Draft Report *December 2011*

The Plaza Plan

A Restoration Master Plan for the Sevenmile Plaza Reach of the Rio Grande



Completed by a Partnership Between the
Colorado Rio Grande Restoration Foundation
and the McDonald Ditch Company

Funded Through the Rio Grande Inter-Basin Roundtable
Colorado Water Conservation Board
Water Supply Reserve Account

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THE PLAZA PLAN

Executive Summary

In 2010, the Colorado Rio Grande Restoration Foundation (Foundation), the fiscal agent for the Rio Grande Headwaters Restoration Project (RGHRP) began working with the McDonald Ditch (McDD) Company to address concerns surrounding the aging and inefficient McDD diversion and headgate structures. Together, the Foundation and the McDD initiated the Plaza Planning Project – Phase 1 (Phase 1) in the Sevenmile Plaza area of Rio Grande County. This document, the Plaza Plan, documents Phase 1.

The Goals of Phase 1 were to: Identify causes of degradation and appropriate improvements to the function of the Rio Grande in the Sevenmile Plaza area in Rio Grande County, Colorado; Improve diversion efficiency in the Project area; Investigate installing low-head micro hydro facilities in the Project area to generate power production; Reduce maintenance costs of diversions and headgates; Improve recreation opportunity in the Project area.

During Phase 1, the Partnership worked with the Plaza Stakeholders to determine the primary issues in the area, identify remediation methods, and develop an implementation plan to improve the health and function of the Rio Grande in the Sevenmile Plaza area. The identified issues include streambank instability in the 2.8-mile Project reach, a degraded wetland, and aging, hazardous, and inefficient diversion and headgate structures.

The Stakeholders developed and analyzed alternatives and provided recommendations for the rehabilitation of the Project elements. These recommendations include replacing three diversions with half concrete and half rock structures that improve diversion efficiency, reduce maintenance, and allow for fish and boat passage; replacing four headgates with concrete structures with automated gates to improve efficiency, reduce inputs, and improve Rio Grande Compact administration; rehabilitating a degraded wetland with regrading and revegetation; and using bioengineering and restoration techniques to improve streambanks in the Project area.

The RGHRP and Stakeholders prioritized implementation of selected alternatives and prepared for the first Phase of implementation of the Plaza Plan. The Plaza Project – Phase 2: McDonald Ditch Implementation Project will include the replacement of the McDD diversion and headgate, installation of automated gates, reclamation of the damaged wetland, and rehabilitation of surrounding streambanks. The other elements will be addressed in future phases.

THE PLAZA PLAN

Section 1 – Introduction

The Plaza Planning Project (Planning Project) was conducted by a Partnership (Partnership) between the Colorado Rio Grande Restoration Foundation (Foundation) and the McDonald Ditch Company (McDD). The Foundation is the fiscal agent for the Rio Grande Headwaters Restoration Project (RGHRP), which oversaw the Planning Project and completed contracting and reporting. The Partnership was guided by the Plaza Stakeholders, who provided input throughout the Project.

1.1 Project Overview and Background

The primary purpose of the Planning Project was to develop the Plaza Plan: a restoration master plan for the Sevenmile Plaza area in Rio Grande County, Colorado.

1.1.1 Organization

In 2010, Jamie Hart, rancher, landowner, and President of the McDD, sought assistance to improve the condition and function of the McDD diversion and headgate, located at Sevenmile Plaza, Rio Grande County. Hart approached the Natural Resources Conservation Services (NRCS) and the RGHRP. The decision was made to involve three neighboring ditch companies, the Prairie Ditch, the Silva Ditch, and the Atencio 2 Ditch, in a scoping study to identify the issues in the Sevenmile Plaza Area and options for remediation.

1.1.2 Funding

The Planning Project cost $82,707. It was funded in part by a grant of $40,000 from the Rio Grande Basin Water Supply Reserve Account. The Partnership was the applicant and fiscal agent for this grant. The RGHRP provided project management, including contracting and reporting, for the grant. The Foundation provided $9,174 of in-kind services, NRCS provided $23,445 of in-kind engineering services, Stakeholders provided $5,988 of in-kind services, and the ditch companies provided $4,100.

1.1.3 Project Coordinator

The Partnership hired a Project Coordinator, Nicole Langley, to facilitate the Planning Project. The Coordinator, a representative of the Partnership, organized the Stakeholders and promoted communication between a diverse mix of governmental and community entities. Langley organized and recorded meetings, fieldtrips, and project breakthroughs. Additionally, the Coordinator helped compile project reports, locate sources of funding for implementation of the Plaza Plan, and assisted in writing the final Plaza Plan.

1.1.4 Plaza Stakeholders

The Plaza Stakeholders, a diverse group of 34 individuals, represent interests within the Sevenmile Plaza and the greater community of the San Luis Valley. The Plaza Stakeholders' role was to advise the Partnership, review and discuss Project deliverables, and make strategic planning decisions with a specific focus on agriculture needs, wetlands, wildlife habitat, and nonconsumptive uses of the Rio Grande. The individuals who volunteered as part of the Plaza Stakeholders are:

- Steve Baer, Rio Grande Water Commissioner, Colorado Division of Water Resources, Division 3
- Rick Basagotia, Area Manager, Colorado Parks and Wildlife
- Mark Brown, Ditch Superintendent, Prairie Ditch Company
- Loren Buss, Irrigator, Silva and Atencio 2 Ditch Companies
- Nancy Butler, Executive Director, Rio Grande Headwaters Land Trust
- Laurie Clark, Civil Engineer, Natural Resources Conservation Service
- Rod Clark, Area Engineer, Natural Resources Conservation Service
- Mike Collins, Area Conservationist, Natural Resources Conservation Service
- Hildreth Cooper, US Army Corps of Engineers
- Craig Cotten, Division Engineer, Colorado Division of Water Resources, Division 3
- Heather Dutton, Coordinator, Rio Grande Headwaters Restoration Project
- Mike Gibson, Manager, San Luis Valley Water Conservancy District
- James Hart, President, McDonald Ditch Company
- Maria Hart, Secretary, McDonald Ditch Company
- LaVern Hart, President, Prairie Ditch Company
- Terryl Jenkins, San Luis Valley Rural Electric Cooperative
- Corey Kanuckel, Program Officer, US Fish and Wildlife, Partners for Fish and Wildlife Program
- Steve Keller, Irrigator, McDonald Ditch Company
- Nicole Langley, Plaza Planning Project Coordinator
- Ruth Lewis, Wildlife Biologist, Natural Resources Conservation Service
- David McCammon, Game Warden, Colorado Parks and Wildlife
- Maria Martinez, Historian and Author, Sevenmile Plaza
- Steve Massey, Landowner and Irrigator, Sevenmile Plaza
- Victoria McCauley, The River House at Sevenmile Plaza
- Doug Messick, Board Member, San Luis Valley Water Conservancy District and the Colorado Rio Grande Restoration Foundation
- Everett Myers, Representative, Silva Ditch Company
- Josh Nehring, Fisheries Biologist, Colorado Parks and Wildlife
- Rita Perrot, Landowner and Irrigator, Sevenmile Plaza

- Ron Riggenbach, District Conservationist, Natural Resources Conservation Service
- Steve Russell, President, Colorado Rio Grande Restoration Foundation, and Board Member, Rio Grande Headwaters Land Trust
- Patrick Sullivan, Director, Rio Grande County Road and Bridge Department
- Amy Trujillo, San Luis Valley Rural Electric Cooperative
- John Valdez, Resident, Sevenmile Plaza
- Cynthia Villa, Area Range Management Specialist, Natural Resources Conservation Service

1.2 Project Goals

The following Project Goals served as guidance for the Project:

Plaza Planning Project Goals

- Identify causes of degradation and appropriate improvements to the function of the Rio Grande in the Sevenmile Plaza area in Rio Grande County, Colorado. Potential improvements may include replacing aging structures, stabilizing streambanks, promoting riparian revegatation, and rehabilitating a nearby damaged wetland.
- Improve diversion efficiency in the Project area; this could be accomplished by improving diversion and headgate structures and installing accurate water measuring gates.
- Investigate installing low-head micro hydro facilities in the Project area to generate power production.
- Reduce maintenance costs of diversions and headgates.
- Improve recreation opportunity in the Project area.

