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Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission (http://wwdc.state.wy.us)

FINAL REPORT
MIDDLE NORTH PLATTE–GLENDO WATERSHED STUDY, LEVEL I
WATERSHED MANAGEMENT PLAN

Topical Report RSI-2673

prepared for

Wyoming Water Development Commission
6920 Yellowtail Road
Cheyenne, Wyoming 82002

November 2016

RESPEC

FINAL REPORT
MIDDLE NORTH PLATTE–GLENDO WATERSHED STUDY LEVEL I WATERSHED MANAGEMENT PLAN

Topical Report RSI-2673

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1.0 INTRODUCTION AND OVERVIEW

1.1 INTRODUCTION

In 2014, the Converse County Conservation District (CCCD) and other adjoining Conservation Districts requested that the Wyoming Water Development Commission (WWDC) conduct a comprehensive study of the Middle North Platte–Glendo Watershed and its water resources. The local sponsors requested that the Level I watershed study evaluate watershed function; assess wetland and riparian conditions; develop geomorphic classifications; and identify resource concerns and water development opportunities on irrigated lands, rangelands, wetlands, and streams. In 2015, the WWDC approved funding for the watershed study and then contracted with RESPEC and its subconsultant, Anderson Consulting Engineers, Inc. (ACE), to provide technical and professional services for the Middle North Platte–Glendo Watershed Study, Level I in June 2015.

1.2 OVERVIEW

The Middle North Platte–Glendo Watershed Study is a comprehensive evaluation and an initial inventory of the water and land resources within the study area. This Level I study provides important information that the CCCD (the study's local sponsor) and the WWDC (the study's sponsor) could use in developing water resources and implementing conservation practices that address water- and land-resource concerns within the study area. This watershed study includes in-depth descriptions about needed water development projects that could provide economic, ecological, and social benefits to the state of Wyoming and its citizens.

The intent of this report, accompanied by the study's digital library and Geographic Information System (GIS) geodatabase, is to provide the results of the Middle North Platte–Glendo Watershed Study. This Level I watershed study included reviewing previously conducted work that was contained in numerous databases, studies, and reports regarding the natural resources within the study area. Additionally, the information that was reviewed and determined to be relevant to the study's purpose was compiled into a digital library and a GIS dataset. Information in the digital library was combined with the data collected during the inventory effort and used to generate proposed conceptual alternatives that are outlined in Chapter 4.0 of this report.

1.2.1 What Is a Watershed Study?

A watershed is defined in the Merriam-Webster Dictionary as "a region or area bounded peripherally by a divide and draining ultimately to a particular watercourse or body of water" [Merriam-Webster, 2013]. The *Operating Criteria of the Wyoming Water Development Program* [WWDC, 2015a] describes Level I studies as preliminary analyses and compares development alternatives. Although, a Level I study is also used for master plans, watershed improvement studies, and other water-planning studies. Specifically, the *Operating Criteria of the Wyoming Water Development Program,* [WWDC, 2015a] describes watershed studies as:

> *These studies provide a detailed evaluation of an individual watershed. The studies may identify water development and system rehabilitation projects as well as address erosion*

> *control, flood control or other non-water development related environmental issues. Watershed improvement studies are an integral part of the Small Water Project Program, which has its own specific criteria. The studies may identify projects that may be eligible for the New Development, Rehabilitation, or Dam and Reservoir Programs.*

However, a watershed study was perhaps best explained in "Conservation and Watershed Studies. What's the Connection?," which is an article that appeared in the WWDC's *Water Planning News* Fall 2009 newsletter [WWDC, 2009].

> *Today, conservation by watershed is an old concept with new horizons. Watersheds have long been recognized in the western Unites States for their significant natural resources and the interrelationships found contained in land areas connected by stream systems. These relationships were recognized by John Wesley Powell from his early expeditions of the west and resulted in proposed conservation, low density open grazing, irrigation systems and state boundaries based on watershed areas.*
>
> *The conservation concept developed over time to coalesce in the early 1930's with the formation of special districts whose boundaries were often based on watersheds. At that time the relationship between stream systems and landscape function was recognized. This relationship was broadened to embrace watershed condition and quality and its response to human influences. This further provided some understanding of the historic land use effect on watershed condition and how management and restoration needs to be based on local landscape characteristics.*
>
> *Today, these relationships are embraced by the Wyoming Water Development Commission and Office through a watershed study program. On behalf of a local community sponsor, a watershed study can provide a comprehensive evaluation, analysis and description of the resources associated with a watershed and the watershed's water development opportunities. It is best stated that information related to the physical sciences is incorporated into a biological system.*
>
> *There are three prominent issues that are important considerations in a watershed information review and study. The first is surface water storage. Surface water storage is often of significant interest to a watershed community in order to address seasonal and/or annual shortages of water supply, augment late season stream flow to benefit riparian habitat and wildlife, address flood impacts, enhance recreation opportunities, improve water quality and steam channel stability.*
>
> *Second is the evaluation of irrigation infrastructure and development of information necessary to guide its rehabilitation. Of interest to local water users are ways to improve water delivery and on-farm irrigation efficiencies often timed to address annual or seasonal shortages of water supply or irrigation water delivery issues.*
>
> *Third is the enhancement of upland water resources and distribution for livestock and wildlife that allows grazing management adjustments for range resource improvement. Benefits to the watershed, through plant community invigoration, reduction of erosion and stream channel stabilization, can be achieved from water development projects being strategically implemented over the watershed. Other issues and opportunities such as*

making beneficial use of produced water and removal of high water demand invasive species can also be important.

A watershed study, providing management and rehabilitation plans for water storage, irrigation systems and upland water development, can help empower a community to proactively enhance their watershed. Conservation by watershed can be an effective holistic approach to embracing the natural resource challenges and opportunities facing a community. A watershed study can provide the information to meet those challenges.

1.2.2 Study Area

The study area for the Middle North Platte–Glendo Watershed, as shown in Figure 1.1, encompasses a portion of the drainage area for the North Platte River that begins west of the town of Glenrock and flows generally east and southeast through Glendo and Guernsey Reservoirs. The headwaters of multiple tributaries to the North Platte River are along the southwest border of the study area, within the Laramie Mountain Range. These tributaries flow generally north and east until they reach the North Platte River. Streams that flow and lands that drain to Glendo Reservoir and Guernsey Reservoir are also included in the study. The terms "watershed" and "study area" are used interchangeably in this report.

The study area covers approximately 3,275 square miles (or 2,095,807 acres) in eastern Wyoming. The watershed is mainly situated within Converse County (62.8 percent) and Platte County (24.8 percent), with small portions of Niobrara County (4.7 percent), Albany County (4.6 percent), Natrona County (2.1 percent), and Goshen County (1.0 percent) also included. The cities, towns, and communities of Douglas, Glendo, Glenrock, Guernsey, Hartville, Lost Springs, and Rolling Hills lie within the watershed.

The watershed is approximately 50 miles north-south and 80 miles east-west and is bounded on the north by the Cheyenne drainage. The study area's west and northwest border is bounded by the Middle North Platte–Casper drainage. On the southwest and east, the study area boundary is along the Laramie Mountain Range and the Guernsey to State Line drainage, respectively.

The North Platte River and its major tributaries (Box Elder, Deer, Horseshoe, LaPrele, Sage, Sand, and Wagon Hound Creeks) are located within the study area. Many other tributaries flow to the North Platte River within the watershed. Approximately 9,590 stream miles are located within the watershed with approximately 1,144 stream miles classified as perennial. The watershed also contains some tributaries that do not flow into the North Platte River but flow instead into Glendo Reservoir and Guernsey Reservoir. These tributaries include Broom, Cottonwood, Elkhorn, Muddy, and Willow Creeks.

1.3 INSTITUTIONAL ISSUES IN THE MIDDLE NORTH PLATTE–GLENDO WATERSHED

Because the watershed is downstream of the Pathfinder, Seminoe, and Alcova Reservoirs and includes Glendo and Guernsey Reservoirs, the constraints and limitations for water development within the study area must be understood. Pathfinder Reservoir is one of the five largest reservoirs and waterbodies in the state of Wyoming [Jacobs and Brosz, 1993; WWC Engineering Inc., 2007]. The study area is located on the North Platte River downstream from the Pathfinder Dam and Reservoir. The

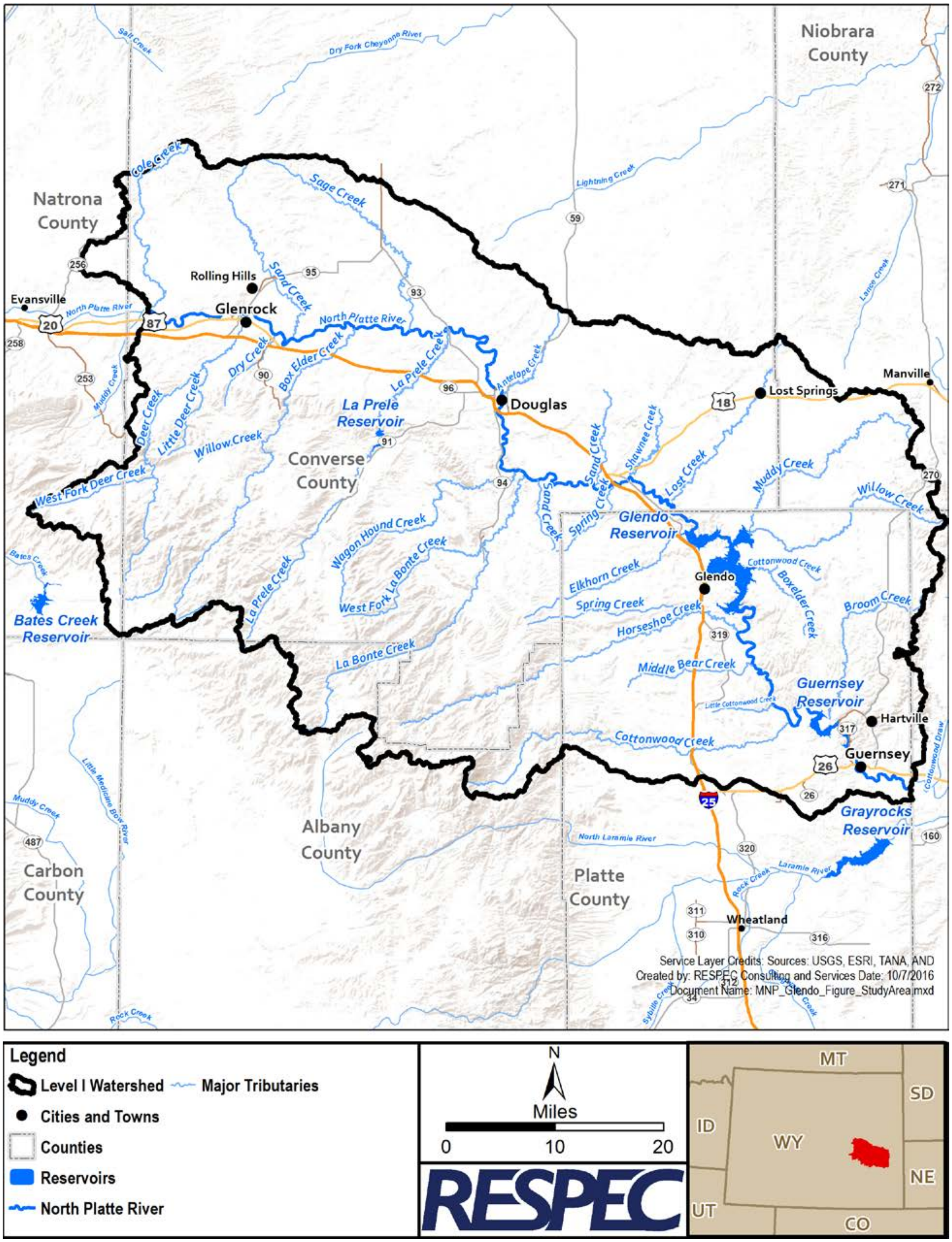


Figure 1.1. Middle North Platte–Glendo Level I Watershed Study Area.

watershed is located within the Pathfinder to Guernsey Platte Basin, as shown in Figure 1.2. Management of Pathfinder, Seminoe, Alcova, Glendo, and Guernsey Reservoirs influence the North Platte River and the water- and land-use activities within the study area. More importantly, this understanding is crucial in identifying potential opportunities, recommended alternatives, and proposed projects and components outlined in Chapter 4.0.

1.3.1 North Platte River Decree

In Wyoming, the State Engineer's Office (SEO) is responsible for regulating and administrating the state's water resources and administers all matters that involve Wyoming's interstate compacts and court decrees. The rights of Wyoming, Colorado, and Nebraska to the waters of the North Platte River have been established by decree of the US Supreme Court [Supreme Court of the United States, 2001; SEO, 2006a]. Before the decree, the apportionment of water between Wyoming, Colorado, and Nebraska for irrigation use was disputed between the three states [Trihydro, 2006]. In 1934, Nebraska filed a lawsuit against Colorado and Wyoming in the US Supreme Court over the flows of the North Platte River and claimed that priority rights in Nebraska were not being honored [SEO, 2006a; Trihydro, 2006].

