork of the North Platte. Concerning the South Fork of Big Creek as well as Indian Creek and the North Fork of the North Platte these proposed instream flows are certain to injure and interfere with the rights to develop these waters for beneficial use. Present and future water users would be deprived from utilizing their full entitlement (private usufructuary property right) for all beneficial uses under the US Supreme Court Decree.

In closing we feel that any future instream flow proposals should be published in the local paper and those proposing these instream flows should consult water right owners who will be directly affected by these proposals.

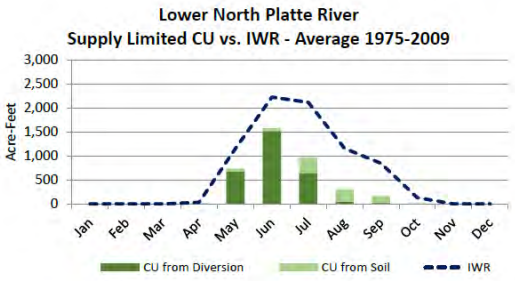
Sincerely,

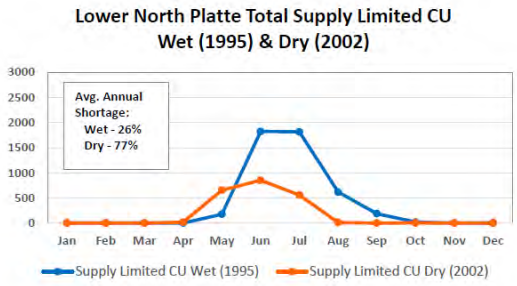
Appendix 4: Agricultural Water Use and Needs by Tributary

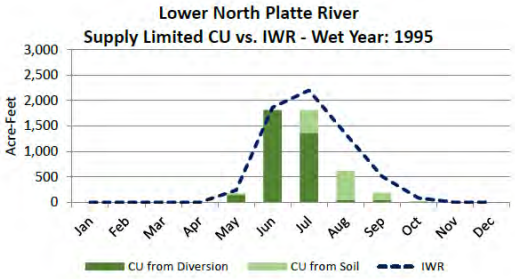
The following consumptive use and shortage graphs for the North Platte River watershed were presented at the December 17, 2013 NPBRT meeting. Additional information presented during the meeting included an overview of the crop consumptive use procedures and discussion on the types of shortages experienced in each sub-basin, both of which are discussed in Section 2 of this report.