Section 2 – Project Area Description, Previous Studies, and Community

The project is located in the Sevenmile Plaza in Rio Grande County. The Project area is a 2.8-mile reach of the Rio Grande 5 miles north and 7 miles west of Monte Vista, Colorado.

2.1 Project Area Description and Previous Studies

The Sevenmile Plaza holds some of the most senior water rights in Colorado, which date back to 1866. Six generations have accessed the Rio Grande for irrigation, ranching, and recreation.

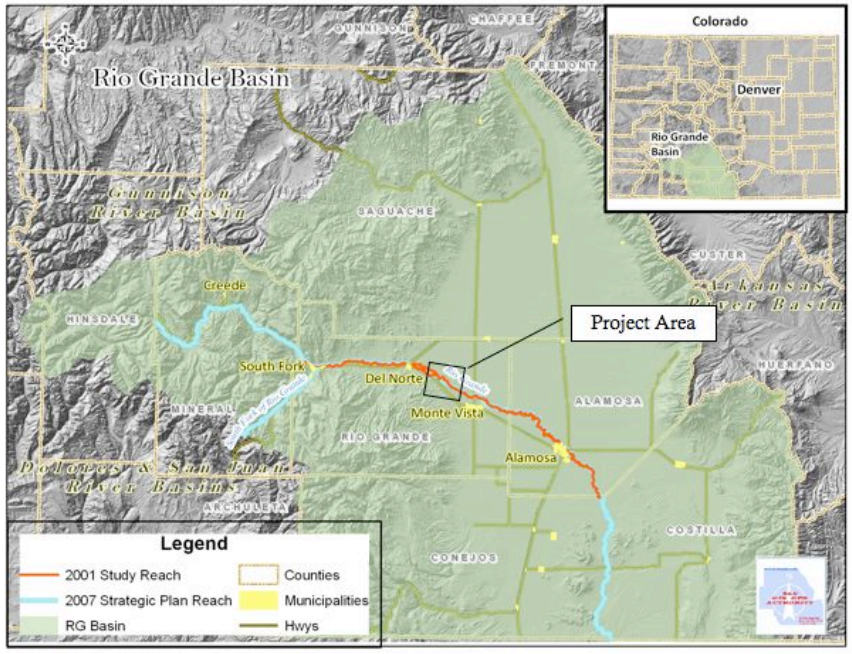

Figure 1. Location of the Plaza Planning Project - Phase 1

2.1.1 Previous Study: The 2001 Study

The Sevenmile Plaza was included in the 2001 Study, a restoration master plan for the Rio Grande from South Fork to the Alamosa/Costilla County line. The 2001 Study was prompted by a group of citizens who were concerned that the river had been impaired. Sponsored by the San Luis Valley Water Conservancy District and funded by the Colorado Water Conservation Board, the 2001 Study analyzed 91 miles of the Rio Grande, determined causes of deterioration in river condition, and made recommendations to improve the river's functions.

The 2001 Study area was broken into reaches based on homogeneity of geomorphic, hydrologic, bed material, and man-influenced conditions. The Planning Project area is located in Reach C, Subreach C1.

Reach C is a moderate sloped, slightly entrenched, cobble/gravel channel. The bed form is riffle/pool. Within reach C, the following issues with river function are present: inadequate floodplain function and connectivity; loss of flow control and system stability; and high diversion maintenance caused by erosion and the accumulation of debris, and sediment. Specifically, the 2001 Study recommended that erosion and deposition problems in the vicinity of the Sevenmile Plaza area be addressed.

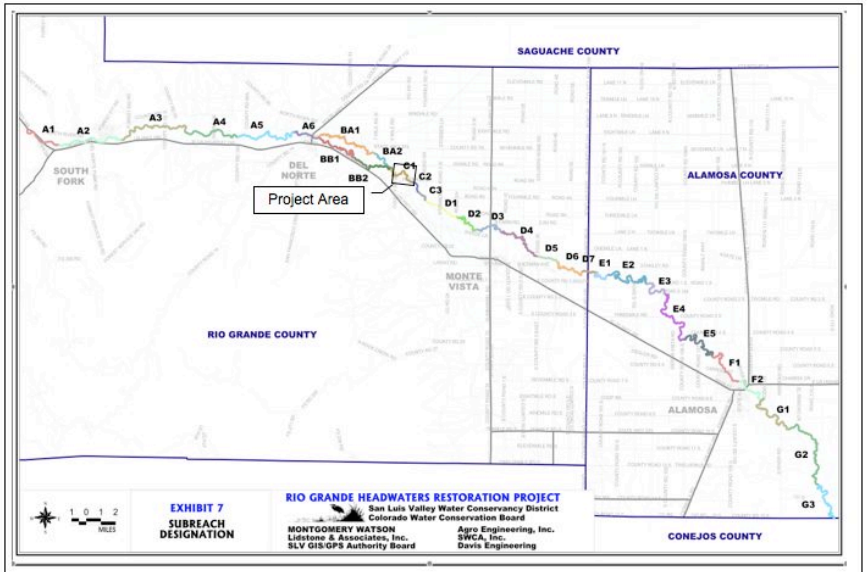

Figure 2. Location of Reach C and Subreach C1 (as designated by the 2001 Study) and the Plaza Planning Project - Phase 1

The fishery in the project area is a transition zone between cold water and warm water fisheries. The main factors limiting the extent and quality of the cold water fishery are dewatering, channelization, and aggradation. The loss of water reduces the pool capacity, increases the water temperature, and provides for high sedimentation rates - all detrimental to the primary cold-water fish, trout. Colorado Parks and Wildlife does not manage for trout in the Project area due to lack of public lands, amount of diversions, and presence of other competing landuses. Therefore, owners of private lands assume the responsibility for the majority of habitat improvements. Habitat improvements include riparian zone restoration and in-stream cover improvements.

The most significant diversion structures in this reach serve the Silva/Atencio 2, McDonald, Prairie, and Monte Vista ditches. The following points summarize the 2001 Study's narratives of the structures within the Project area:

- Silva and Atencio 2 Ditches: The Silva and Atencio 2 Ditches share a diversion structure. The channel upstream and downstream of the diversion entrance is unstable. The dam creates a backwater pool and problems with debris accumulation are noted at the diversion entrance. The structure cannot carry its decreed capacity in moderate to high flow situations. The Silva/Atencio 2 Diversion is known to have a problem accessing the river.
- McDonald Ditch: The primary problems center on the pier and rubble from the old Sevenmile Plaza Bridge (on road 5N) that were left in the channel to form the McDD diversion dam, which is an obstacle to high flows and is known to cause flooding. The McDonald diversion is known to have a problem accessing the river. The channel is relatively stable. Opposite bank erosion, debris and sediment accumulation at the diversion impact its stability. However, stability in the area is controlled by bedrock.
- Prairie Ditch: No channel stability problems were noted. There is potential for sediment accumulation due to the headgate location.

2.1.2 The Community

The Sevenmile Plaza, historically known as *Plaza de los Valdeses,* has a rich cultural history. Descendants of Juan Pio Valdes, the original founder of the Plaza, still reside in this area. As the first non-Native American farmers to use the waters of the Rio Grande, Valdes and others used shovels and horse-drawn slips to dig the original ditches. In 1866, the first application of water in District Number 20 was made at the Sevenmile Plaza. Farming in the area began following the construction of the Silva, Atencio, and Lucero irrigation ditches, which diverted water from the Rio Grande west of present-day Monte Vista.