In 1945, the US Supreme Court handed down a decree that apportioned the waters of the North Platte among the states, set limitations on water appropriations in Wyoming, and included the following provisions [Supreme Court of the United States, 2001; SEO, 2006a; Trihydro, 2006; Purcell, 2014]:

1. *Exclusive of the Kendrick Project and Seminoe Reservoir, the state of Wyoming is enjoined from diverting water from the North Platte River above the Guernsey Reservoir and from the North Platte River and its tributaries above Pathfinder Dam, for the irrigation of more than a total 168,000 acres of land during irrigation season.*
2. *Exclusive of the Kendrick Project and Seminoe Reservoir, the state of Wyoming is enjoined from storing more than 18,000 acre-feet of water from the North Platte River and its tributaries above the Pathfinder Reservoir for irrigation during any 1 year.*
3. *The storage rights of the Pathfinder, Guernsey, Seminoe, and Alcova Reservoirs are junior to 1,165 cubic feet per second (cfs) for the irrigation of land in western Nebraska, and the state of Wyoming is enjoined from storing or permitting the storage of water in these reservoirs otherwise than in accordance with the rule of priority.*
4. *The natural flow of the North Platte River in the section of the river between the Guernsey Dam and Tri-State Dam, or approximately the Wyoming-Nebraska state line, between May 1 and September 30 of each year, is apportioned 25 percent to Wyoming and 75 percent to Nebraska.*

The 1945 decree also limited the amount of irrigated acres, water storage, and diversions annually within the North Platte River Basin in Colorado [SEO, 2006a]. Subsequently, the 1945 decree was amended in 1953 with a stipulation agreed to by the three states and approved by the US Supreme Court, which increased the irrigated acreage in Colorado and permitted Wyoming and Nebraska to store water in Glendo Reservoir [SEO, 2006a]. In 1986, Nebraska filed a lawsuit in the US Supreme Court alleging that Wyoming had violated the 1945 decree, which reopened the decree and resulted in the US Supreme Court approving the Final Settlement Stipulation. The US Supreme Court also ordered the Modified North Platte Decree in 2001 that replaced the 1945 decree and its 1953 modification [Supreme Court of the United States, 2001; SEO, 2006a; Trihydro, 2006; Purcell, 2014].

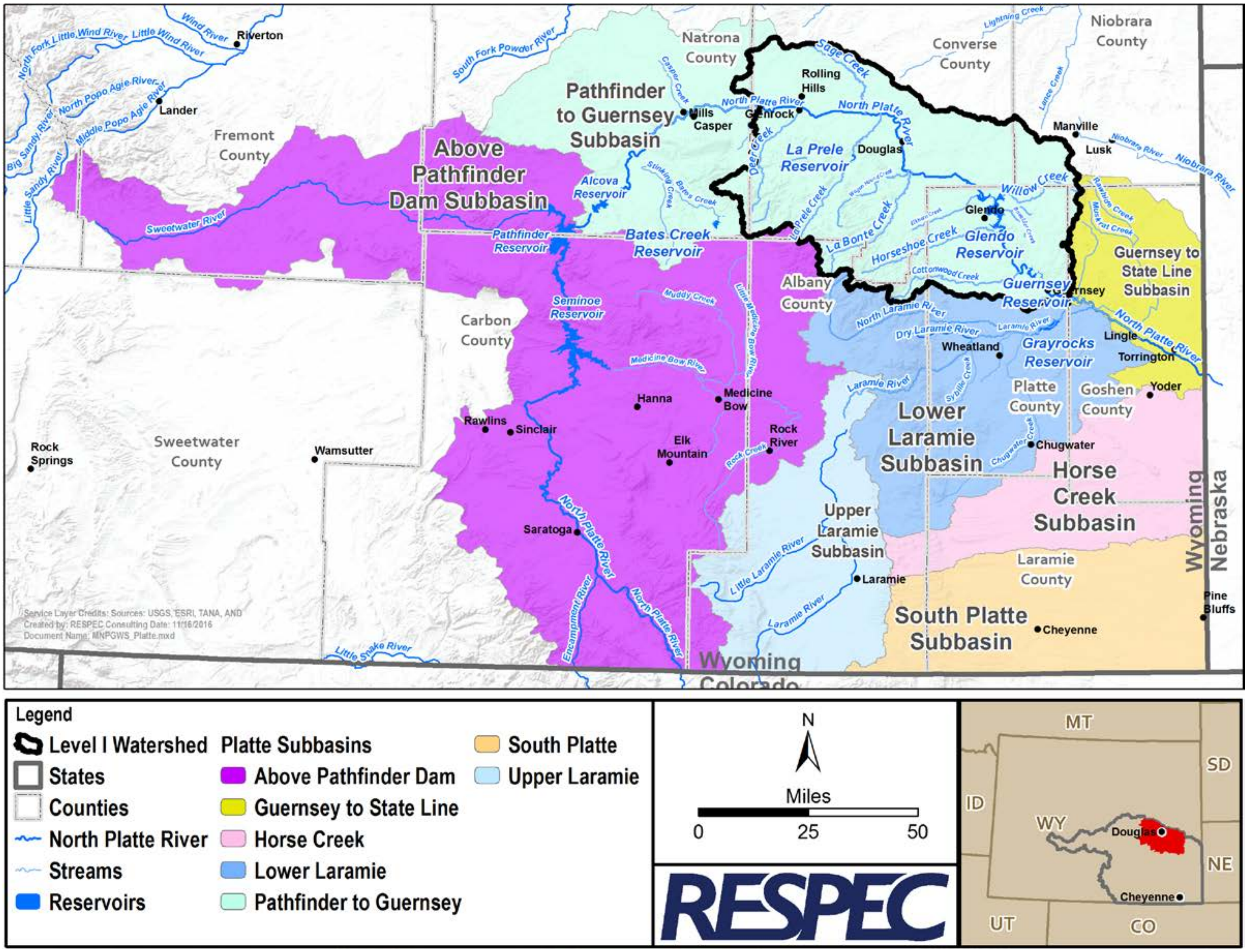


Figure 1.2 Middle North Platte–Glendo Watershed's Location Within the Platte Basin.

More information about the Final Settlement within the North Platte Basin can be found in Appendix A, *Settlement of the Nebraska v. Wyoming Law Suit, North Platte River Basin Planning Study*, prepared by Mike Purcell, past Director of the WWDC [Purcell, 2014]. A brief summary of the provisions in the 1945 North Platte Decree and 2001 Modified Decree include, but are not limited to the following [Supreme Court of the United States, 2001; SEO, 2006a; Trihydro, 2006; Purcell, 2014]:

1. Exclusive of the Kendrick Project, for the North Platte River and its tributaries upstream of Guernsey Reservoir including water from hydrologically connected groundwater wells, Wyoming is enjoined from intentionally irrigating more than a total of 226,000 acres of land during any one irrigation season. Ten years following the settlement date, this provision will be replaced with two injunctions: one intentionally irrigated limitation for the area above Pathfinder Reservoir and one for the area between Guernsey Reservoir and Pathfinder Reservoir. The total of the two shall not exceed 226,000 acres.

2. The storage limitation injunction from the 1945 Decree is unchanged in the 2001 Modified North Platte Decree: Wyoming is enjoined from storing or permitting the storage of more than 18,000 acre-feet of water for irrigation purposes upstream of Pathfinder Reservoir exclusive of Seminoe Reservoir during any 1 year.

3. The priority for filling the federal reservoirs was: 1) Pathfinder Reservoir; 2) Guernsey Reservoir; 3) Seminoe Reservoir; 5) Alcova Reservoir; and 6) Glendo Reservoir. *(The Inland Lakes were not included in this list.)*

The 2001 Decree's acreage limitations include water from hydrologically connected groundwater wells. These wells are defined as being located and constructed such that if water were intentionally withdrawn by the well continuously for 40 years, the cumulative stream depletion would be greater than or equal to 28 percent of the total groundwater withdrawn by that well [Supreme Court of the United States, 2001]. The SEO has developed "Green Area" maps that delineate areas where groundwater resources are considered nonhydrologically connected to the river and its tributaries under the 2001 Decree, the Wyoming Depletions Plan, and the Platte River Recovery Implementation Program (Program) [SEO, 2015]. The study area is located in the "Alcova to Guernsey" "Green Area" map and is available at the SEO website (*http://seo.wyo.gov/documents-data/maps-and-spatial-data*). Additional information about the "Green Area" within the study area is included in Section 3.6.1.6.

The Final Settlement Stipulation and the 2001 Modified North Platte Decree contain many provisions and several articles that pertain to the interstate apportionment of water in the North Platte River. For additional information regarding the 2001 Modified North Platte Decree, visit the SEO's website (*http://seo.state.wy.us/*). Also, the SEO's Interstate Streams Division compiled documents regarding interstate streams into a report titled *Wyoming's Compacts, Treaties, and Court Decrees* (*https://sites.google.com/a/wyo.gov/seo/seo-files/Wyoming_Compacts_Treaties_Decrees.pdf*). The report includes a summary of the North Platte Decree, modifications, and final settlement stipulations for water-rights administration and consumptive use limitations [SEO, 2006a]. More information can be obtained, if needed, by contacting the SEO North Platte Coordinator.

Water users upstream of Pathfinder Reservoir have long been concerned about water-rights administration for the benefit of Seminoe and Pathfinder Reservoirs and that the Pathfinder

Modification Project (PMP) would result in additional allocation years and, therefore, cause additional regulation in the nonirrigation season [Purcell, 2014]. The water users formally protested the US Bureau of Reclamation's (USBR) application to the Wyoming Board of Control to change part of the use of the storage right for Pathfinder Reservoir needed to implement the PMP [Purcell, 2014]. However, this matter was resolved in a Stipulation and Settlement Agreement, dated October 16, 2008, between the Upper North Platte Valley Water Users, the Upper North Platte Valley Water Conservation Association, the USBR, and the Wyoming Water Development Office (WWDO) [Purcell, 2014].

1.3.2 Platte River Recovery Implementation Program

This section was authored by Mr. Michael K. Purcell, past Director of the WWDC [Purcell, 2014; RESPEC and ACE, 2014]. More information about the Final Settlement is included in Appendix A, *Settlement of the Nebraska v. Wyoming Law Suit, North Platte River Basin Planning Study*, [Purcell, 2014].

> *The Endangered Species Act (ESA) and the critical habitat for whooping cranes, piping plover, and least terns in the Central Platte River in Nebraska has impacted water management and development in the North Platte River Basin since the 1970s. Therefore, the states of Wyoming, Nebraska, and Colorado entered into a cooperative agreement in 1997 for the Platte River Recovery Implementation Program (referred to as the Program) with the US Department of Interior (USDI). The states became interested in the Program when it became apparent that the ESA provided the US Fish and Wildlife Service (USFWS) with the authority to require replacing existing depletions until it achieved its water-supply goal of 417,000 acre-feet per year for critical habitat in the Central Platte River in Nebraska [RESPEC and ACE, 2014]. The USFWS could also assess fees to acquire 29,000 acres of habitat in the Central Platte River [Purcell, 2014; RESPEC and ACE, 2014].*
>
> *The Program serves as a reasonable alternative under the ESA for irrigation, municipal, industrial, and other water uses in place on or before July 1, 1997 [Purcell, 2014; RESPEC and ACE, 2014]. Without the Program, the USFWS could use the ESA consultations required for future federal actions (permits including renewals, funding, contracts, easements) to require water users to replace existing and new depletions until the water goals were met [Purcell, 2014; RESPEC and ACE, 2014]. The goal of the Program is to provide approximately 150,000 acre-feet of water and 10,000 acres of habitat in the Central Platte River [USDI, 2006; Purcell, 2014; RESPEC and ACE, 2014]. Additionally, the states agreed to curtail new depletions. In Wyoming, the Platte Basin is fully appropriated, which means that there are more water rights than there is water in dry and some average years [Purcell, 2014; RESPEC and ACE, 2014]. Therefore, water rights with a current priority would not produce a reliable water supply and would likely need to transfer water rights from other uses to secure that supply [Purcell, 2014; RESPEC and ACE, 2014].*
>
> *Each state wrote a depletion plan that explained existing and future depletion management as part of the cooperative agreement [USDI, 2006]. The Wyoming Depletions Plan (referred to as the Plan) identifies existing and new water-related activities that are covered by the Program [SEO, 2006b]. The goal of the Plan is to provide coverage for*

depletions that were authorized by existing, valid Wyoming water rights with a priority date before July 1, 1997. The Plan also addresses new depletions if they do not exceed 20 acre-feet per year [Purcell, 2014]. The SEO's North Platte River Coordinator is responsible for determining the depletions covered by the Plan, identifying new depletions requiring mitigation, and approving mitigation plans for new depletions [RESPEC and ACE, 2014].

1.4 STUDY ISSUES AND UNDERSTANDING

This Level I watershed study provides a comprehensive description and preliminary analysis of the Middle North Platte–Glendo Watershed and includes the Watershed Management and Rehabilitation Plan, which is included in Chapter 4.0 of this report. The Watershed Management and Rehabilitation Plan outlines the proposed practical and feasible alternatives that address water- and land-resource issues and concerns. The expectation of the local sponsor (CCCD); neighboring conservation districts, including the Platte County Resource Districts (PCRD), Niobrara Conservation District (NCD), Laramie Rivers Natural Resource District (LRCD), Natrona County Conservation District (NCCD), and the Lingle-Ft. Laramie Conservation District (LFLCD); and the WWDC was to identify water development opportunities within the study area. In developing the Watershed Management and Rehabilitation Plan, the consultant worked with the local sponsors, the WWDO, and several study participants to address the key issues within the watershed, as listed in Table 1.1.