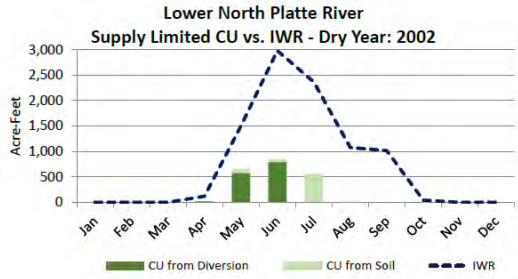


Lower North Platte Sub-Basin

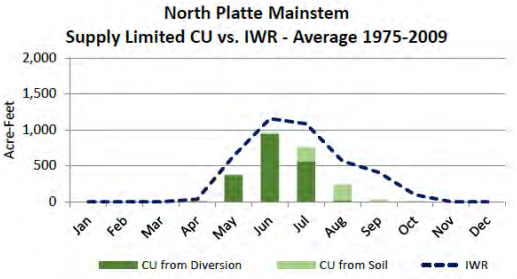


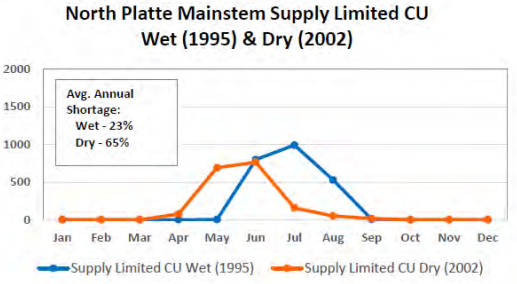


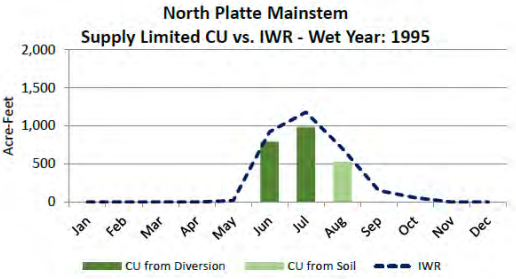


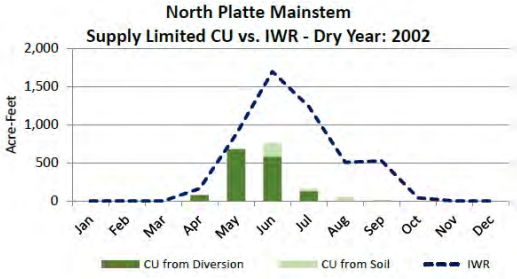


North Platte Mainstem Sub-Basin

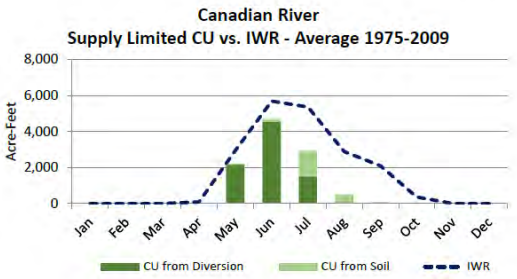


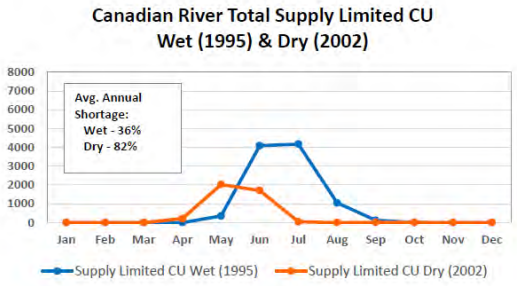


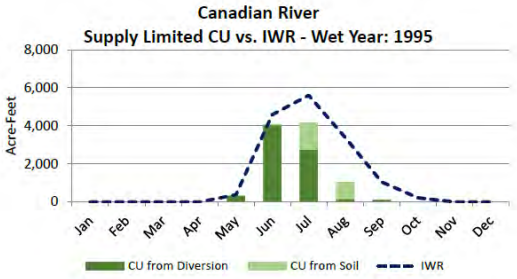


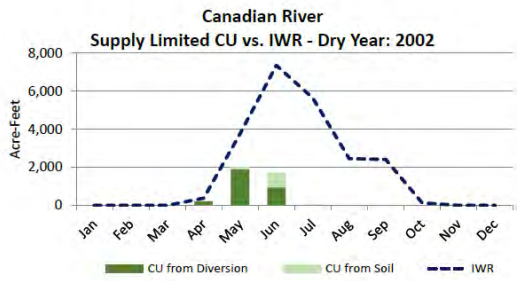


Canadian River Sub-Basin

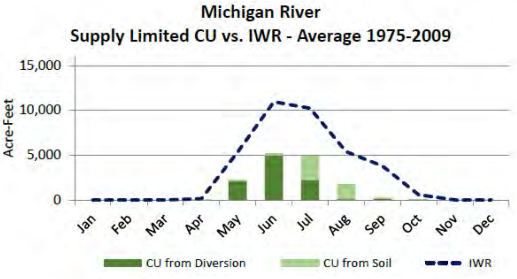


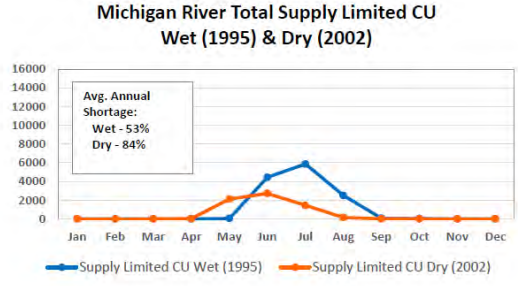


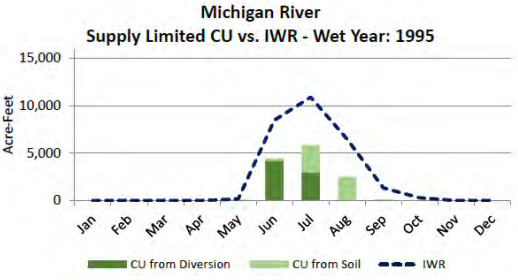