Also of significance are the conservation easements other residents in the Project area have placed on their property. One easement, held by the Rio Grande Headwaters Land Trust (RiGHT), is south of the McDD diversion and borders the river for over two miles. North of the Silva/Atencio 2 diversion dam is a conservation easement held by the NRCS Wetland Reserve Program (WRP). These efforts protect wildlife habitat, riparian areas, and wetlands into perpetuity.

Section 3 – Project Elements

For Stakeholders to become familiar with the project area, four scheduled site visits, several informational meetings, and meetings with local landowners were held. Stakeholders examined the condition of diversions, headgates, riparian areas, and wetlands within the project area. Using the information from the 2001 Study and their own knowledge of the area, the Stakeholders identified the following key elements to be addressed through the Planning Project:

- Project Element #1: McDonald Ditch Diversion and Headgate
- Project Element #2: Prairie Ditch Diversion and Headgate
- Project Element #3: Silva and Atencio 2 Ditches Diversion and Headgates
- Project Element #4: Streambanks within Project Area
- Project Element #5: Wetland adjacent to McDonald Ditch Diversion, owned by Rio Grande County

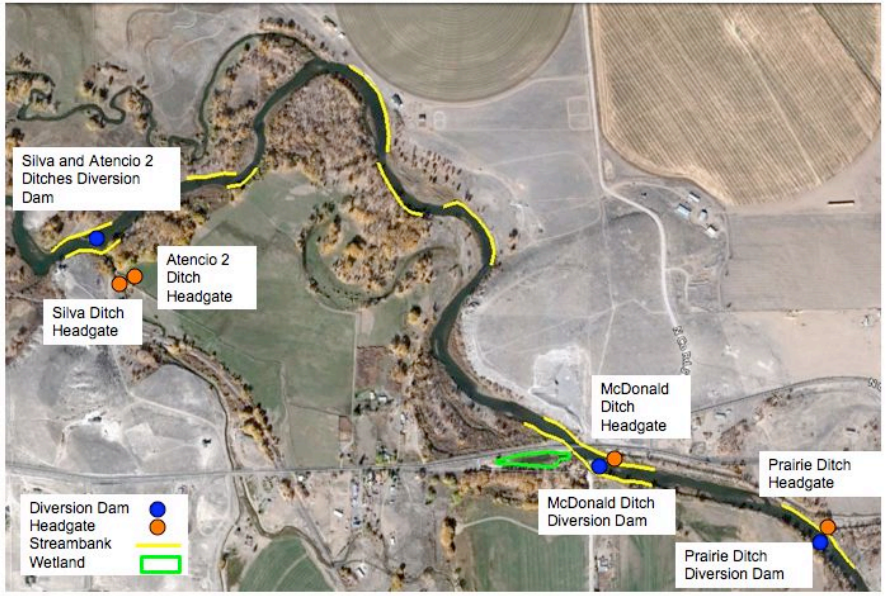

Figure 3. Plaza Planning Project - Phase 1 Project Elements

3.1 Project Element #1: McDonald Ditch Diversion and Headgate

The McDonald Ditch Company was incorporated as a mutual irrigation ditch company on December 17, 1921, and on May 23, 1950 the company's corporate existence was extended to perpetuity. The McDonald Ditch diverts approximately 4,500 acre feet of water from the Rio Grande at the Sevenmile Plaza Bridge, which is 5 miles north and 7 miles west of the town of Monte Vista. The irrigation system is approximately 2.5 miles long and services nine landowners irrigating approximately 1,320 acres. The water right is

14.4 cubic feet per second (cfs), with a river priority number 11 on 13.4 cfs, and number 18 on 1.0 cfs. Due to high priority of the water right, water is accessible throughout the irrigation season.

3.1.1 McDonald Ditch Diversion and Headgate Current Condition

As described above, the McDD Diversion functions poorly and negatively influences the condition of the Rio Grande. The diversion is built from concrete rubble, dirt, wooden debris, and a bridge pier from the old Sevenmile Plaza Bridge. The diversion is inefficient, aging, and requires annual maintenance. Additionally, the diversion is poorly placed in the river and, due to the angle of the dam, pushes the flow of the river into the opposite bank. This results in bank instability and erosion, negatively impacting the power poles and road atop the bank. The headgate contains a single slide gate that is set back from the river and screened by a fence gate. Without a sluice, sediment is trapped in the inflow of the headgate, which has been raised many times in the last decades to overcome sediment accumulation. The gate often becomes filled with trash and debris and requires constant maintenance and cleaning. Because of these issues, the McDD diversion dam and headgate were highlighted as structural priorities for rehabilitation in the 2001 Study.

Figure 4. McDonald Ditch Diversion (Looking Downstream)

Figure 5. McDonald Ditch Headgate

3.1.2. McDonald Ditch Diversion and Headgate Objectives

The stakeholders identified the following objectives for the McDD Diversion and Headgate. The analysis of the project alternatives was conducted with these objectives and the broader goal of the Planning Project in mind:

- Replace diversion dam with an efficient, low maintenance, environmentally sound structure;
- Replace headgate with low maintenance, automated structure with mechanisms for debris control/removal;
- Complete streambank stabilization around the diversion and in areas disturbed in construction;
- Investigate potential for micro-hydro power production in the diversion dam or headgate.

3.2 Project Element #2: Prairie Ditch Diversion and Headgate

The Prairie Ditch headgate and diversion are located approximately 0.5 miles downstream of the McDD diversion. The irrigation system services up to 65 landowners with a decreed water right of 367 cfs.

3.2.1 Prairie Ditch Diversion and Headgate Current Condition

The Prairie Ditch Diversion dam is in stable condition. It is built of rocks and steel pilings and is impassable to boaters and wildlife. The headgate is aging and in need of repair. Accumulation of sediment and debris are a problem, requiring maintenance throughout the irrigation season. A makeshift trash rack has been created by placing a floating well casing in the river in front of the headgate, which sits back from the river in a side channel. The trash rack protects the headgate from a great deal of large trash, but debris still travels under the rack and requires the ditch superintendent to clean it out. The superintendent's nephew designed and built an automated gate control system on the headgate, which allows for greater accuracy in ditch flow. The ditch company has estimated savings from the use of this system as approximately $20,000. The ditch company is interested in investigating improvements to this water gate system.

Figure 6. Prairie Ditch Diversion (Looking Upstream)

Figure 7. Prairie Ditch Headgate

3.2.2 Prairie Ditch Objectives

The stakeholders identified the following objectives for the Prairie Ditch Diversion and Headgate. Because the Prairie Ditch Company was not sure if a total diversion and headgate replacement was necessary, the objectives focused on exploring options and ensuring actions taken by the Prairie Ditch Company are complimentary to those of surrounding entities. The analysis of the project alternatives was conducted with these objectives and the broader goal of the Planning Project in mind:

- Evaluate existing structures for diversion efficiency and identify measures to minimize irrigation operating and maintenance costs;
- Improve gate automation and mechanisms for debris control/removal;
- Investigate potential for micro-hydro power production in the diversion dam or headgate;
- Coordinate design of the Prairie Ditch elements with that of the upstream Silva, Atencio 2, and McDonald Ditches.

3.3 Project Element #3: Silva and Atencio 2 Ditch Diversion and Headgates

3.3.1 Silva and Atencio 2 Ditch Diversion and Headgates Current Condition

The Silva Ditch and Atencio 2 Ditch divert water using the same diversion dam. The diversion is a mix of rock, trees, and woody debris. Sediment and debris accumulation is an issue. The diversion is placed at a very wide point in the river, making the diversion longer than required and increasing the cost of maintenance. The diversion is very tall (8-12 feet) and is currently impassible to boats and wildlife. The headgates of the Silva and the Atencio 2 are set back from the river. A channel between the river and the headgates feeds the ditches. This channel acts as a settling pond, collecting sediment and debris, and requiring periodic dredging and maintenance. The headgates are metal and are aging; they are not level, rusting, and sinking into the channel. Additionally, there are holes in the pipes in the headgates.