Table 1.1. Key Issues Within the Watershed and Applicable Report Sections

Key Issues Within the Watershed	Applicable Section(s) of the Report
Surface-water availability and storage opportunities	3.6.2 Surface Water 3.9 Water Storage 4.6 Surface-Water Storage Opportunities
Irrigation system inventory and potential improvements	3.4.3 Irrigation 3.4.7 Irrigation Inventory 4.3 Irrigation System Proposed Projects 6.1 Irrigation System Components Cost Estimates
Rangeland and grazing inventory and potential improvements	3.3.3 Land Cover 3.3.4 Vegetation 3.4.8 Grazing 4.4 Livestock/Wildlife Watering Opportunities 4.5 Grazing Management Opportunities 6.2 Livestock/Wildlife Water Components
Wetland and riparian area restoration and channel stability	3.3.3 Land Cover 3.3.4 Wetlands 3.7 Stream Geomorphology 4.7 Channel Stability Opportunities 4.8 Wetlands Enhancement Opportunities

1.5 PURPOSE AND SCOPE

The purpose of this Level I watershed study was to combine available data and information with study-generated inventory data to develop a comprehensive watershed management and rehabilitation plan that outlines proposed and potential water development opportunities. To accomplish this effort, the following objectives were completed:

- Foster communication among residents and landowners, the local sponsors (CCCD, PCRD, NCD, LRCD, NCCD, and LFLCD), and the WWDC
- Solicit public participation in the watershed study
- Inventory and evaluate the watershed with emphasis on surface-water quantity and quality in addition to upland and riparian ecological conditions
- Perform a geomorphic classification of the major tributaries in the study area to identify impaired reaches and improvement options to restore channel stability
- Assess existing irrigation systems and generate rehabilitation alternatives for the irrigators participating in the study
- Evaluate existing surface-water features, storage requirements, and potential opportunities to improve water availability for livestock and wildlife
- Prepare a watershed Management and Rehabilitation Plan that includes problem areas and proposes improvement alternatives within the watershed
- Identify permits, easements, and clearances necessary for plan implementation
- Estimate costs for proposed improvement alternatives and potential projects
- Complete an economic analysis and identify potential sources of funding.

2.0 PROJECT MEETINGS

2.1 INTRODUCTION

Public involvement and landowner participation were important elements of the Middle North Platte–Glendo Watershed Study effort because of the amount and complexity of the water and land issues and concerns within the study area. Therefore, considerable emphasis and time was placed on this aspect of the study. RESPEC was awarded the contract in June 2015 and began gathering background information and preparing for planned scoping meetings.

2.2 SCOPING MEETINGS, OPEN HOUSES, AND COORDINATION MEETINGS

Scoping meetings, landowner open houses, landowner meetings, and on-site field visits were conducted by RESPEC and ACE staff in cooperation with the CCCD, NCD, PCRD, WWDO, and Natural Resources Conservation Service (NRCS). Scoping meetings, landowner open houses, landowner meetings, and field visits were coordinated by RESPEC with assistance from CCCD, PCRD, WWDO, and NRCS. Table 2.1 lists the meetings conducted during the watershed study. Scoping meetings typically included formal presentations conducted by RESPEC staff. The objectives of the scoping meeting, landowner open houses, and landowner meetings included the following:

- Discuss the purpose, existing data, and available information for the watershed study
- Obtain input and opinions from residents and landowners about the study area
- Identify concerns and answer questions regarding the area's water and land resources
- Request participation in the study effort and coordinate inventory activities
- Present initial results and preliminary findings from the watershed study.

Invitations to the two scoping meetings (held in Douglas and Glendo) and three open houses (held in Douglas, Wheatland, and Lusk) for the watershed study were sent to more than 1,100 addresses within the watershed on three different occasions. The scoping meetings and open houses were also advertised in the local newspapers, including the *Douglas Budget*, *Glenrock Independent*, *Platte County Record-Times*, *Guernsey Gazette*, *Lusk Herald*, and the *Wyoming Livestock Roundup*. Additionally, announcements for the scoping meetings and open houses were included in the conservation district newsletter mailings. The CCCD created a webpage on their website (*http://www.conserveconverse.org/*), as shown in Figure 2.1, which included information about the Level I watershed study.

During the scoping meetings in Douglas and Glendo in the fall of 2015, as shown in Figures 2.2 and 2.3, RESPEC representatives summarized the study's purpose and outlined tasks. Maps were generated with available GIS data and were presented to inform attendees of study progress. Some questions were asked by attendees that were answered during the meetings, but most discussions took place between the attendees and representatives from local sponsors and partners after the meeting. A total of 12 landowners attended the scoping meeting in Douglas, and 24 landowners attended the scoping meeting in Glendo.

Table 2.1. Scoping, Sponsor, and Coordination Meetings

Date	Type	Location
July 20, 2015	Coordination Meeting	Conference Call
August 6, 2015	Local Sponsor Meeting	PCRD Office, Wheatland
August 26, 2015	Scoping Meeting	Eastern Wyoming College, Douglas
September 7, 2015	Irrigation District Meeting	LID Office, Douglas
September 8, 2015	Local Sponsor Meeting	PCRD Office, Wheatland
September 8, 2015	Site Visit	LaPrele Reservoir and LID System
September 23, 2015	Scoping Meeting	Glendo Town Hall
September 24, 2015	Site Visit	Chamberlain Reservoir and LID System
October 14, 2015	Landowner Meeting	Twin Pine Ranch
March 5, 2016	Irrigation District Meeting	Converse County Courthouse, Douglas
March 8, 2016	Open House	CCCD Office, Douglas
March 9, 2016	Open House	PCRD Office, Wheatland
March 15, 2016	Open House	NCD Office, Lusk
May 25, 2016	Landowner Meeting	Clark-Mares Ranch
May 25, 2016	Landowner Meeting	Howrey Ranch
May 26, 2016	Landowner Meeting	Collins Ranch
May 26, 2016	Landowner Meeting	Miller Ranch
June 1, 2016	Landowner Meeting	Middle Bear Ranch
June 1, 2016	Landowner Meeting	Hoopman Farm
June 15, 2016	Project Meeting and Tour	CCCD Office and LID Diversion
June 22, 2016	Landowner Meeting	Blue Downey Reservoir
June 23, 2016	Landowner Meeting	Sharptail LLC/Wyohoma Properties
July 13, 2016	Coordination Meeting	SEO Office, Douglas
July 14, 2016	Coordination Meeting	CCCD Office, Douglas
July 14, 2016	Coordination Meeting	LID Office, Douglas
August 24, 2016	Landowner Meeting	Horseshoe Valley Ranch
August 24, 2016	Landowner Meeting	Twiford Ranch
August 25, 2016	Coordination Meeting	LID Office, Douglas
August 25, 2016	Landowner Meeting	Prado Property
August 25, 2016	Landowner Meeting	Johnson Ranch
September 12, 2016	Local Sponsor Meeting	Conference Call
September 15, 2016	Landowner Meeting	Easy Acres Farm
September 15, 2016	Landowner Meeting	Mercer/Wolfley Property
September 16, 2016	Landowner Meeting	Sarvey Property
September 16, 2016	Landowner Meeting	Rodeman Ranch

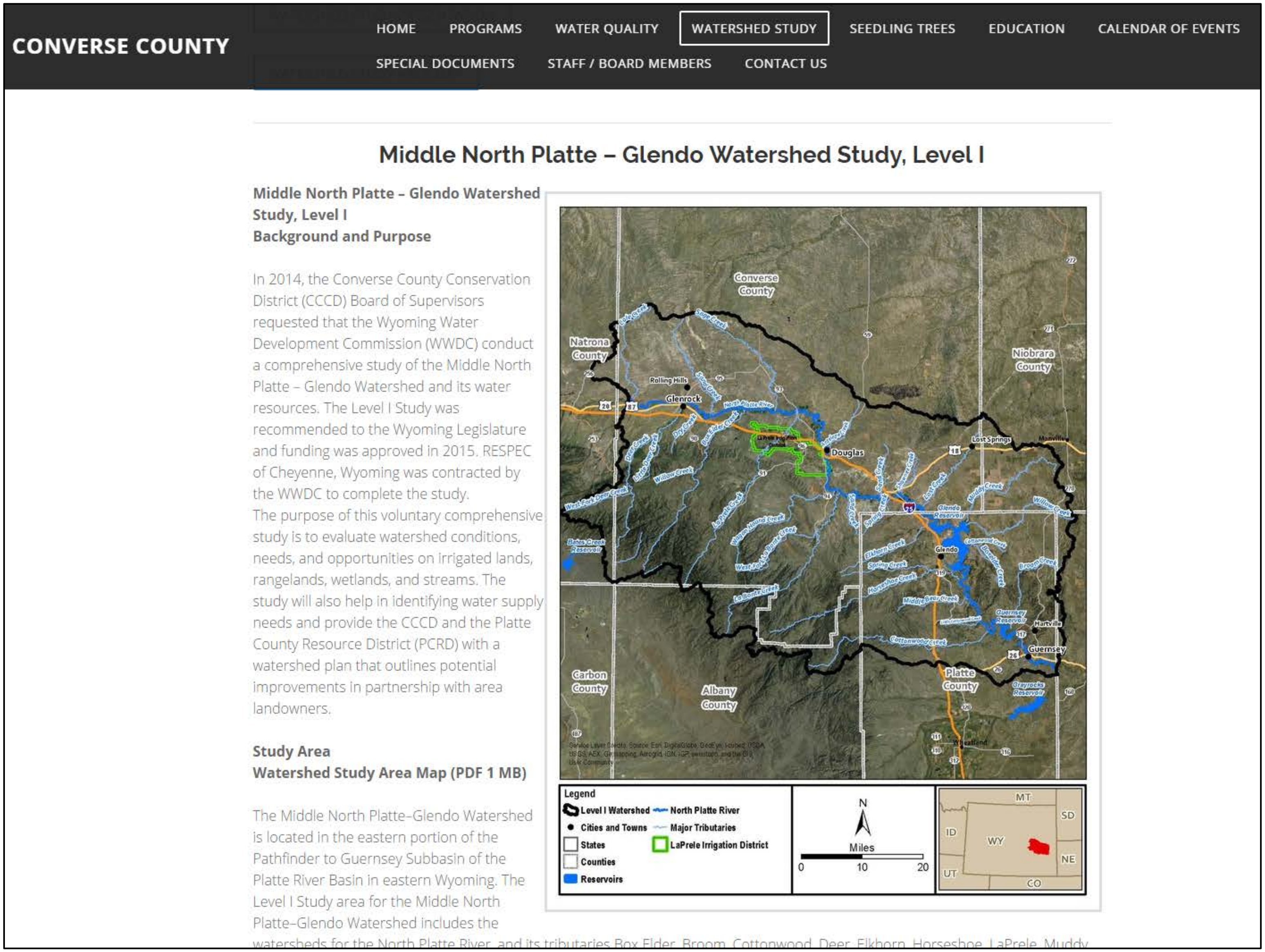


Figure 2.1 Converse County Conservation District's Website With the Level I Study Information.

Figure 2.2. Level I Study Scoping Meeting in Douglas, Wyoming.

Figure 2.3. Level I Study Scoping Meeting in Glendo, Wyoming.

In the spring of 2016, three open houses were held in Douglas, Wheatland, and Lusk. Thirteen landowners attended the open houses. During the open houses, landowners discussed their concerns and potential projects with the consultant and representatives from the CCCD, PCRD, NCD, WWDO, and/or NRCS. Consultant staff presented maps, explained findings, and described alternatives.

In addition to the scoping meetings and landowner open houses, the LaPrele Irrigation District (LID) held their annual meeting at the Converse County Courthouse in Douglas on March 5, 2016, and invited representatives from RESPEC to discuss potential alternatives for improving water storage and irrigation water delivery within the study area. The consultant handed out maps, explained the study's purpose, and described potential projects. During the presentation, some questions were asked by attendees but more discussions took place between the attendees and the consultant after the meeting. Twenty-five irrigators attended the LID's annual meeting in Douglas. Additionally, the consultant attended the CCCD, PCRD, and the LaPrele Irrigation District board meetings periodically during the study.

2.3 LANDOWNER MEETINGS AND FIELD VISITS

RESPEC staff met with 13 landowners during 3 open houses and met with 17 landowners during field visits. During a scoping meeting or open house, landowners invited the consultant, CCCD, PCRD, NCD, or NRCS staff to discuss their project. Field visits were then scheduled at the landowners' residence or property where discussions focused on their land- and water-resource issues. Typically, the landowner gave a tour of the property to the consultant. During these visits, preliminary planning and conceptual designs were discussed for potential projects.

For efficiency, field inventory efforts were conducted in coordination with planned meetings, open houses, district board meetings, and landowner visits. Field activities focused on irrigation inventory, upland livestock/wildlife water opportunities, riparian and stream-channel conditions, dam and reservoir assessment, and hydrologic investigations. Throughout the study, local ranchers, irrigators, and residents who discussed issues and concerns with the consultant staff demonstrated comprehensive knowledge and valuable insight about the watershed. Because of the willingness of landowners to share information and insight, the study team was able to incorporate this knowledge and experience into the study and provide a more effective evaluation of the watershed.

3.0 WATERSHED DESCRIPTION AND INVENTORY

3.1 INTRODUCTION AND PURPOSE

A substantial amount of information exists about the land and water resources within the Middle North Platte–Glendo Watershed. The objective of the watershed description and inventory task was to gather, review, and compile data and findings in existing databases, studies, and reports regarding the resources within the study area into a digital library and geographic information system (GIS) geodatabase. This material was then used to describe, characterize, and summarize key features; identify problems or issues; and outline water-development opportunities and improvement alternatives within the watershed.

This description and inventory chapter covers many of the study area's natural resources including history, land use, land ownership, transportation, irrigation, energy, climate, hydrology, geology, soils, and vegetation. Brief reviews of the current conditions of natural resources in the area are also included. Specifically, the soil, vegetative, hydrologic, agricultural, urban, and wildlife data were mapped, analyzed, and summarized. In addition to the mapped features of the watershed, summary tables are included for several attributes.