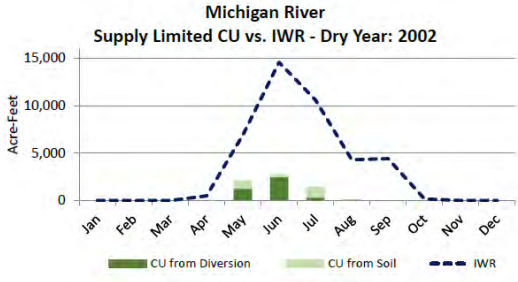


Michigan River Sub-Basin

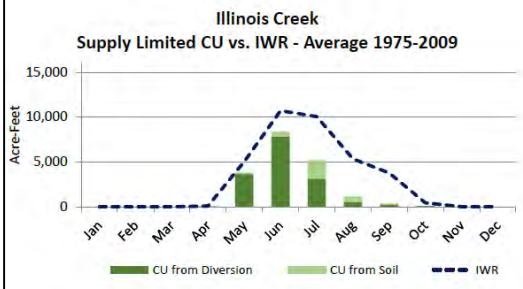


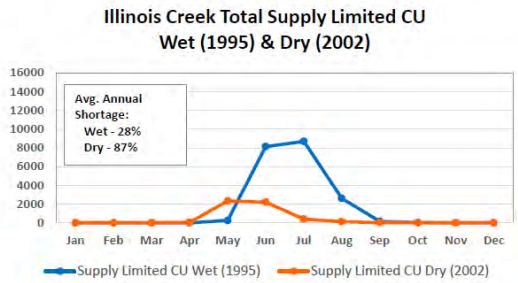


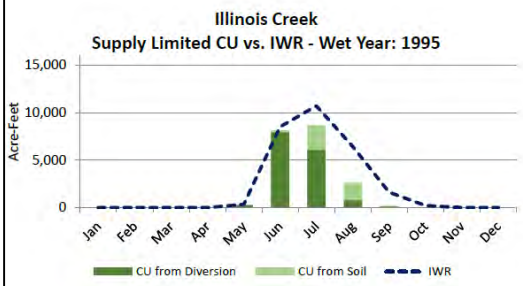


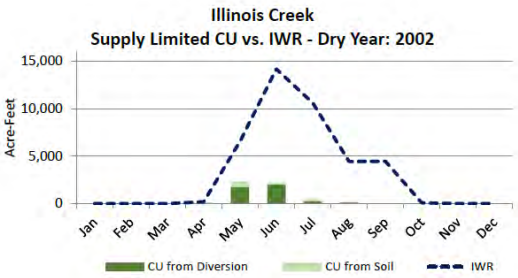


Illinois River Sub-Basin

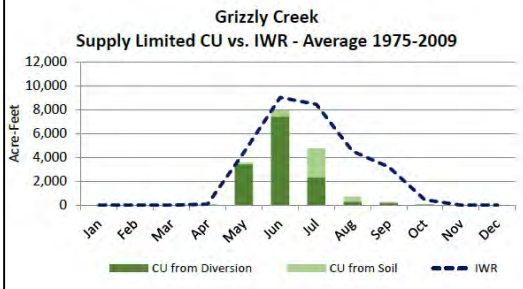


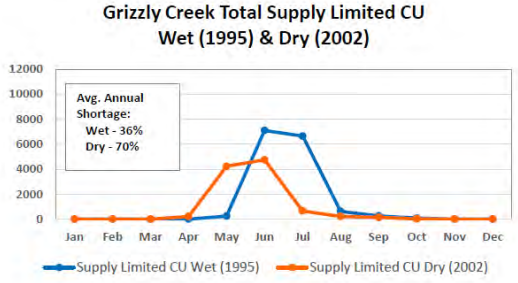


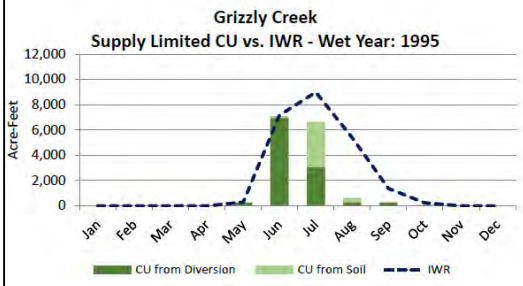


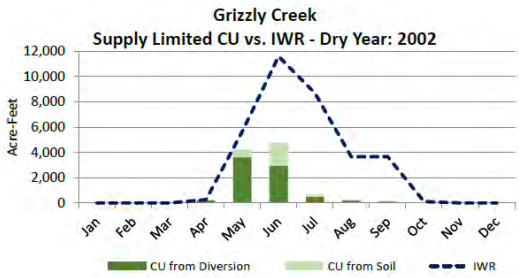


Grizzly Creek Sub-Basin

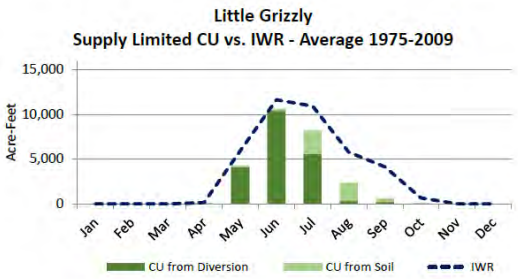


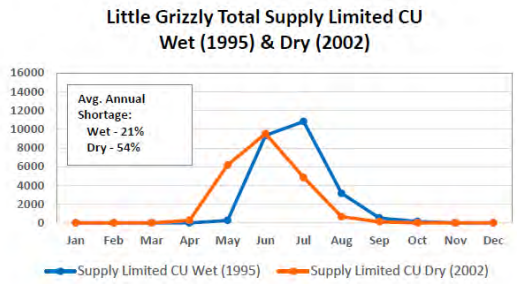


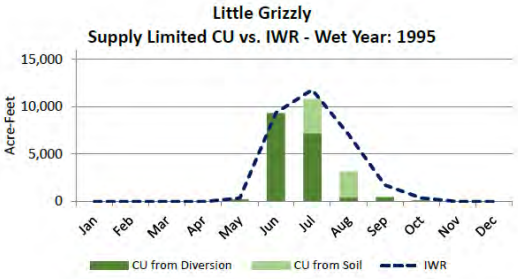