Figure 8. Silva and Atencio 2 Ditches Diversion

Figure 9. Silva Ditch Headgate (Right)

Figure 10. Atencio 2 Ditch Headgate (Left)

3.3.2 Silva and Atencio 2 Ditch Objectives

The stakeholders identified the following objectives for the Silva and Atencio 2 Ditches Diversion and Headgates. Because the Silva and Atencio 2 Ditch Company would like to improve the diversion, but were not sure if a total replacement of the diversion and headgates was necessary, the objectives focused on exploring options and ensuring actions taken are complimentary to those of surrounding entities. The analysis of the project alternatives was conducted with these objectives and the broader goal of the Planning Project in mind:

- Evaluate existing structures for diversion efficiency and identify measures to minimize irrigation operating and maintenance costs;
- Explore options to modify or replace the diversion dam with an efficient, low maintenance, environmentally sound structure;
- Improve gate automation and mechanisms for debris control/removal;
- Investigate potential for micro-hydro power production in the diversion dam or headgate;
- Coordinate design of the Silva and Atencio 2 Ditches elements with that of the downstream McDonald and Prairie Ditches.

3.4 Project Element #4: Streambanks

As discussed above, the Project area is within Reach C, Subreach C1 of the 2001 Study. This reach is laterally erosive, but highly depositional. As such, the streambank condition in the Project area is variable and dependent on streambank stability, vegetation establishment, and landuse.

3.4.1 Streambanks Current Condition

A group of the stakeholders, including representatives from the RGHRP, NRCS, and USFWS walked all of the 2.8 miles of streambank of the project area. Through this investigation, the condition of the streambanks was documented and potential remediation measures, if any, were identified.

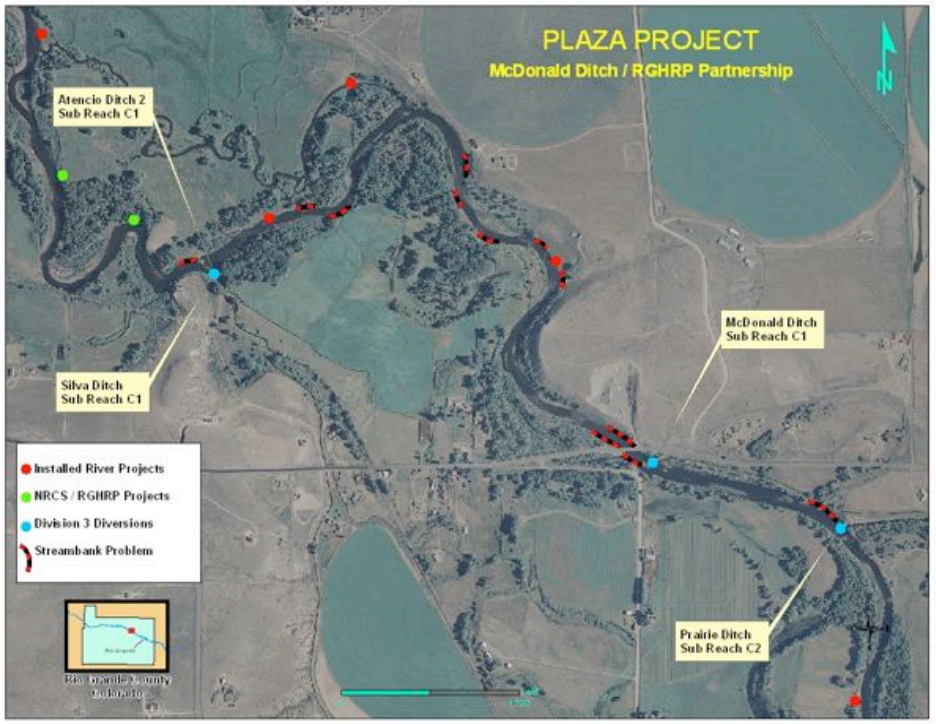

Figure 11. Streambanks in the Project Area, Including the Location of Previously Completed Streambank Stabilization Projects

Figure 12. Example of Steep, Eroding Streambanks in the Project Area

Figure 13. Example of Stable Streambanks with Mature Vegetation in the Project Area

3.4.2 Streambanks Objectives

The stakeholders identified objectives for the streambanks in the Project area. The analysis of the project alternatives was conducted with these objectives and the broader goal of the Planning Project in mind:

- Evaluate streambank stability, vegetation cover, and potential improvements to riparian habitat;
- Explore options to improve streambank condition;
- Coordinate streambank improvements with the efforts at the Silva, Atencio 2, McDonald, and Prairie Ditches.

3.5 Project Element #5: Wetland

There is a 2-acre jurisdictional wetland (wetland), owned by Rio Grande County, within the project area. The wetland is located directly west of the McDD Diversion on the south side of the river. This wetland has long been an area where trash is illegally dumped. In 2010, Rio Grande County personnel cleaned out the trash and hauled away more than 5 large trucks of debris. In the process of digging out the trash, which included furniture, appliances, and car bodies, vegetation was removed and the topography of the wetland was altered. In an effort to discourage dumping, a portion of the wetland was filled with gravel and soil. At this time, Rio Grande County was not aware this site was classified as a jurisdictional wetland. A concerned citizen notified the United States Army Corps of Engineers (USACE) of these actions and Rio Grande County was informed of a violation of the

Clean Water Act. Rio Grande County officials have committed to reclaiming the wetland and played an active role in the Project. Because of this engagement and a commitment by the RGHRP to ensure wetland reclamation is completed, USACE will not engage the Environmental Protection Agency (EPA) to further investigate the issue.

3.5.1. Wetland Current Condition

The wetland is directly connected to the river through a side channel and water elevation changes with river flow. The wetland is an oval, with water in the middle, riparian plants encircling the water, and upland plants circling the riparian plants. This uniform topography reduces water edge, limiting the quantity of habitat for riparian species. The species present are typical riparian species in the region. As such, the primary issue is the altered topography of the wetland.

Figure 14. Damaged Wetland in the Project Area

3.5.2 Wetland Objectives

The stakeholders identified the following objectives for the wetland. The analysis of the project alternatives was conducted with these objectives and the broader goal of the Planning Project in mind:

- Develop a plan to reclaim the damaged wetland that meets the requirements of USACE;
- Ensure acreage after Project completion is equal to acreage before damage;
- Ensure topography maximizes edge effects and opportunity for riparian species colonization;
- Ensure proper functioning hydrology is intact;
- Coordinate wetland improvements with the efforts at the nearby streambanks and McDonald Ditch.

Section 4 – Alternatives Development and Evaluation

4.1 Alternatives Considered for Diversions

The Stakeholders began studying potential alternatives for diversion replacements and modifications with the McDonald Ditch as the priority project. Through the analysis, it became apparent that the conditions within the channel were similar enough that the selected type of diversion would be appropriate at each of the three diversion sites, with local modifications for each ditch and headgate's characteristics.

Pulling from personal accounts and field trips to diversions on the Rio Grande, Arkansas, Poudre, and Big Thompson Rivers, the Stakeholders identified types of diversions they were interested in examining for potential application in the Project area. The NRCS performed preliminary surveys of the project elements and developed initial designs and cost estimates for each of the alternatives. Costs were derived by the NRCS from "The Means Heavy Construction Cost Data."

The four alternatives were:

- Diversion Alternative #1: Concrete Diversion
- Diversion Alternative #2: Steel and Grouted Rock Diversion
- Diversion Alternative #3: Hybrid Rock and Concrete Diversion
- Diversion Alternative #4: Pipeline

4.1.1 Diversion Alternative #1: Concrete Diversion

A concrete diversion dam would span the entire width of the river, checking the water behind it. The concrete structure would have the highest installation costs, but the lowest maintenance costs of all of the proposed diversion alternatives. The structure would not be passable to fish or boaters. It was recognized that a side channel could be added to allow fish passage. This would add to the costs of the diversion. Such a structure is shown in Figure 16.