3.2 DATA COLLECTION AND MANAGEMENT

3.2.1 Collection of Existing Information

The following sections discuss the data sources and the associated management. A significant amount of data, plans, and reports regarding the land and water resources were collected as part of the study. Much of this information is obtainable from local, state, and federal personnel and websites. During this study, representatives of private, local, state, and federal organizations were contacted in person, by telephone, or via email to request available data and to verify the datasets downloaded from websites. The list below includes the organizations that were contacted and/or accessed for data collection as part of the study effort:

- Albany County
- Converse County
- Goshen County
- Niobrara County
- Natrona County
- Platte County
- The Nature Conservancy
- Wyoming Water Development Commission (WWDC)
- Wyoming Department of Environmental Quality (WDEQ)
- Wyoming State Engineer's Office (SEO)
- Wyoming Department of Transportation (WYDOT)

- Wyoming Game and Fish Department (WGFD)
- Wyoming State Geological Survey (WSGS)
- Wyoming Geographic Information Science Center (WyGISC)
- Wyoming Oil and Gas Conservation Commission (WOGCC)
- Wyoming Office of State Lands and Investments (OSLI)
  - Wyoming State Board of Land Commissioners (SBLC)
  - Wyoming State Loan and Investment Board (SLIB)
- Wyoming State Historic Preservation Office (SHPO)
- Wyoming Wildlife and Natural Resources Trust (WWNRT)
- US Department of Agriculture (USDA)
  - Farm Service Agency (FSA)
  - US Forest Service (USFS)
  - Natural Resource Conservation Service (NRCS)
- US Environmental Protection Agency (EPA)
- US Department of the Interior (USDI)
  - US Bureau of Reclamation (USBR)
  - US Geological Survey (USGS)
  - National Park Service (NPS)
  - Bureau of Land Management (BLM)
  - US Fish and Wildlife Service (USFWS).

3.2.2 Geographic Information System

The data collected for this study was compiled into a GIS using ESRI's ArcGIS 10.3. This format allows the data to be visualized, analyzed, compared, and evaluated to interpret and understand many resource attributes. GIS helps with integrating the spatial and tabular data in conjunction with linking spreadsheets, reference documents, photographs, and field data and allows for centralized storage. As part of the GIS, an ESRI ArcMap document ("mxd" file extension) was created for sponsors and other ArcGIS software users.

The data in the study's GIS is stored in an easily accessible file structure that uses a geodatabase format with feature datasets and feature classes to represent geographic locations and attributes for geometric features represented by points, lines, and polygons. All feature classes are in the North American Datum (NAD) of 1983 Universal Transverse Mercator (UTM) Zone 13 North projected coordinate system that can be measured in several geographic coordinate systems including decimal degrees.

The spatial data gathered during the study were obtained from Albany, Converse, Goshen, Niobrara, and Platte Counties, as well as the SEO, WDEQ, WyGISC, NPS, BLM, USGS, NRCS, WGFD, USFS, and others. In addition, spatial data were collected and developed in association with landowners and participants. Table 3.1 lists the datasets, maps, and imagery included in the study's GIS. The GIS can also be used for

Table 3.1. Feature Datasets and Classes Contained in the Study's Geographic Information System (Page 1 of 5)

Feature Dataset	Feature Class	Feature Dataset	Feature Class
Basin Plan	gagingstations_05	MNP_Glendo_ Upland_ Sources	LW_Proposed_Projects_Central
	Irrigation_Districts		LW_Proposed_Projects_Locations
	MNP_Glendo_PLThuc6basins		NON_Viable_Wells_Springs_Ponds_Resvrs
	opportunities_05		SEO_Permitted_Reservoirs_LW_Ponds_ Reservoirs
	Pathfinder_Guernsey_ PLTSubbasins		Viable_Springs_Ponds_Reservoirs
	PLT_Golf_Course_Poly		Viable_Springs_Ponds_Reservoirs_Buffer
	PLThuc4basins		Viable_Wells
	PLThuc4watershed		Viable_Wells_Buffer
	PLThuc6basins	MNPGWS	All_geotagged_photos_10_08_2016
	PLThydro100k_mnp_glendo		gps_field_pts_utmz13_NAD83
	PLTSubbasins		LW_Existing_and_Proposed_Project_Lines
	POD_05		LW_Existing_and_Proposed_Projects
	Reservoirs_05		LW_Proposed_Projects
Boundaries	Conservation_Districts_mnp_ glendo		LW_Proposed_Projects_Locations
	Conservation_Districts_WY		LW_Existing_and_Proposed_Project_Lines
	Project		LW_Existing_and_Proposed_Projects
Climate	AveMaxTemp_1981_2010		LW_Existing_Projects
	AveMinTemp_1981_2010		LW_Existing_Reservoirs_Ponds
	AvePrecip_1981_2010		LW_Proposed_Projects
	AvePrecip1971_2000	Natrona_ County	NC_Address
	precip_a_wy		NC_Roads
	Weather_Stations		NC_Subdivisions
	Weather_Stations_mnp_ glendo	NHD_2016	HYDRO_NET_Junctions_mnpglendo
Cultural	historic_pt_NPS		NHDArea_mnpglendo
	Monuments_and_Markers		NHDFlowline_mnpglendo
	Pioneer_Trails		NHDLine_mnpglendo
	SHPO_Cultural_Sites_2016		NHDPoint_mnpglendo

Table 3.1. Feature Datasets and Classes Contained in the Study's Geographic Information System (Page 2 of 5)

Feature Dataset	Feature Class	Feature Dataset	Feature Class
Energy	Pipelines	NHD_2016 (continued)	NHDPointEventFC_mnpglendo
	Power_Generation		NHDWaterbody_mnpglendo
	Power_Generation_mnpglendo	Oil_Gas	BLM_Leases_authorized
	powerlines_WUS_CAN_sgca		EPCA_Oil_and_Gas_Fields
	Wind_Projects		WOGCC_Permanently_abandoned
	Wind Projects		WOGCC_Permanently_abandoned_mnp_glendo
	Active_LQD_Permits_mnpglendo		WOGCC_Well_Head
	Wyoming_Active_Coal_Permit_Boundaries_February_2015		WOGCC_Well_Head_mnp_glendo
	Wyoming_Coal_Fields_2014		Oil_Gas_areal_fields_2012
	Wyoming_Coal_Outcrops_2014		Oil_Gas_point_fields
Geography	Cities	Other	NWIS_WQFeatures_mnp_glendo
	Cities_mnp_glendo		wrds_all_mnp_glendo
	Cities_other	Parcels	MNP_Glendo_Participants_10_01_2016_parcels
	Counties		parcels_2011_platte
	Counties_mnp_glendo		parcels_2014_converse
	MNP_Glendo_Counties		parcels_2014_natrona
	MNP_Glendo_Districts		parcels_2015_albany
	Municipal_Boundaries		parcels_2015_goshen
	quad_map_24k_index		parcels_2015_niobrara
	section24k_mnp_glendo	Soils	ESD_mnp_glendo_FINAL
	States		soilmu_a_wyALL_comp_mnp_glendo_textures
	tr24k_mnp_glendo		soilmu_a_wyALL_comp_mnp_glendo
	tr24k_mnp_glendo_intersect		STATSGO2_MUN_mnp_glendo
	UTM	Transportation	Major_Highways
Geology	Bedrock_Geology		Major_Highways_mnp_glendo
	Bedrock_Geology_500k		railroads

Table 3.1. Feature Datasets and Classes Contained in the Study's Geographic Information System (Page 3 of 5)

<table>
<tr><th>Feature Dataset</th><th>Feature Class</th><th>Feature Dataset</th><th>Feature Class</th></tr>
<tr><td rowspan="6">Geology (continued)</td><td>Bedrock_Geology_500k_mnp_glendo</td><td rowspan="3">Transportation (continued)</td><td>road100k_mnp_glendo</td></tr>
<tr><td>Faults_mnp_glendo</td><td>WYDOT_County_Roads</td></tr>
<tr><td>Faults_WY</td><td>WYDOT_Highways</td></tr>
<tr><td>Surficial_Geology_500k_mnp_glendo</td><td rowspan="9">Water_Rights</td><td>POD_WR_Div1_Dist_1114155203_mnpglendo</td></tr>
<tr><td>WY_Landslides</td><td>POD_WR_Div1_Dist_1114155203_mnpglendo_5cfs</td></tr>
<tr><td>WY_Landslides_mnp_glendo</td><td>POD_WR_Div1_Dist_1114155203_mnpglendo_5cfs_stream</td></tr>
<tr><td rowspan="9">Habitat</td><td>AquaticCrucial_hp09</td><td>POD_WR_Div1_Dist_1114155203_mnpglendo_reservoirs</td></tr>
<tr><td>AquaticEnhancement_hp09</td><td>POD_WR_Div1_Dist_1114155203_mnpglendo_reservoirs_adjudicated_complete</td></tr>
<tr><td>CombCrucial_hp09</td><td>POD_WR_Div1_District_11_14_155_20_3</td></tr>
<tr><td>CombEnhancement_hp09</td><td>POD_WR_Div1_mnpglendo_reservoirs_1_20AF</td></tr>
<tr><td>CriticalStreamCorridors</td><td>POD_WR_Div1_mnpglendo_reservoirs_1_20AF_nodups</td></tr>
<tr><td>KNWA</td><td>POD_WR_Div1_mnpglendo_reservoirs_20_1000AF</td></tr>
<tr><td>TerrestrialCrucial_hp09</td><td rowspan="5">Wells</td><td>SEOWells_09_mnp_glendo</td></tr>
<tr><td>TerrestrialEnhancement_hp09</td><td>SEOWells_2015_mnp_glendo</td></tr>
<tr><td>WGFD_Streams_Blue</td><td>SEOWell5_2015_mnp_glendo_complete_adjudicated</td></tr>
<tr><td rowspan="4">Hydrography</td><td>PreviouslyProposed_Reservoirs</td><td>SEOWells_2015_mnp_glendo_STK</td></tr>
<tr><td>StockReservoirs_Glendo</td><td>AlcovatoGuernsey_Reservoir_Green_Areas</td></tr>
<tr><td>CONUS_wet_poly_mnp_glendo</td><td rowspan="2">Wildlife</td><td>ant05mb</td></tr>
<tr><td>Division2_WR_ALL_NoRep</td><td>ant08mr</td></tr>
<tr><td rowspan="3">Hydrography (continued)</td><td>mnp_glendo_Rosgen</td><td rowspan="3">Wildlife (continued)</td><td>ant12cr</td></tr>
<tr><td>MNP_Glendo_SEO_WR_05_10_2016</td><td>ant12hh</td></tr>
<tr><td>mnp_glendo_streams</td><td>ant12pa</td></tr>
</table>

Table 3.1. Feature Datasets and Classes Contained in the Study's Geographic Information System (Page 4 of 5)

Feature Dataset	Feature Class	Feature Dataset	Feature Class
Hydrography (continued)	NHD_Major_Reservoirs	Wildlife (continued)	ant12sr
	NHD_Major_Reservoirs_mnpglendo		bbrllhm
	NHD_Named_Reservoirs_mnpglendo		bhs05mb
	NHD_Streamgages		bhs08mr
	nhdflowline		bhs12cr
	NHDflowline_all		bhs12hh
	NHDflowline_Ditches		bhs12pa
	NHDflowline_Ditches_5cfs		coreareas_v3_062910_mnp_glendo
	NHDflowline_fisheries		corev4_072915_final_mnpglendo
	NHDflowline_named		devhab_mnp_glendo
	NHDflowline_perennial		elk05mb
	nhdwaterbody		elk08mr
	Reservoirs		elk12cr
	Reservoirs_points		elk12hh
	SEO_gages		elk12pa
	streams_other		elk12sr
	streams_outside_mnp_glendo		leks_lam_mnp_glendo
	WetlandComplexes2010		mdr05mb
	WY_Wetlands_Project_ Metadata_mnp_giendo		mdr08mr
Hydrologic_ Units	MNPC_HUC12		mdr12cr
	WBD_HUC10		mdr12hh
	WBD_HUC10_Project		mdr12pa
	WBD_HUC12		mdr12sr
	WBD_HUC6		mln12hm
	WBD_HUC8		moo05mb
Infrastructure	cellular_WY		moo06mr
	FCC_asr		moo12cr
	FCC_cellular_towers		moo12hh
	FCC_microwave		moo12pa

Table 3.1. Feature Datasets and Classes Contained in the Study's Geographic Information System (Page 5 of 5)

Feature Dataset	Feature Class	Feature Dataset	Feature Class
Infrastructure (continued)	Major_Roads	Wildlife (continued)	moo12sr
	railroads_wy		rmg06mr
	road100k		rmg12cr
	transmission_wy		rmg12hh
Irrigation	Irrigated_Land_WY		rmg12pa
	Irrigated_Land_WY_mnp_glendo		rmg12sr
	LaPrele_Irrigation_District		sghab_mnp_glendo
	POD_mnp_glendo		wtd05mb
	SEO_Divl_Districts		wtd06mr
Land_Management	agland_mnp_glendo		wtd12cr
	agland_ni_ir_mnp_glendo		wtd12hh
	Agriculture_Grazing_Allotments_USFS		wtd12sr
	Agriculture_Grazing_Allotments_USFS_mnp_glendo		WY_Raptors_mnp_glendo
	BLM_Allotments_WY		WyomingCurrentRange2015
	BLM_Allotments_WY_mnp_glendo		WYSagegrouse_currentdistribution_1
	BLM_AMBU		WYSagegrouse_currentdistribution_mnp_glendo
	BLM_Land_Ownership_24k_nad83	Raster	LANDFIRE_EVT_mnp_glendo
	blm_right_of_way		LANDFIRE_EVT_mnp_glendo_riparian_wetland
	blm_right_of_way_closed		nlcd_2011_mnp_glendo
	ConservationDist		WY_Landcover_GAP_Analysis
	Surface_Management		WY_Landcover_GAP_mnp_glendo
	Surface_Fed_Min_2013		WY_Landcover_GAP_mnp_glendo_riparian
	Surface_Fed_Min_2013_mnp_glendo		
	Surface_Lands		
	USFS_Ranger_Districts_mnp_glendo		
	WY_BLM_FIELD_OFFICE_BOUNDARIES		

future planning efforts, such as completing permits, environmental assessments, program applications, and project mapping. Because the datasets are updated periodically, future users are encouraged to obtain the latest datasets from the original sources.