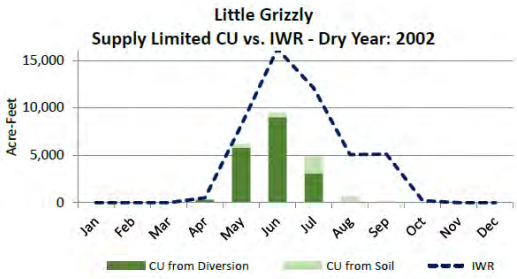


Little Grizzly Creek Sub-Basin

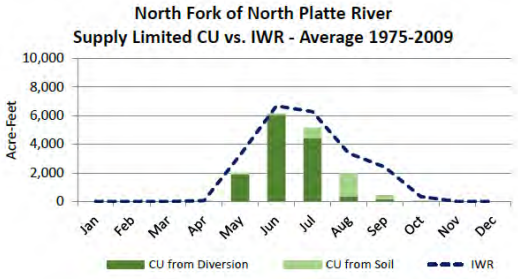


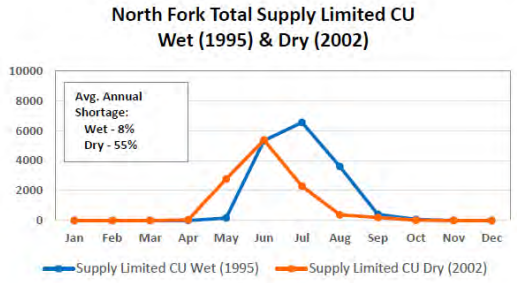


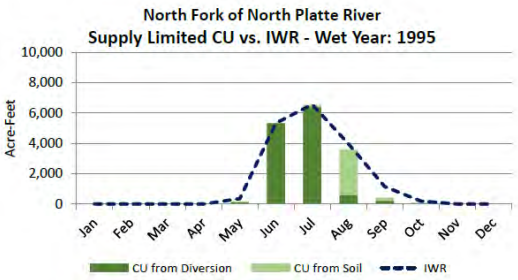


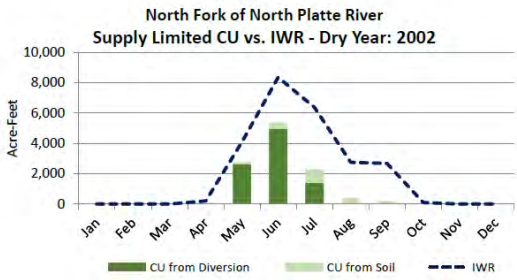


North Fork of North Platte River Sub-Basin









The December 17, 2013 NPBRT presentation did not include the graphical summaries for the Laramie River watershed. The following graphs, based on information queried from the Historical Crop Consumptive Use Analysis for the South Platte Decision Support System analysis, present the agricultural information for this watershed.