Figure 15. Proposed Design for Alternative 1: Concrete Diversion Dam

Figure 16. Example of Concrete Diversion Dam

4.1.2 Diversion Alternative #2: Steel and Grouted Rock Diversion

A steel and grouted rock dam would span the entire width of the river, checking the water behind it. The steel and rock structure would have lower installation costs than the concrete dam, but greater maintenance needs and costs. While this structure is more "natural looking" than concrete, it is impassable by fish and boaters. Similar to Alternative #1, a side channel could be added to allow fish passage.

Figure 17. Proposed Design for Alternative 2: Grouted Rock Diversion Dam

Figure 18. Example Grouted Rock Diversion Dam

4.1.3 Diversion Alternative #3: Hybrid Rock and Concrete Diversion

A hybrid rock and concrete diversion would be half concrete and half rock. The concrete would be adjacent to the headgate and extend half way across the river. The rocks would comprise the other half of the dam and include a series of drop structures, allowing for fish and boat passage. This structure would be comparable to the grouted rock and steel diversion in terms of installation cost. It would have higher maintenance than the concrete structure and lower maintenance than the grouted rock and steel structure. Because this alternative provides boat and fish passage, it would fulfill numerous nonconsumptive needs including recreation and habitat improvement. This option was the most favorable of the diversion alternatives.

Figure 19. Proposed Design for Alternative 3: Hybrid Concrete and Grouted Rock Diversion Dam

Figure 20. Example Hybrid Concrete and Grouted Rock Diversion Dam (Near Salida, CO on the Arkansas River)

4.1.4 Diversion Alternative #4: Pipeline

The final alternative was specific to the Silva, Atencio 2, and McDD diversions. This alternative would include the removing the current McDD diversion and moving its headgate upstream to the location of the Silva and Atencio 2 headgates. The Silva and Atencio 2 diversion would be replaced with the most favorable diversion option, Alternative #3, and all water for the Silva, Atencio 2, and McDD would be diverted from this location. The Silva and Atencio 2 would divert their water into their ditches at the location of their current headgates. The McDD would divert their water (14.4 cfs) into the Silva Ditch for 0.5 mile, then divert it into a pipeline, which would travel approximately 0.5 miles along County Road 5N, over the river, and into the current McDD concrete lined ditch. Combining the Silva, Atencio 2, and McDonald diversions, would reduce overall maintenance. Furthermore, the current structure at the Sevenmile Plaza bridge would be removed, which was a priority project identified by the 2001 Study. Installing the concrete and grouted rock hybrid structure would have the advantages and disadvantages discussed above. However, the McDD would have to go through Water Court to change their point of diversion. Additional complications include the evaporative losses of transporting water in an open ditch before the pipeline, lack of sufficient right-of-way along County Road 5 North, and the need for the need for the pipeline to cross the Rio Grande. Finally, engineers from the Colorado NRCS State Office raised issue with removing the McDD diversion structure entirely as this diversion dam is controlling the grade of the river in the area. The concern is that without grade control, scour could occur at the bridge, causing instability. As such, it would be necessary to install a grade control structure at the current diversion. The cost of installing two check structures, three headgates, and a pipeline would make Alternative #4 twice the cost of all other alternatives.

Figure 21. Proposed Design for Alternative 4: Diversion Rehabilitation and Pipeline

Figure 22. Example of Pipeline Installation

4.2 Micro-Hydropower Production Potential

Stakeholders were very interested in investigating the potential to include low head micro-hydropower (micro-hydro) production in the diversions or headgates in the Project area.

A feasibility study was commissioned with Applegate Group Inc., who recently completed a study on including micro-hydro production in canals and ditches across Colorado. Micro-hydro production is not feasible at any of the Plaza Project elements at this time. Below is the Executive Summary from the feasibility study.

PLAZA PROJECT HYDROPOWER FEASIBLITY STUDY - EXECUTIVE SUMMARY

The Plaza Project is considering improvements to the irrigation diversion dams on the Rio Grande in the Sevenmile Plaza area, near Monte Vista, Colorado. The stakeholders would like to consider both improvements to the irrigation diversions including automation of headgates and the addition of low head hydropower. The McDonald Ditch diversion dam and headgate are the concentration of the first phase of the project. The second phase will focus on the Silva/Atencio and Prairie Ditch diversion dams. Consideration of hydropower at this stage of a project is a very proactive approach to renewable energy and implementation. The costs associated with installing hydropower can be minimized by incorporating specific features in to the diversion structure at the time of construction or rehabilitation. This report focuses on the feasibility of the hydropower portion of this project.

Figure 23. Typical Micro-hydro Power Production Facility

A site visit was conducted and information was gathered regarding the proposed improvements. Data was collected and analyzed from nearby stream gages and historic irrigation diversions. Using this information hydropower alternatives were developed and explored.

A total of six alternatives were considered for hydropower development associated with the replacement of the McDonald Ditch Diversion Dam. Three possible turbines for installation in the diversion dam and three pipeline alternatives were explored. The pipeline

alternatives were quickly shown to be infeasible due to high friction losses in the pipeline and the low flows available. The three turbine alternatives for the diversion dam were explored in more detail and were shown to be economically unfavorable. The same three turbines were considered at the Silva/Atencio and Prairie Ditch diversion dams. The slightly higher heads available did decrease the payback period, but not enough to make the sites economically favorable.

The following table summarizes the turbine types, capacity, revenue potential, turbine cost and resulting payback. The economic analysis considered the cost of the turbine only and not the additional civil infrastructure or interconnection costs associated with implementation. Also the analysis does not consider any costs for the operation and maintenance of the system.

McDonald Ditch Alternatives	Size (kW)	Annual Revenue	Turbine Cost	Simple Payback (years)
VLH Turbine	100	$ 17,500	$ 1,000,000	57
Hydrodynamic Screw	6	$ 1,800	$ 100,000	55
Hydrokinetic	3.4	$ 875	$ 20,000	23
Silva/Atencio Ditch				
VLH Turbine	130	$ 26,400	$ 1,000,000	38
Hydrodynamic Screw	32	$ 9,800	$ 320,000	33
Hydrokinetic	3.4	$ 875	$ 20,000	23
Prairie Ditch				
VLH Turbine	120	$ 21,350	$ 1,000,000	47
Hydrodynamic Screw	28	$ 8,600	$ 280,000	33
Hydrokinetic	3.4	$ 875	$ 20,000	23

At this time, the development of the three sites is not recommended. The very low head available at the diversion dams and the high friction losses associated with the pipeline options makes a potential project economically unfavorable. Innovative low head turbines are relatively new to the market and are priced at a premium. As more of these turbines are installed, we hope that the prices will come down and make these sites more favorable.

4.3 Headgate Considerations

Each headgate will vary based on the conveyance requirements and preferences of the ditch company. Headgate specifics are discussed in greater detail in Section 5. Commonalities include the desire to improve diversion efficiency, reduce maintenance costs, and explore the possibilities of including automation in the headgates.

4.3.1 Automated Gates and Precise Water Management

To research automated gates, the stakeholders met with Kyle Clair, engineer of the Prairie Ditch automated gate system, and Rubicon Systems America, Inc. (Rubicon Water). Clair's system uses the data transmitted by the Prairie Ditch gauging station to the Colorado Division of Water Resources. The ditch superintendent programs the desired flow rate into the automated gate system, which then triggers a motor to raise and lower the headgate until the flow the gauging station is reporting equals the desired flow.

Figure 24. Automated Gate at the Prairie Ditch Headgate.

Rubicon Water, an Australian based company, provides cutting edge water management systems. Rubicon's system has an operating system that can be programmed onsite or remotely via computer or smart phone. Rubicon utilizes overshot gates with sensors that measure the upstream and downstream pools. The gate then adjusts to deliver the programmed flow. Because the Rubicon system measures upstream and downstream pools, it can be installed at numerous places on the irrigation system and regulate the flow of the entire ditch. This is known at Total Canal (TC) control. Rubicon engineers complete the gate design and installation. They then provide training and costumer support for the system.