3.2.3 Digital Library

The study's digital library includes reference documents, maps, figures, spreadsheets, and images collected and produced during the study. The digital library contains a list of all of the available documents that can be viewed by clicking the links, searching for keywords, or browsing the library.

3.3 SETTING AND ENVIRONMENT

The setting and environment for the watershed are discussed in the following sections.

3.3.1 Topography

The Middle North Platte–Glendo Watershed covers parts of the Western Great Plains Range and Irrigated Region and a portion of the Rocky Mountain Range and Forest Region, with varied topography including rugged mountains, mountain valleys, rolling plains, plateaus and buttes, terraces and alluvial fans, and river valleys. Elevations range from 4,280 feet above mean sea level (msl) at the Platte–Goshen county line on the North Platte River to approximately 10,036 feet msl at Laramie Peak.

3.3.2 Climate

The wide-ranging topography of the watershed results in a variable climate with typical annual precipitation rates ranging from 9 inches per year (in/year) in the northwest and central basin to over 30 inches per year in the Laramie Mountains in the southwestern portion of the watershed. Maximum precipitation occurs as rain in the spring and early summer months, likely as a result of thunderstorms or cold fronts moving through the study area. A drier period typically occurs from August through October with the remaining precipitation accumulating as snowfall from November through May. Data from the Parameter-Elevation Regressions on Independent Slopes Model (PRISM) were used to display the average annual precipitation in and surrounding the watershed as shown in Figure 3.1.

The watershed has a variable climate, including a short growing season of 100 days at the Glenrock 14 SSE (483960) meteorological station to a growing season of 149 days at the Guernsey Dam No. 2 (484126) meteorological station. A total of 21 historic and current National Weather Service Cooperative Observer Network (COOP) stations are located within the study area, 6 of which are under current operation. Figure 3.2 overlays the period of record for each meteorological station, and their locations are illustrated in Figure 3.1.

Climatic data were obtained for five meteorological stations that are chosen because of their period of record, available data, and location, from the website (*http://www.wrcc.dri.edu/summary/Climsmwy.html*) or accessible through the University of Wyoming's Water Resources Data System (WRDS) (*http://www.wrds.uwyo.edu/sco/data/datamap.html*). Table 3.2 summarizes the climatic data by month and by station, while Figure 3.3 displays the average maximum air temperature trends by month, Figure 3.4 displays the average minimum air temperature trends by month, and Figure 3.5 displays the average monthly precipitation. Figure 3.6 shows the annual precipitation from 1941 through 2015 for the Douglas 1 SE Weather Station (482685), which is located roughly 1 mile southeast of the town of Douglas, Wyoming.

In addition to the climatic data from weather stations within the watershed, Applied Weather Associates, LLC (AWA) prepared a Probable Maximum Precipitation (PMP) study for Wyoming

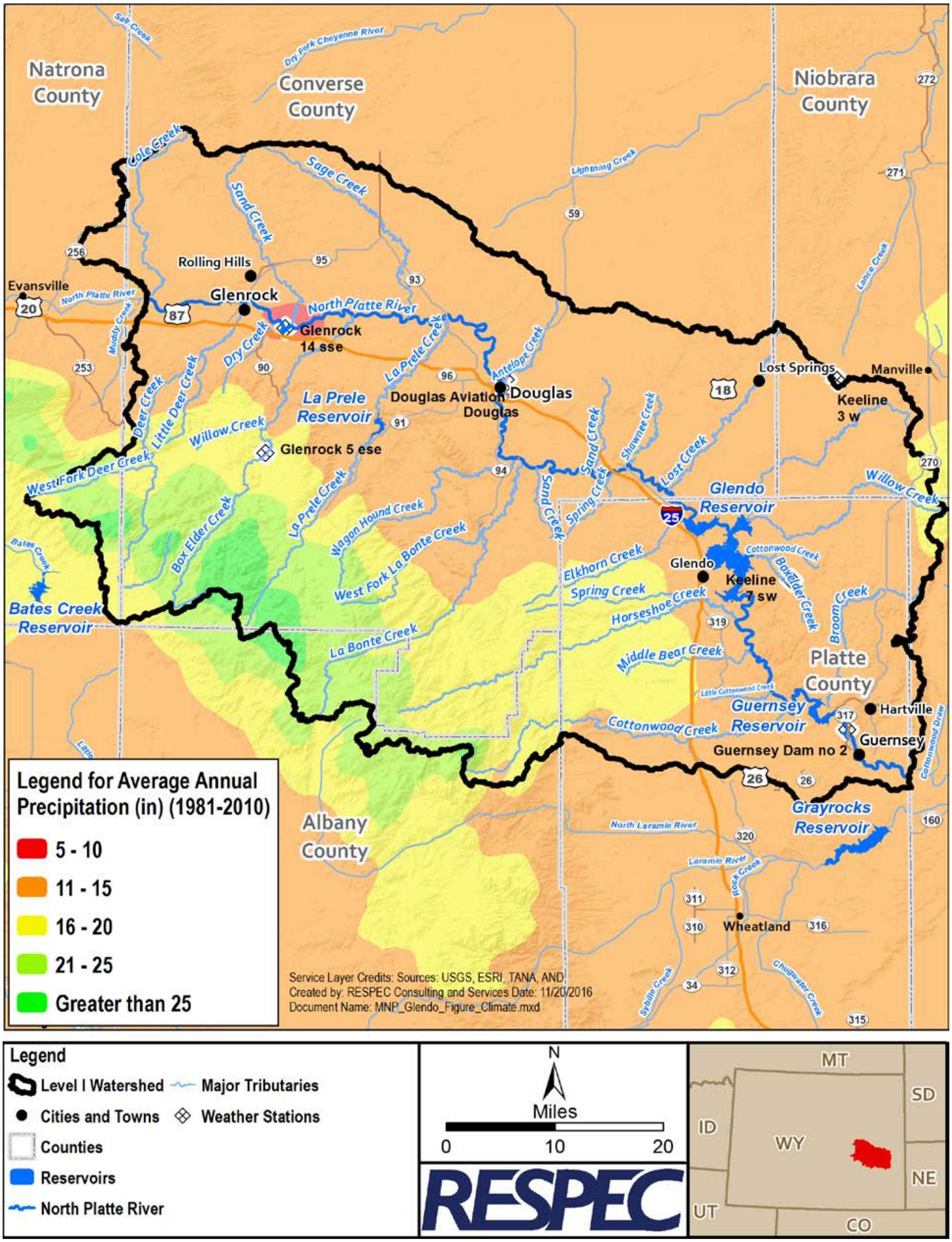


Figure 3.1. Average Annual Precipitation Throughout the Study Area [PRISM, 2016].

[Kappel et al., 2014]. PMPs are defined as the theoretically greatest depth of precipitation for a given duration [Corrigan, 1999]. For this report, rainfall depths and spatial distributions from two storm types (local and general storms) and four storm durations (6-, 24-, 48-, and 72-hour) were analyzed and interpolated across the watershed. Local storms are events that occur over a small area (less than 500 square miles) and over a shorter time period (precipitation rarely exceeding 6 hours). These storm events are typically from an isolated thunderstorm. General storms are defined as an event that produces precipitation over an area greater than 500 square miles with a duration longer than 6 hours; and these storms are associated with a major synoptic weather feature [Kappel et al., 2014].

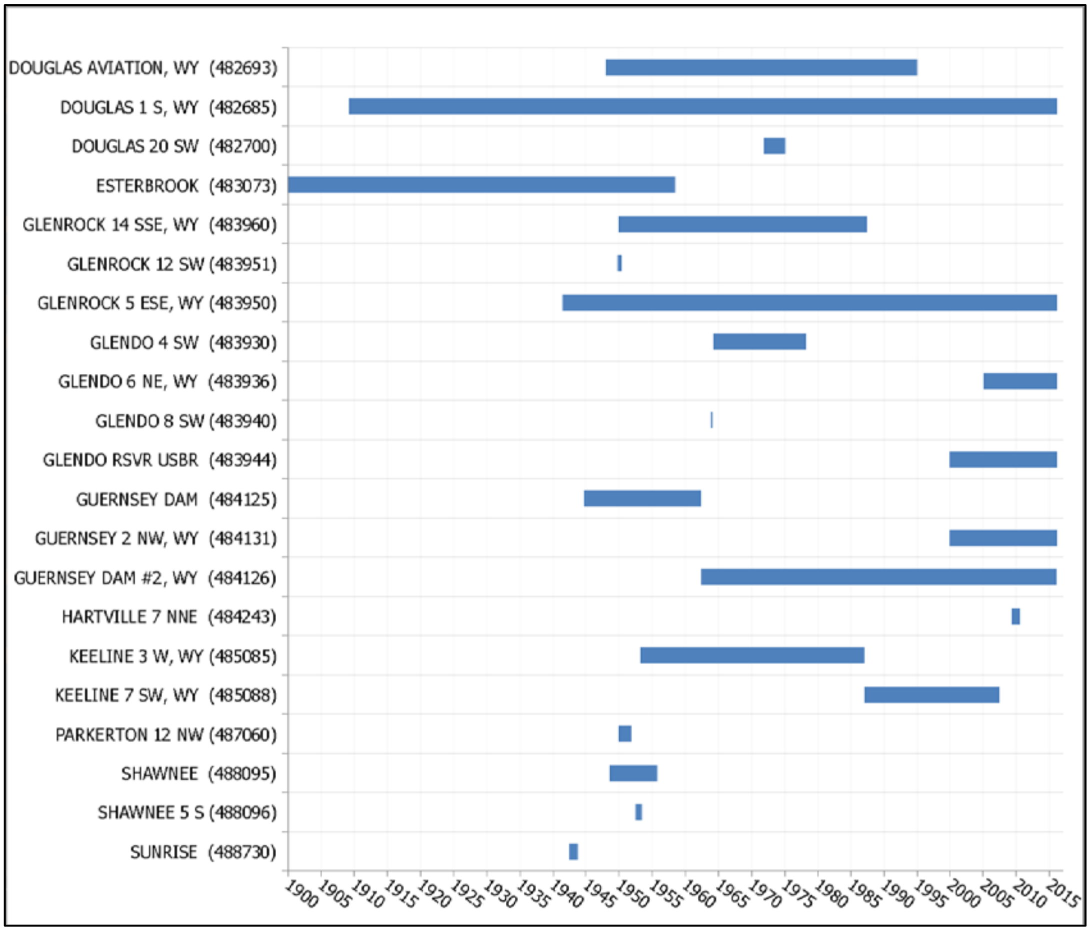


Figure 3.2. Period of Records for Meteorological Stations Within the Watershed.

PMP values were linearly interpolated across the entire watershed and interpolated using the average Hydrologic Unit Code (HUC 12) area of 43.7 square miles for a 6-hour local storm and 24-, 48-, and 72-hour general storms. The maximum PMPs within the study area are located in the Laramie Mountain Range and a localized minimum PMP depth is located in the southwest corner of the watershed boundary (Figure 3.7). For a 24-hour general storm, the average PMP depth for the watershed is 8.30 inches while the average PMP depth at the HUC 12 level is 15.67 inches. The HUC 12 PMPs have a greater depth because of the maximum possible precipitation falling over a smaller area (i.e., depth of precipitation from one storm over 43.7 square miles (sq. mi.) for the average HUC 12 area versus 3,275 sq. mi. for the entire watershed's area). Figures 3.7 and 3.8 display a spatial distribution of

Table 3.2. Monthly Climatic Data for Weather Stations Within the Study Area [Western Regional Climate Center, 2016]