Figure 25. Example of Rubicon Automated Gates

The Stakeholders were impressed with the automated systems and insist they be included in headgates in the Project area. This will allow for improved irrigation efficiency and accounting of water, which is critical to on-farm and Rio Grande Compact management.

Section 5 - Selected Alternatives for Each Element

The stakeholders narrowed the developed alternatives and crafted a desired implementation plan for each of the project elements. The stakeholders developed the implementation plans with the project goal and objectives for each element in mind.

5.1 Selected Alternatives for the McDonald Ditch

The Stakeholders selected mitigation measures for the McDD diversion and headgate. These mitigation measures included considerations for surrounding infrastructure issues including the Sevenmile Plaza Bridge and power poles owned by San Luis Valley Rural Electric Cooperative (SLVREC).

5.1.1 McDonald Ditch Diversion

The Stakeholders selected Diversion Alternative #3: Hybrid Rock and Concrete Diversion for the McDD diversion replacement. This option will greatly improve diversion efficiency and riparian condition. The diversion will have a sluice, which will move sediment and debris past the headgate and downstream. The angle of the diversion will be changed so it extends across the narrowest part of the river and is perpendicular to the direction of flow. This will improve the channel and streambank stability near the diversion, as the current diversion pushes flow into the banks. Finally, the grouted rock drop structures will allow for fish and boat passage; this will improve the habitat and recreation potential in the reach.

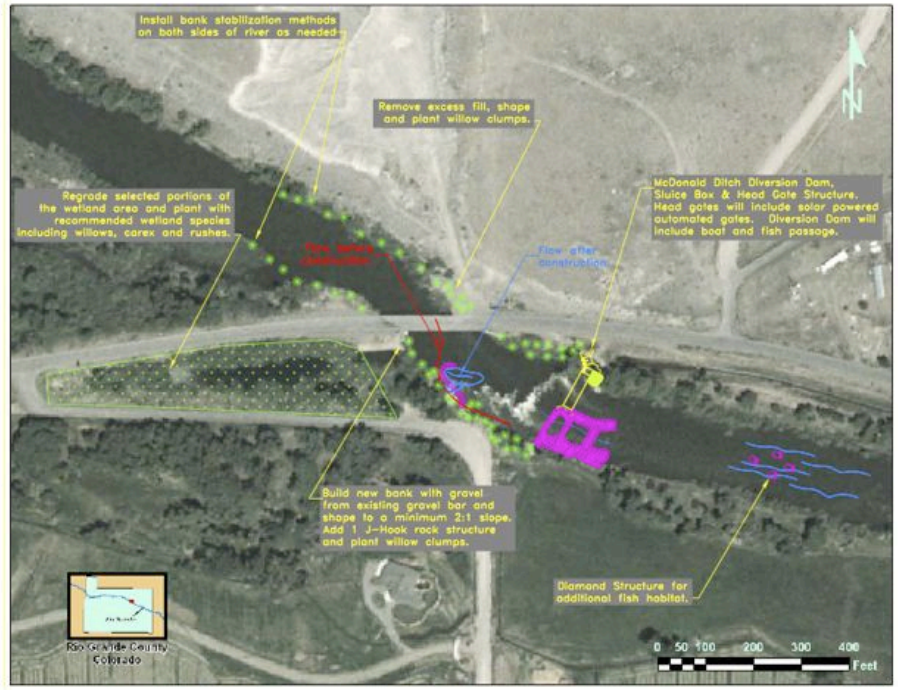

Figure 26. Selected Alternatives for the McDonald Ditch.

5.1.2 McDonald Ditch Headgate

The Stakeholders selected a concrete headgate with two gates. One manual gate and one solar-powered automated gate. The manual gate will be closest to the river and will be used to open or close the headgate to flows, allowing the McDD to close the gate in the winter and protect the automated gate from ice and freezing. Additionally, the manual gate will be used to regulate ditch flows if the automated gate malfunctions. The automated

gate will be closest to the ditch and will regulate ditch flows, improving diversion accuracy and accounting.

5.1.3 Sevenmile Plaza Bridge Stability

As discussed in Section 4.1.4, concerns were shared about the stability of the Sevenmile Plaza Bridge, which is owned by Rio Grande County, in the event the current McDD diversion dam is removed. For decades, the existing diversion has held the channel at a steady elevation. There is a risk that removing the diversion would lead to an increase in flow velocity, increased grade in this reach of the river, and instability of the bridge. Although the stakeholders decided to replace the structure, it was unsure if any changes in the new structure would impact the bridge's stability or influence scouring near the bridge's piers. At one time, the bridge was on the Colorado bridge scour list. The scouring was caused during a high water event, when a tree snagged on the middle pier of the bridge. To determine if the McDD diversion is having any affect on the Sevenmile Plaza Bridge, the RGHRP hired Stantec Consulting Services, Inc (Stantec). Stantec has worked on inspections and scour analysis projects for this bridge. NRCS and RGHRP staff collected survey and cross section data. Stantec used this information to build an existing conditions model. The model will be used to perform HECRAS modeling to determine the impacts of current and proposed structures on the Sevenmile Plaza Bridge. Stantec's final report on the Sevenmile Plaza Bridge will be complete in January 2012.

Figure 27. Sevenmile Plaza Bridge and McDonald Ditch Diversion

5.1.4 Location of Power poles

Stakeholders were concerned about the potential risks involved with two power poles belonging to San Luis Valley Rural Electric Cooperative (SLVREC), located in close proximity to the McDD diversion. The two power poles sit approximately 10 and 70 feet from the edge of the riverbank. This bank, which is currently vertical, has eroded in the past, causing SLVREC to move the pole back. Through the project, the banks will be shaped and the new diversion and streambank stabilization structures will be tied into it.

Figure 28. Power Poles Near the McDonald Ditch Diversion

A meeting was arranged between SLVREC and stakeholders to discuss concerns and precautionary measures recommended by SLVREC. SLVREC summarized the situation and their concerns in a letter to Stakeholders. The following passage is from the letter:

"At the intersection of the Rio Grande river and the Rio Grande County Rd. 5W there is two 12.5 kV distribution lines that cross the Rio Grande River, running from north to the south and on the south side of the crossing, they are on each side of the County Rd. 5W. The eastern most circuit, (Plaza Substation, Circuit 7), appears to be out of the way as the first pole on the south side of the crossing is approximately 70 feet or more away from the proposed construction area. The western most circuit (Plaza Substation, Circuit 3) is an older crossing, and the first pole (Pole # 2) on the south side of the River is somewhat of a concern. Based on the sketch provided it should also be out of the construction area, however it is still very close. If the bank is disturbed, the means of support would be compromised requiring changes to be made. The span length between Pole #1 and Pole #2 is 525 feet, which is the maximum distance that can be spanned with the 2/0 ACSR conductor that is being used for this crossing. If it is necessary to remove the pole # 2, a new pole will have to be inserted approximately 100 ft south of Pole # 1 and Pole # 3 which is currently a 40 ft pole, would have to be replaced with a 50 ft pole increasing its height by 10 ft so to provide adequate clearance over the county road and the river."