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
DOUGLAS 1 S, WY (482685) 1909–2016													
Average Maximum Temperature (F)	37.2	39.8	47.4	57.9	67.5	78.6	87.5	85.1	74.6	61.7	47.9	38.0	60.3
Average Minimum Temperature (F)	11.5	14.6	21.6	30.6	39.3	48.6	55.2	52.8	42.3	31.6	21.6	13.0	31.9
Average Total Precipitation (in)	0.47	0.59	0.86	1.80	2.41	1.81	1.30	1.06	1.23	1.26	0.59	0.52	13.9
GLENROCK 5 ESE, WY (483950) 1941–2016													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Maximum Temperature (F)	37.8	41.1	48.1	58.8	68.6	79.9	89.0	87.2	76.4	63.1	47.4	39.3	61.4
Average Minimum Temperature (F)	15.0	18.2	23.4	31.6	40.3	49.1	55.7	53.6	43.3	33.5	24.1	17.2	33.8
Average Total Precipitation (in)	0.40	0.43	0.83	1.52	2.33	1.72	1.07	0.73	1.05	1.05	0.59	0.35	12.07
GLENDO RSVR USBR (483944) 2000–2016													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Maximum Temperature (F)	38.2	38.7	51.2	57.4	65.9	78.8	87.1	85.7	76.5	60.8	48.3	36.3	56.5
Average Minimum Temperature (F)	16.2	17.2	26.7	32.8	42.0	51.0	58.0	56.7	47.0	35.4	22.2	15.0	32.9
Average Total Precipitation (in)	0.28	0.60	0.57	1.77	1.96	1.29	1.29	0.62	1.01	1.24	0.51	0.21	11.59
GUERNSEY DAM #2, WY (484126) 1962–2016													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Maximum Temperature (F)	31.8	50.1	52.3	60.0	72.7	82.1	89.7	87.7	83.1	75.7	0.0	0.0	0.0
Average Minimum Temperature (F)	1.4	18.6	25.0	34.3	42.6	52.6	58.6	55.9	49.5	42.1	0.0	0.0	0.0
Average Total Precipitation (in)	0.30	0.28	0.68	1.84	2.40	2.51	1.78	1.04	1.14	0.84	0.44	0.34	13.6
KEELINE 3 W, WY (485085) 1953–1987													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Maximum Temperature (F)	33.4	38.0	45.2	55.3	66.3	78.1	86.1	84.8	74.6	62.0	44.7	36.4	58.7
Average Minimum Temperature (F)	10.1	15.3	21.0	29.0	38.3	47.4	53.8	52.4	42.6	32.6	20.3	13.4	31.3
Average Total Precipitation (in)	0.51	0.54	0.90	1.86	2.22	2.11	1.63	1.09	1.09	0.80	0.64	0.49	13.87

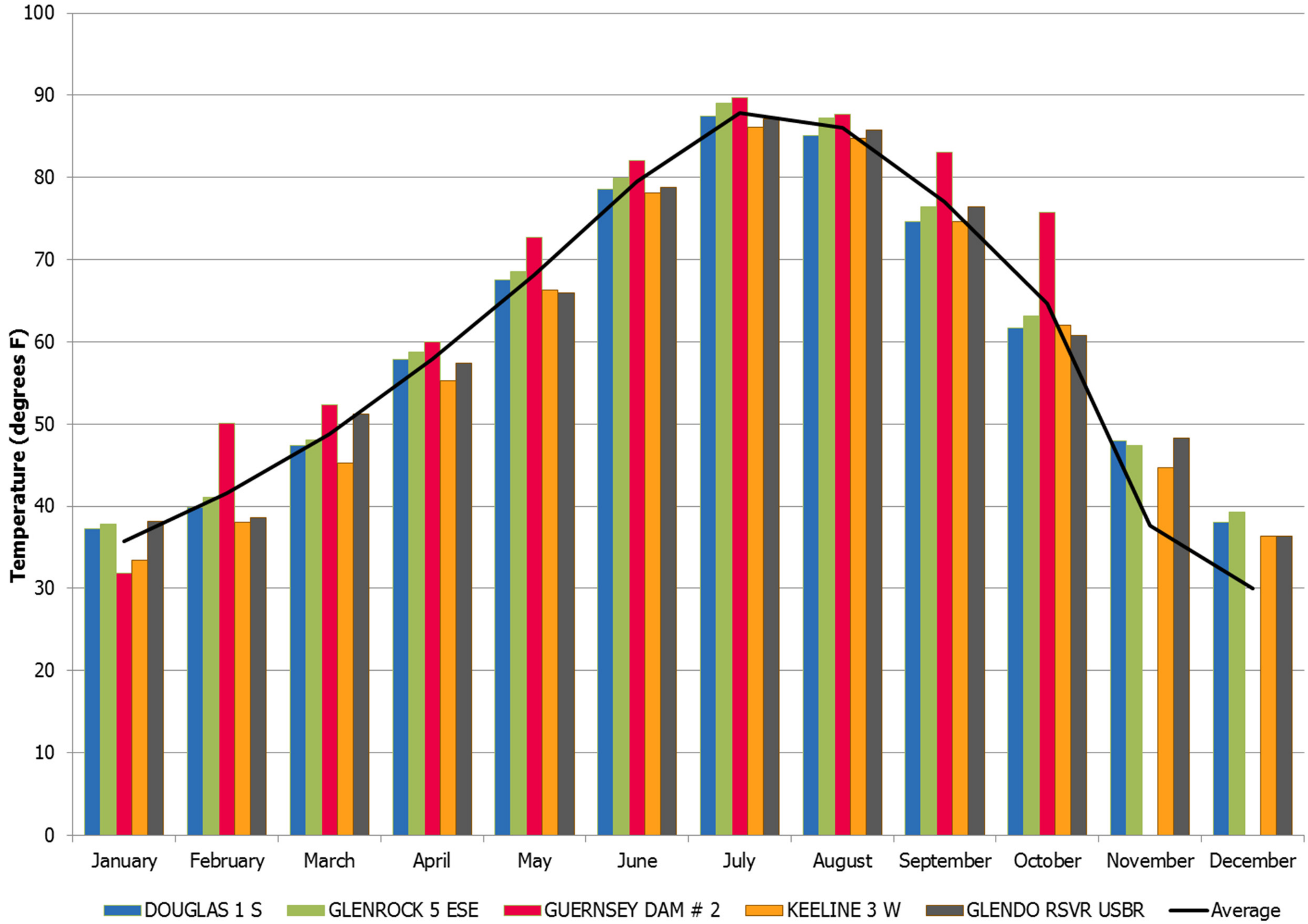


Figure 3.3. Monthly Average Maximum Temperature for Weather Stations Across the Study Area.

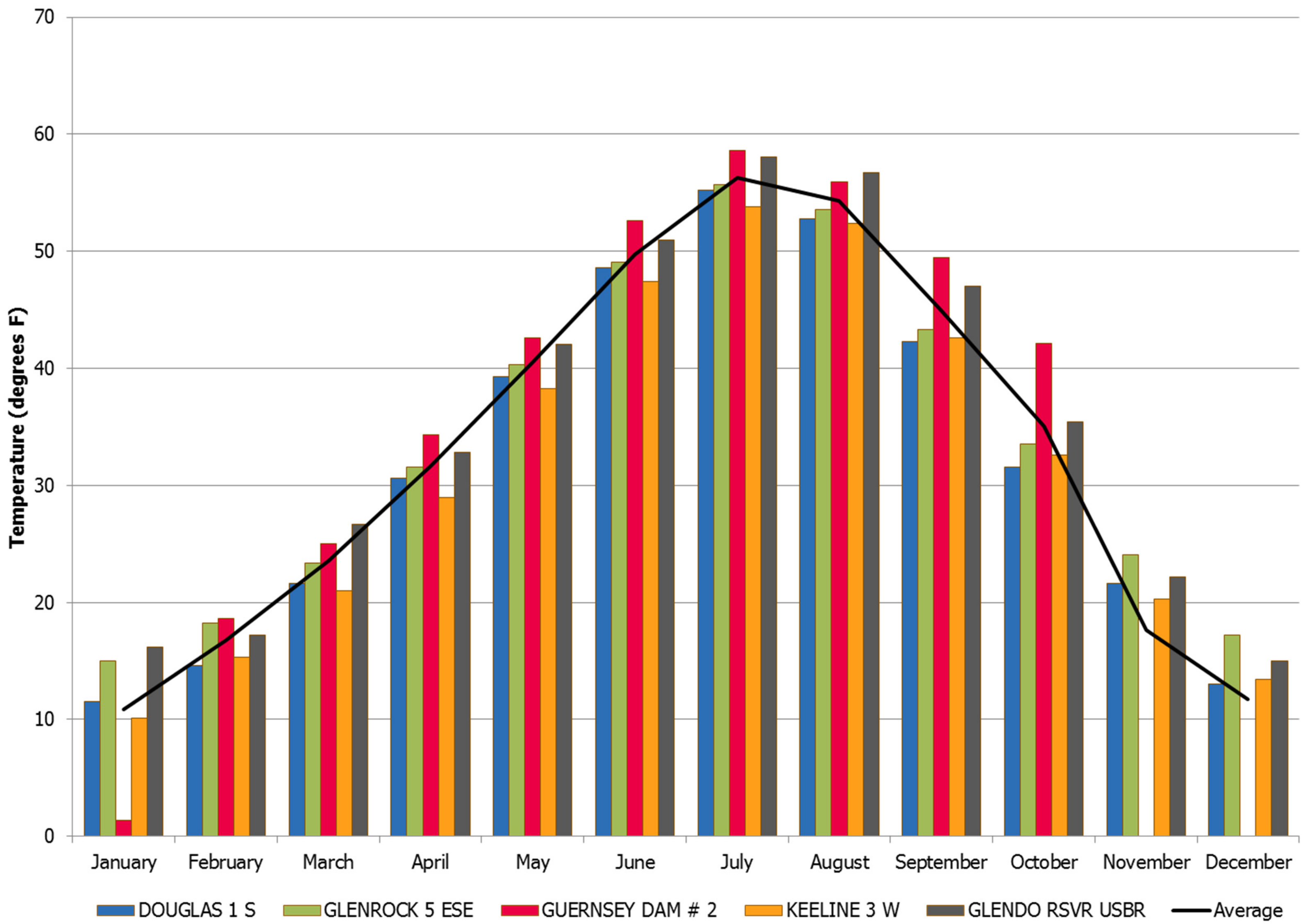


Figure 3.4. Monthly Average Minimum Temperature for Weather Stations Within the Study Area.

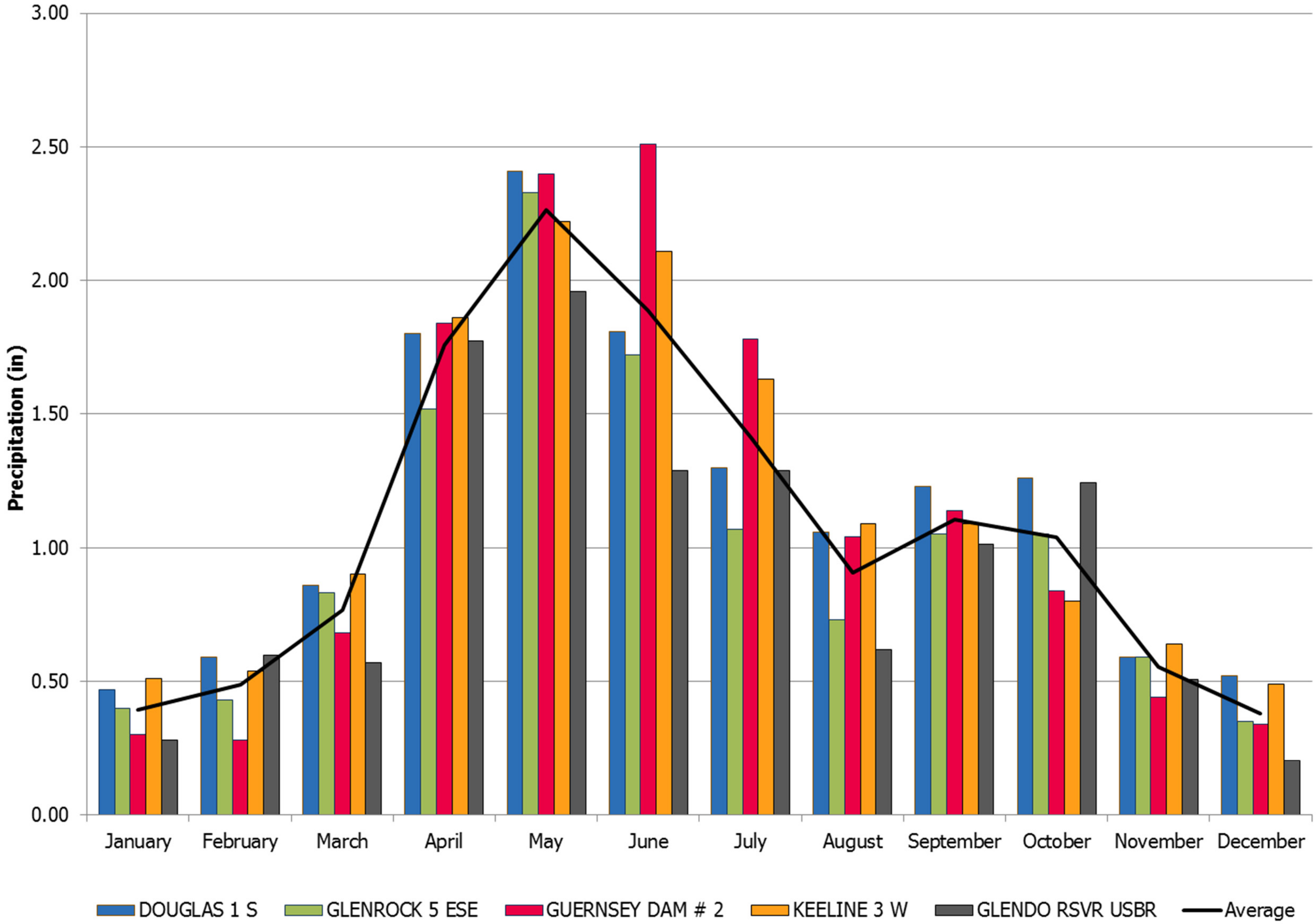


Figure 3.5. Monthly Average Rainfall Totals for Weather Stations Within the Study Area.

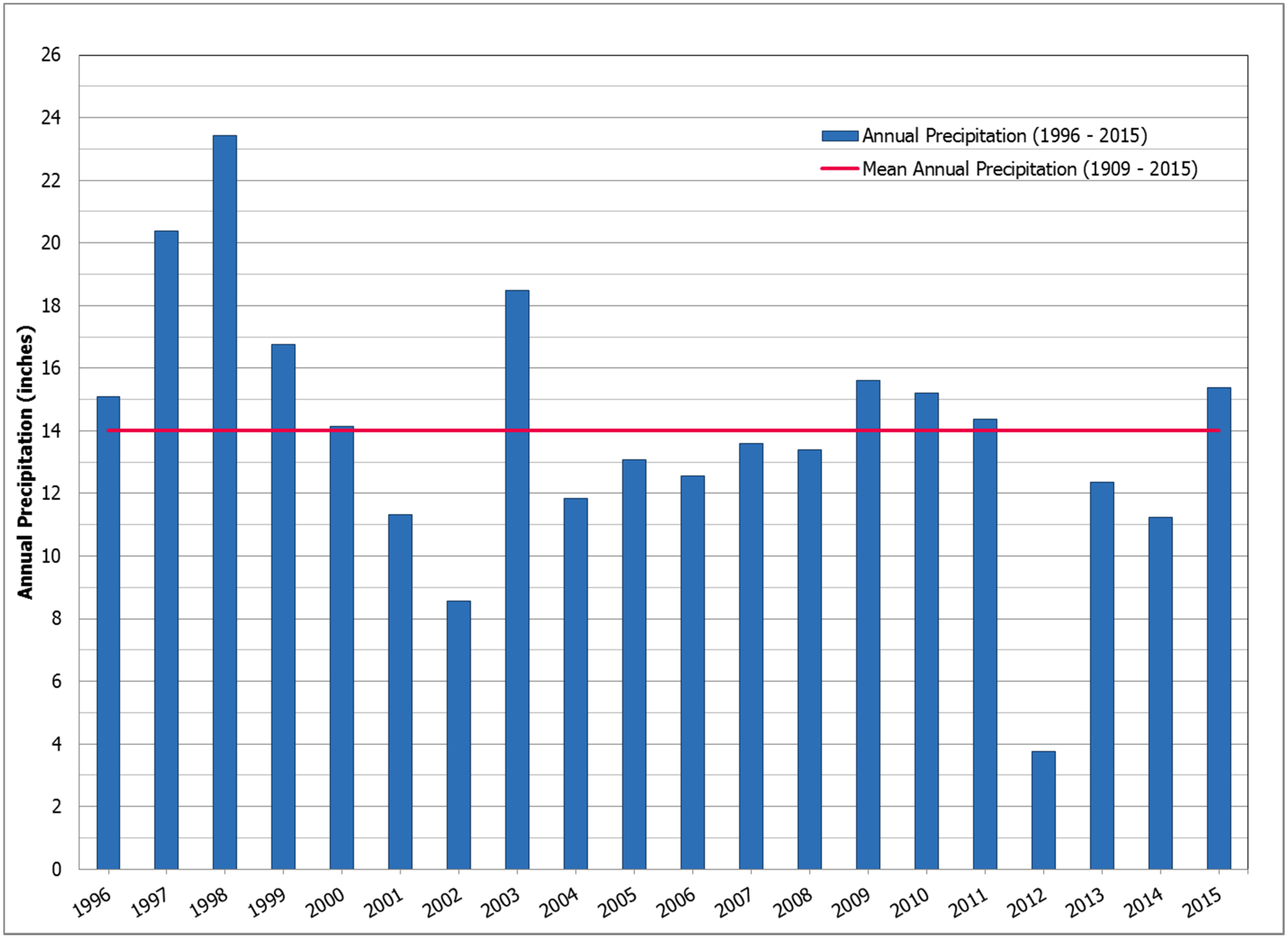


Figure 3.6. Annual Precipitation From 1996 to 2015 for the Douglas 1 SE Weather Station (482685).

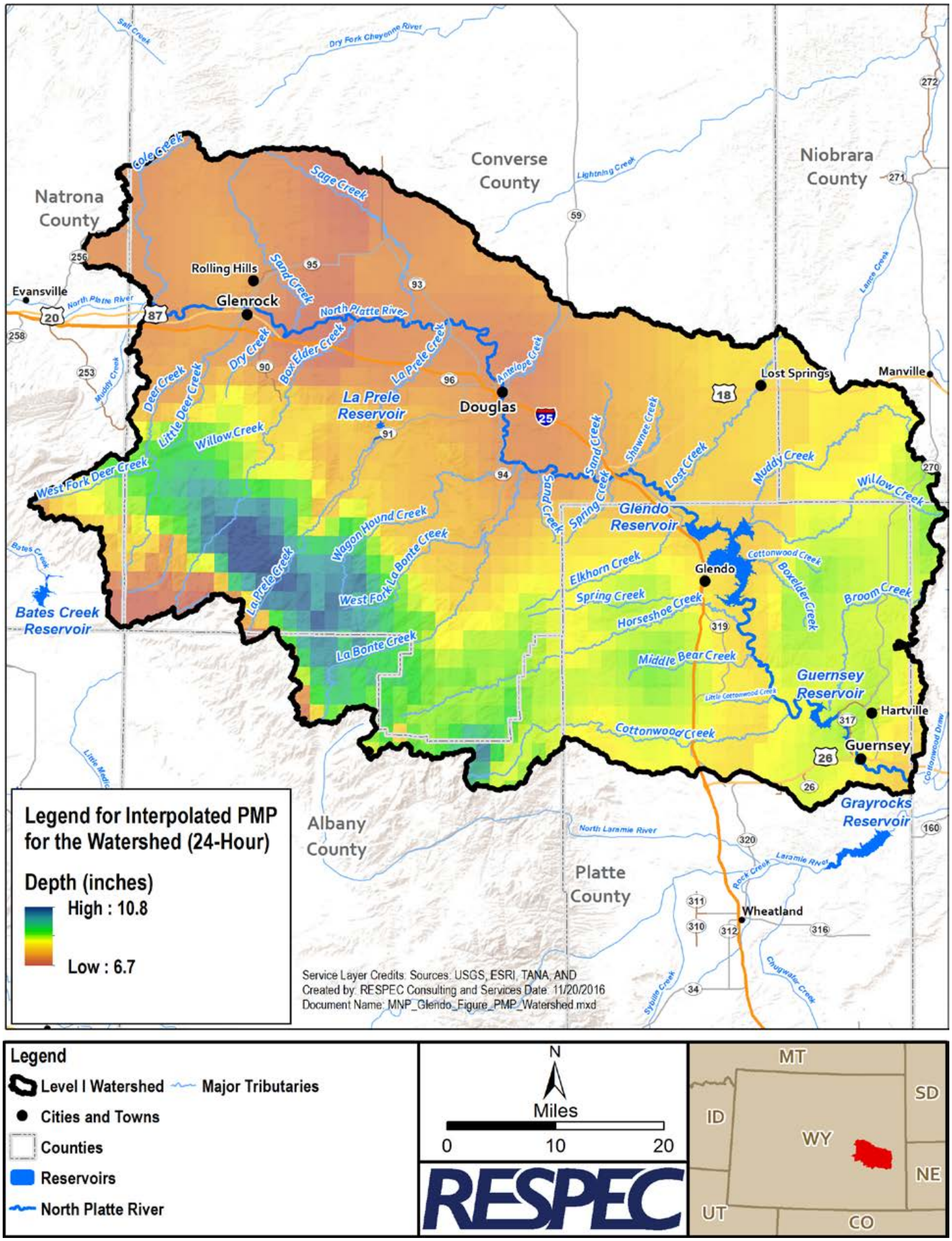


Figure 3.7. 24-Hour Probable Maximum Precipitation Storm Interpolated to the Watershed.

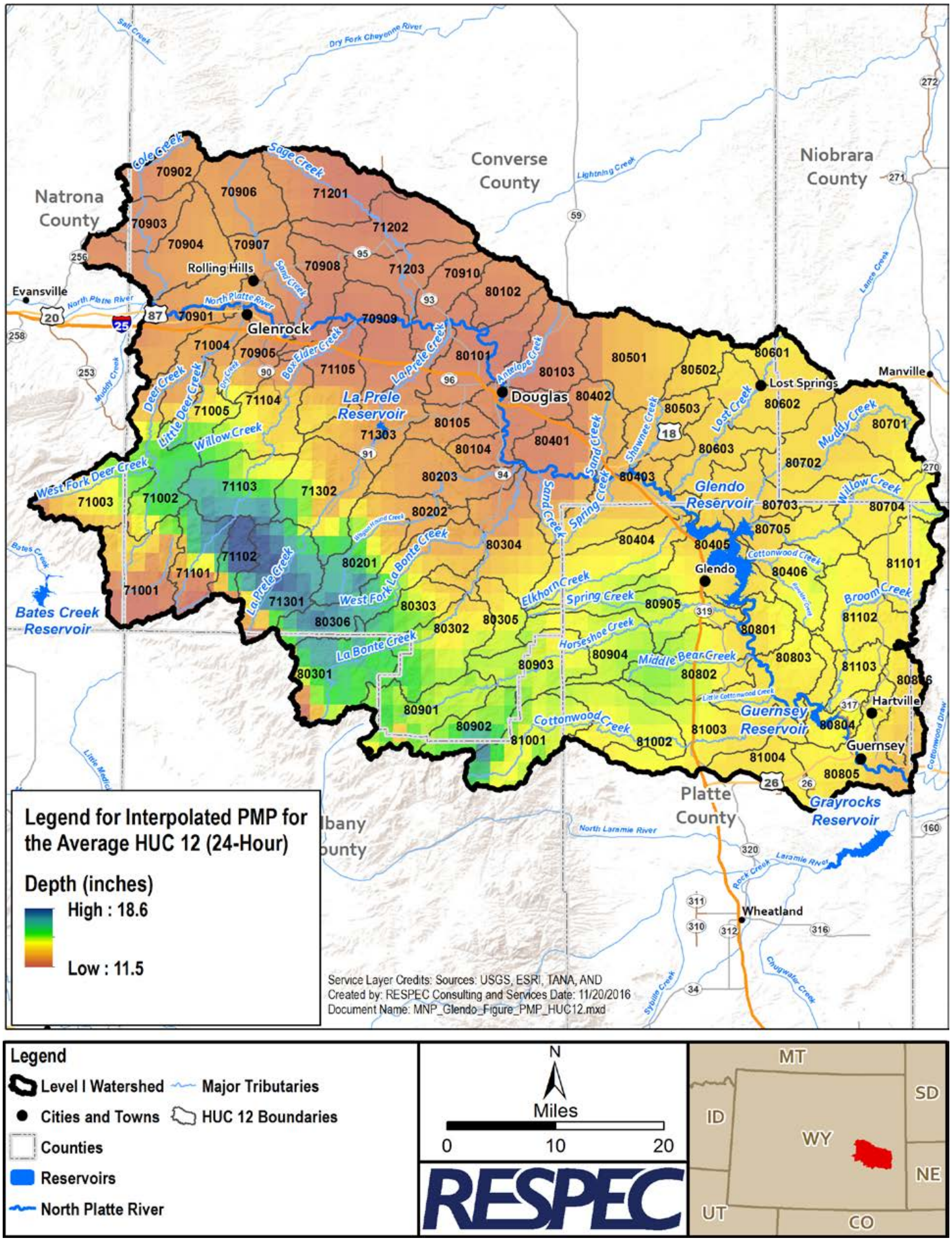


Figure 3.8. 24-Hour Probable Maximum Precipitation Storm Interpolated to the Average HUC 12.

PMP values for a 24-hour general storm watershed-wide and interpolated at the HUC 12 level. These figures illustrate the 24-hour PMP depth, in inches, with a grid cell separated evenly every 0.025 degrees and had an approximate area of 2.2-square miles.

3.3.3 Land Cover

The 2011 National Land Cover Database (NLCD) classifications summarize the characteristics of the land surface and include but are not limited to shrub/scrub, grassland/herbaceous, deciduous or evergreen forest, developed urban, crops, wetlands, water, and barren ground. The NLCD is distributed by the Multi-Resolution Land Characteristics Consortium (MRLC) and serves as the definitive Landsat-based, 30-meter resolution, land-cover database with a 16-category classification that is applied across the United States [USGS, 2012]. The 2001 NLCD was obtained and used in determining the predominant surface cover types that exist within the watershed. In addition to the NLCD, existing vegetation cover types, vegetative communities, and targeted vegetation species that occur within the watershed are discussed in further detail in Sections 3.3.3.1 through 3.3.3.3.

An analysis of the 2011 NLCD data indicates that approximately 865,724 acres (41.3 percent) of land cover within the study area is composed of grassland/herbaceous. Another 774,609 acres (36.9 percent) of the watershed are classified as shrub/scrub cover, and 279,089 acres (13.3 percent) as evergreen, deciduous, and mixed forests. The remaining areas consist of pasture and hay, emergent wetlands, woody wetlands, crops, and other small classes. Barren land, which includes rock, sand, and clay occurring on bedrock, scarps, sand dunes, strip mines, gravel pits, covers approximately 26,689 acres (1.27 percent) of the study area. Approximately 11,360 acres (17.7 square miles) of water covers 0.5 percent of the study area. Table 3.3 is a summary of land-cover classifications NLCD data in 2011.

In summary, approximately 78 percent of the watershed's land cover consists of grass and shrub lands, which are typically used for livestock grazing. The remaining 22 percent of the study area consists of evergreen forest, pasture and hay, and water based on the 2011 NLCD. Furthermore, barren land covers only 1.27 percent of the watershed. Because the study area's land surface is covered predominantly by permanent herbaceous vegetation with a small portion of impervious area, the watershed is characteristic of other watersheds within the Rocky Mountains and central Wyoming. There has not been widespread conversion of grass/shrub lands to crop lands or agricultural lands to urban areas within the watershed. Although the area north of Glendo Reservoir has been changed from grass/shrub land to crop and pasture lands and there are also localized areas converted from grass/shrub land to suburban/urban areas near Douglas and Glenrock. Generally, the watershed's land cover types exhibit properties that aid the hydrologic process and watershed function in capturing precipitation, improving infiltration and storage of surface water, and reducing runoff of surface water.