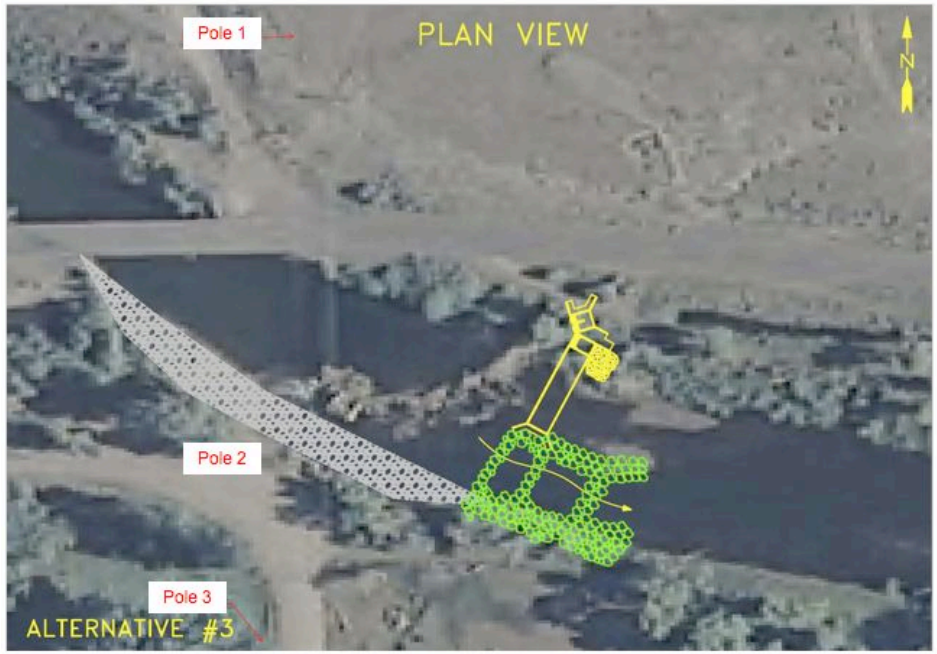

Figure 29. Location of Power Poles Near the McDonald Ditch Diversion

It was determined the poles would be moved in Phase 2 as in-kind project contribution from SLVREC. Additionally, the power can be moved between the two 12.5 kV electrical lines, which run parallel across the river, to accommodate in-stream heavy equipment operation.

The handling of the two major infrastructure concerns, the Rio Grande County owned Sevenmile Plaza Bridge and the SLVREC power poles, illustrates the collaboration which existed throughout the Plaza Planning Project and the many cross-sector benefits that were derived from the Plaza Stakeholder process.

5.1.5 Preserving the Old Sevenmile Plaza Bridge Pier

During the alternative investigation and implementation planning, a resident of the Sevenmile Plaza expressed the desire to conserve the pier from the old Sevenmile Plaza Bridge, which currently comprises a portion of the McDD diversion. As such, NRCS considered keeping the pier in place to serve as part of the new diversion. However, it was determined that, because the footer and bed material beneath the pier are unknown, it was too risky to tie the new diversion into the pier and impossible to ensure the structure would be stable. To honor the sentiment of this historic piece of the Sevenmile Plaza, the stakeholders proposed installing a sign or plaque once the new diversion is in place.

Figure 30. Old Sevenmile Plaza Bridge Pier; Currently Part of the McDonald Ditch Diversion

5.2 Selected Alternatives for the Prairie Ditch

The Stakeholders selected the following mitigation measures for the Prairie Ditch diversion and headgate.

5.2.1 Prairie Ditch Diversion

The Stakeholders selected Diversion Alternative #3: Hybrid Rock and Concrete Diversion to replace the current Prairie Ditch diversion. This option will greatly improve diversion efficiency and riparian condition. The diversion will have a sluice, which will move sediment and debris past the headgate and downstream. Finally, the grouted rock drop structures will allow for fish and boat passage; this will improve the habitat and recreation potential in the reach.

5.2.2 Prairie Ditch Headgate

The Stakeholders selected a concrete headgate with two gates. One manual gate and one solar-powered automated gate. The manual gate will be closest to the river and will be used to open or close the headgate to flows, allowing the Prairie Ditch to close the gate in the winter and protect the automated gate from ice and freezing. Additionally, the manual gate will be used to regulate ditch flows if the automated gate malfunctions. The automated gate will be closest to the ditch and will regulate ditch flows, improving diversion accuracy and accounting.

Figure 31. Selected Alternatives for the Prairie Ditch

5.3 Selected Alternatives for the Silva and Atencio 2 Ditches

The Stakeholders selected the following mitigation measures for the Silva and Atencio 2 Ditch diversion and headgates. It is important to note that toward the end of the Planning Project, the primary representative for the Silva and Atencio 2 Ditches sold his land and water rights and no longer attended planning meetings. As such, the Stakeholders used the established objectives as guidance to select alternatives for the Silva and Atencio 2 Ditches. When the stockholders are ready to go forward with updates to their infrastructure, the selected alternatives will be reviewed with the ditch companies to ensure they are inline with the water users' needs.

5.3.1 Silva and Atencio Ditch Diversion

The Stakeholders selected Diversion Alternative #3: Hybrid Rock and Concrete Diversion to replace the current Silva and Atencio 2 Ditch diversion. The Stakeholders recommended modifying the angle and length of the diversion by moving the south end of the diversion slightly downstream, thus shortening it and reducing the cost of replacement. This option will greatly improve diversion efficiency and riparian condition. The diversion will have a sluice, which will move sediment and debris past the headgate and downstream. Additionally, the grouted rock drop structures will allow for fish and boat passage; this will improve the habitat and recreation potential in the reach. With boat and

fish passage in all three locations, the Rio Grande would be opened to recreation from Del Norte through the Project area, a distance of over 20 river miles.

5.3.2 Silva and Atencio Ditch Headgates

The Stakeholders recommended replacing the old, rusted metal headgates that service the Silva and Atencio 2 Ditches with new concrete structures with automated headgates. Additionally, the headgates should be moved toward the river to avoid maintenance problems associated with being on a long side channel.

Figure 32. Selected Alternatives for the Silva and Atencio 2 Ditches

5.3.3 Landownership Considerations

A landowner adjacent to the Silva and Atencio 2 Diversions uses her land for spiritual retreats and grief counseling, with hillside memorial monuments to honor loved ones. This landowner expressed concern that in the process of rehabilitating the diversion, the memorial garden would be damaged. A letter expressing these thoughts is on file with the RGHRP. The Stakeholders committed to completing upgrades without any impacts to the neighboring properties.

5.4 Selected Alternatives for the Streambanks

As discussed in Section 3.4.1, the condition of the streambanks was documented through Stakeholder field trips. The stakeholders examined the condition of each streambank and developed desired mitigation measures including: no action needed, bioengineering needed, stream access point development, and extensive streambank stabilization recommended. The streambank recommendations coincide with the recommendations for other elements. Because the streambanks in the project reach are all privately owned, the implementation of the stakeholders' recommendations will be dependent on landowner preference.

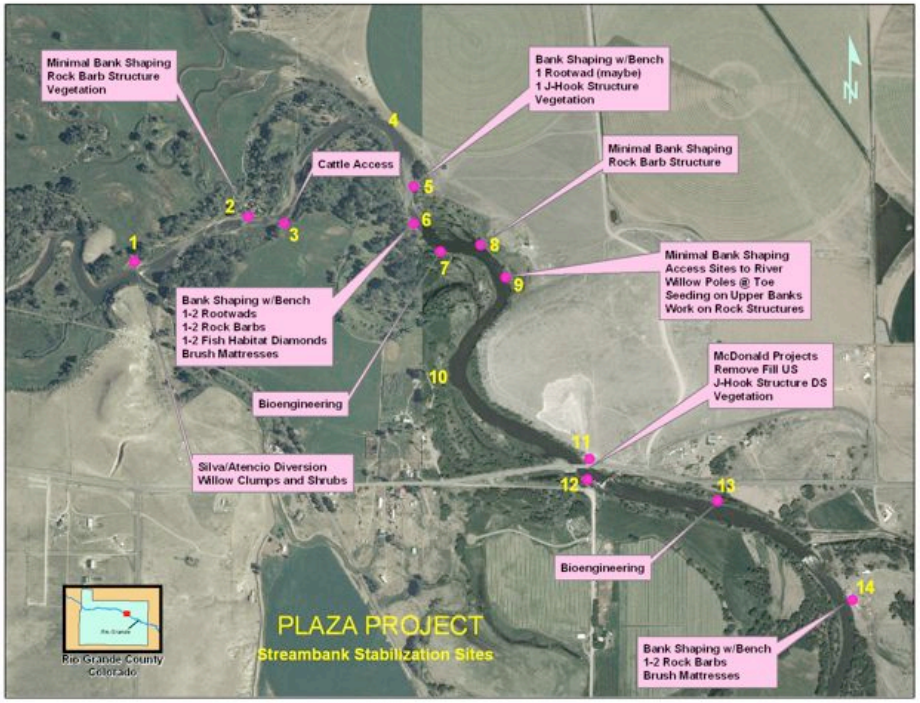

Figure 33. Selected Alternatives for the Streambanks

In addition to improvements to the streambanks, the landowners can also take action to improve the riparian and aquatic habitat. As described in the 2001 study, the following actions will lead to habitat improvements:

- Protecting the riparian zone (reducing cattle grazing, provide development buffer, etc.);
- Creating various runs and riffles, thereby decreasing the existing large expanses of slow-moving water (which is lacking in habitat);
- Instigating special regulations on the taking of trout and provide more stocking;
- Preventing erosion and flooding.

5.5 Selected Alternatives for the Wetland

The Stakeholders worked closely with Rio Grande County officials and representatives from the US Army Corps of Engineers (USACE) to ensure all requirements for reclaiming the wetland were addressed. The primary objective is to ensure the acreage of wetland reclaimed is equal to the acreage before disturbance. It is also important to the USACE that the wetland be regraded to decrease uniformity and add in additional topography. The wetland will be revegetated with native riparian species such as willows, carex, rushes, grasses, and forbs.

Figure 34. Selected Alternative for the Wetland

Section 6 – Project Prioritization and Future Phases

The stakeholders prioritized implementation of the selected alternatives. Prioritization was guided by urgency and instability, maintenance requirements of structures, readiness for implementation, and importance outlined in the 2001 Study. The project elements will be addressed in future phases of the Plaza Project.

Project Prioritization:

- Priority 1 – McDonald Ditch Diversion and Headgate Replacement
- Priority 2 – Rio Grande County Wetland Reclamation
- Priority 3 – Streambank Stabilization near the McDonald Ditch
- Priority 4 – Prairie Ditch Diversion and Headgate Replacement
- Priority 5 – Streambank Stabilization near the Prairie Ditch
- Priority 6 – Silva and Atencio 2 Ditches Diversion and Headgates Replacement
- Priority 7 – Streambank Stabilization near the Silva and Atencio 2 Ditches
- Priority 8 – Streambank Stabilization between the Silva and Atencio 2 Ditches and the McDonald Ditch

Section 6.2 Plaza Project - Phase 2: McDonald Ditch Implementation Project

The Plaza Project - Phase 2: McDonald Ditch Implementation Project (Phase 2) is the first phase of implementation of the Plaza Plan. The top three priorities, Priority 1 – McDonald Ditch Diversion and Headgate Replacement, Priority 2 – Rio Grande County Wetland Reclamation, and Priority 3 – Streambank Stabilization near the McDonald Ditch, are included in Phase 2. Phase 2 integrates the rehabilitation of the McDonald Ditch diversion with the multiple objectives of the 2001 Study, the anticipated future rehabilitation of the neighboring Silva, Atencio, and Prairie diversions, and the stabilization and restoration of the surrounding riparian areas. Preliminary designs for the McDonald Ditch headgate and diversion, streambanks, and wetland were developed by the NRCS in Phase 1. In Phase 2, Project engineers will finalize the design for each of the project elements. Phase 2 is underway with Project implementation in 2012 and monitoring each year until 2015.

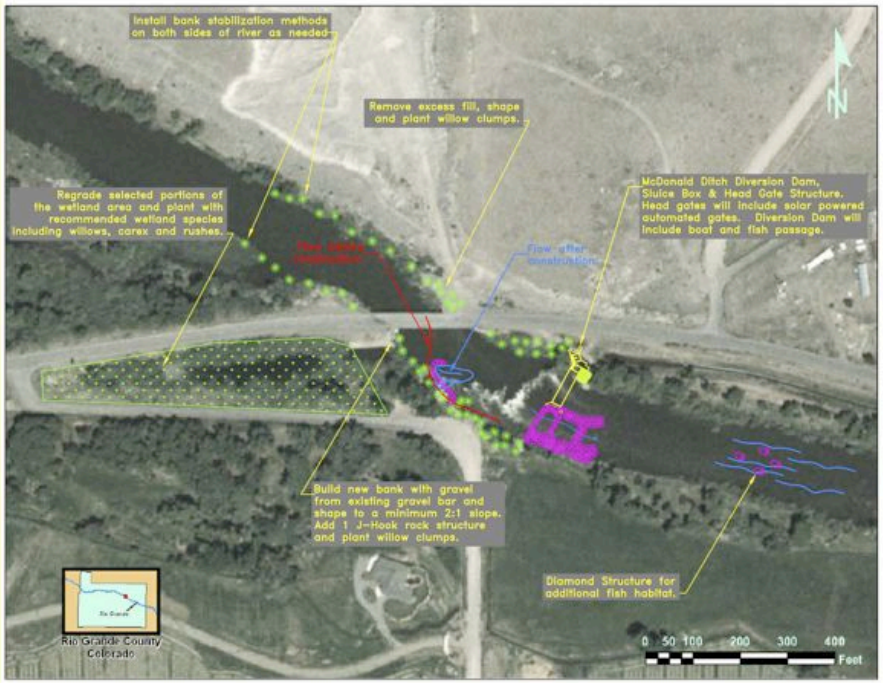

Figure 35. Project Elements and Deliverables - Phase 2: McDonald Ditch Implementation Project

Section 6.2.1 Phase 2 Funding

Phase 2 will be funded with $295,000.00 from the Colorado Water Conservation Board (CWCB) Water Supply Reserve Account (WSRA), $150,000 from the NRCS Environmental Quality Incentives Program (EQIP), $50,000 from the Colorado Partnership Program (CPP), $200,000 from the Cooperative Conservation Partnership Initiative (CCPI) Program, $70,000 from Landowners, $10,000 from Rio Grande County, and $133,000 from in-kind services. Total estimated project cost is $908,000.00.

Section 6.2.2 Phase 2 Objectives

The objectives of Phase 2 are to:

- Improve diversion efficiency and reduce maintenance by replacing the aging McDonald Ditch headgate, installing a solar-powered automated water gate, and replacing the McDonald Ditch diversion structure with the alternative chosen by the Plaza Stakeholders during Phase 1;
- Enhance water quality by reducing erosion and sediment input;
- Improve riparian and wetland condition by reclaiming a 2-acre wetland and stabilizing up to 2,000 linear feet of streambanks in the project area;
- Increase the capacity of the Rio Grande to transport sediment;
- Improve aquatic and wildlife habitat;
- Encourage local recreation by including fish and boat passage in the new diversion structure;
- Promote public involvement in water improvement activities through public outreach and education.

Section 6.3 Plaza Project - Phase 3: Prairie Ditch Implementation Project

The Plaza Project - Phase 3: Prairie Ditch Implementation Project (Phase 3) is the second phase of implementation of the Plaza Plan. Priorities 4 and 5, Prairie Ditch diversion and headgate replacement and streambank stabilization near the Prairie Ditch will be included in Phase 3. Planning for Phase 3 is underway and

the RGHRP, NRCS, landowners, and Prairie Ditch stockholders will organize funding and designs in 2012.

Section 6.4 Plaza Project - Phase 4: Silva and Atencio 2 Ditch Implementation Project

The Plaza Project - Phase 4: Silva and Atencio 2 Ditch Implementation Project (Phase 4) is the third phase of implementation of the Plaza Plan. Priorities 6, 7, and 8, Silva and Atencio 2 diversion and headgates replacement and streambank stabilization near the Silva and Atencio 2 Ditches and between the Silva and Atencio 2 Ditches and the McDonald Ditch, will be included in Phase 4. Planning for Phase 4 is underway. It is expected funding will be sought for Project implementation in 2013.