3.3.3.1 *Existing Vegetation Cover*

In addition to the NLCD, existing vegetative cover in the watershed was evaluated by using data obtained through the LANDFIRE program [USGS, 2010]. LANDFIRE vegetation maps are mostly derived from the NatureServe ecological classifications. Other data are derived from the NLCD, National Vegetation Classification Standard (NVCS) Alliances, and LANDFIRE specific types. The LANDFIRE data includes many relevant attributes such as existing vegetation type (EVT), existing vegetation height (EVH), and existing vegetation cover (EVC).

Table 3.3. 2011 National Land Cover Database Classifications Within the Study Area

Classification	Description	Area (acres)	Percent of Study Area
Grassland and Herbaceous	Gramanoid or herbaceous vegetation, generally greater than 80 percent of total vegetation cover. These areas are not subject to tilling but are used for grazing.	865,724	41.3
Shrub/Scrub	Shrubs less than 16 feet tall with canopy typically greater than 20 percent of total vegetation. This class includes shrubs and trees in early successional stages or stunted from environmental conditions.	774,609	36.9
Evergreen Forest	Trees greater than 16 feet tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.	275,351	13.1
Cultivated Crops	Productions of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. This class accounts for greater than 20 percent of total vegetation and includes all of the land being actively tilled.	53,170	2.54
Woody Wetlands	Forests or shrublands account for greater than 20 percent, and the soil is periodically covered with water.	27,230	1.30
Barren Land (Rock/Sand/Clay)	Bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other earthen material. Vegetation accounts for less than 15 percent of total.	26,689	1.27
Pasture and Hay	Grasses, legumes, or mixtures planted for livestock grazing or producing seed or hay crops on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.	23,977	1.14
Emergent Herbaceous Wetlands	Perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover, and the soil or substrate is periodically covered with water.	16,691	0.80
Developed, Open Space	A mixture of constructed materials, but mostly lawn grasses. Impervious surfaces account for less than 20 percent of cover. These areas commonly include single-family housing units; parks; golf courses; and vegetation planted for recreation, erosion control, or aesthetics.	14,970	0.71
Open Water	Open water, less than 25 percent cover of vegetation/soil.	11,360	0.54
Deciduous Forest	Trees greater than 16 feet tall and greater than 20 percent of vegetation cover. More than 75 percent of the tree species shed foliage in response to a seasonal change.	3,704	0.18
Developed, Low Intensity	A mixture of constructed materials and vegetation. Impervious surfaces account for 50–79 percent of the total cover. These areas most commonly include single-family housing units.	2,981	0.14
Other	Areas with less than 0.1 percent of the study area.	926	< 0.1
Total		**2,097,382**	**100.0**

The LANDFIRE existing vegetation data specify 42 different vegetation classes and 68 different vegetation types within the study area. The LANDFIRE EVT data were analyzed, and all of the classifications are summarized in Table 3.4. The dominant EVTs include Northwestern Great Plains Mixedgrass Prairie (26.7 percent), Inter-Mountain Basins Big Sagebrush Steppe (12.1 percent), Western Great Plains Shortgrass Prairie (8.5 percent), Western Great Plains Sand Prairie (8.0 percent), and Inter-Mountain Basins Montane Sagebrush Steppe (6.4 percent), which all cover a total of 61.7 percent of the watershed. The remaining 38.3 percent of the watershed consisted of 63 different vegetation types.

Although data from LANDFIRE can be used to gain an understanding about the condition of the watershed, presenting LANDFIRE data is challenging, because the vegetation classifications are plotted on a 30-meter by 30-meter grid. Therefore, the Gap Analysis Program (GAP) data for Wyoming were obtained and are shown in Figure 3.9. The LANDFIRE datasets are contained within the study's GIS and can be used in future mapping projects.

The Wyoming Gap Analysis project (WY-GAP) was initiated in 1991 as a cooperative effort between the USGS and state, federal, and private natural-resources groups in Wyoming [University of Wyoming, Spatial Data Visualization Center, 1996]. Three data layers (land cover, species distribution, and conservation status) comprise a typical GAP analysis. Table 3.5 lists the Wyoming GAP vegetation land-cover types within the study area. A total of 44 distinctive classifications that occur within the watershed; however, three predominant classes comprise more than 68 percent of the study area. The predominant GAP classifications within the watershed are the Northwestern Great Plains Mixedgrass Prairie (31.1 percent), Inter-Mountain Basins Big Sagebrush Steppe (26.9 percent), and the Northwestern Great Plains–Black Hills Ponderosa Pine Woodland and Savanna (10.4 percent).

3.3.3.2 *Vegetative Communities*

Vegetative communities within the study area vary because of the differing topography, geology, soils, climate, fire history, and surface management. In general, the desirable grass species in the watershed include western wheatgrass, needle-and-thread, prairie Junegrass, Indian ricegrass, blue grama, Sandberg bluegrass, sand dropseed, threeawn, little bluestem, and threadleaf sedge. Summary descriptions for vegetative communities that occur in the study area can be found in Appendix A. Additionally, the plant species of concern as determined by the Wyoming Natural Diversity Database (WYNDD) that are located in the watershed are listed in Table 3.6.

3.3.3.3 *Targeted Vegetation*

A total of 26 designated and prohibited noxious weeds are on the state of Wyoming's *Weed and Pest Control Act* Designated List as shown in Table 3.7 [Wyoming Weed and Pest Council, 2015]. The plants are problematic because they affect desirable plants, land uses, and existing habitats. "Declared weeds" are listed by weed-control districts in Albany, Converse, Goshen, Niobrara, and Platte Counties in accordance with Declared Pest and Declared Weed Program Participation W.S. 11-5-102(a)(vii). Tables 3.8 through Table 3.13 lists the 3 declared weeds in Albany County, 43 declared weeds in Converse County, 2 declared weeds in Goshen County, 12 declared weeds in Natrona County, 4 declared weeds in Niobrara County, and 4 declared weeds Platte County, respectively [Wyoming Weed and Pest Council, 2015]. Wyoming weed-control districts meet specific weed or pest needs by offering technical assistance, cost-share programs, and inspection services.

Table 3.4. Existing Vegetation Types (LANDFIRE) Within the Study Area

Existing Vegetation Type	Area (acres)	Percent of Study Area
Northwestern Great Plains Mixedgrass Prairie	559,582	26.7
Inter-Mountain Basins Big Sagebrush Steppe	254,066	12.1
Western Great Plains Shortgrass Prairie	178,923	8.5
Western Great Plains Sand Prairie	168,027	8.0
Inter-Mountain Basins Montane Sagebrush Steppe	134,271	6.4
NASS-Close Grown Crop	101,515	4.8
Inter-Mountain Basins Big Sagebrush Shrubland	72,313	3.4
Southern Rocky Mountain Ponderosa Pine Woodland	62,718	3.0
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	53,751	2.6
Northwestern Great Plains–Black Hills Ponderosa Pine Woodland and Savanna	52,385	2.5
Western Great Plains Sparsely Vegetated Systems	52,343	2.5
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	52,158	2.5
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	36,829	1.8
Southern Rocky Mountain Ponderosa Pine Savanna	31,708	1.5
Rocky Mountain Lodgepole Pine Forest	30,893	1.5
Barren	27,849	1.3
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	27,428	1.3
Rocky Mountain Montane Riparian Systems	23,872	1.1
Agriculture-Cultivated Crops and Irrigated Agriculture	21,106	1.0
Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	20,631	1.0
Introduced Upland Vegetation–Annual Grassland	20,584	1.0
Herbaceous Wetlands	13,538	0.6
Rocky Mountain Foothill Limber Pine-Juniper Woodland	9,655	0.5
Developed-Roads	8,756	0.4
Western Great Plains Floodplain Systems	8,047	0.4
Open Water	7,756	0.4
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	7,733	0.4
Rocky Mountain Aspen Forest and Woodland	7,557	0.4
Agriculture-Pasture and Hay	7,133	0.3
Inter-Mountain Basins Greasewood Flat	6,556	0.3
Developed-Upland Herbaceous	5,787	0.3
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	5,127	0.2
Northern Rocky Mountain Subalpine-Upper Montane Grassland	4,660	0.2
Rocky Mountain Subalpine/Upper Montane Riparian Systems	4,332	0.2
Other (Less Than 0.2 Percent)	17,773	0.9
Total	**2,097,362**	**100.0**

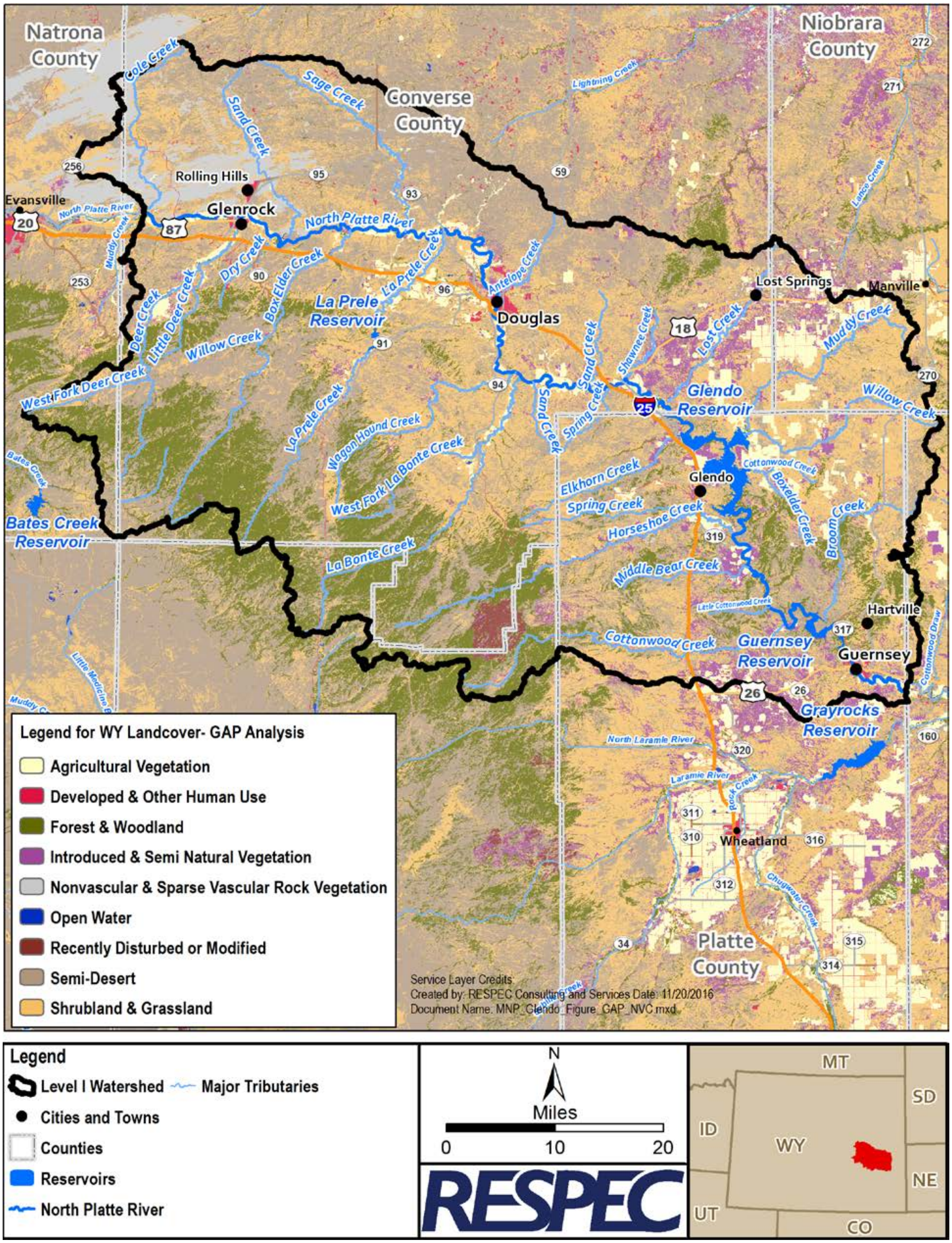


Figure 3.9. Gap Analysis Program Land Cover Within the Watershed.

Table 3.5. Gap Analysis Program Land Cover Within the Study Area

National Vegetation Classification	Area (acres)	Percent of Study Area
Northwestern Great Plains Mixedgrass Prairie	651,404	31.1
Inter-Mountain Basins Big Sagebrush Steppe	563,748	26.9
Northwestern Great Plains–Black Hills Ponderosa Pine Woodland and Savanna	218,965	10.4
Inter-Mountain Basins Montane Sagebrush Steppe	128,266	6.12
Pasture/Hay	107,170	5.11
Introduced Upland Vegetation–Annual Grassland	92,838	4.43
Inter-Mountain Basins Active and Stabilized Dune	44,870	2.14
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	40,272	1.92
Southern Rocky Mountain Ponderosa Pine Woodland	32,287	1.54
Northwestern Great Plains Riparian	27,970	1.33
Rocky Mountain Lodgepole Pine Forest	19,867	0.95
Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	18,075	0.86
Developed, Open Space	17,839	0.85
Open Water (Fresh)	14,864	0.71
Western Great Plains Riparian Woodland and Shrubland	14,486	0.69
Rocky Mountain Lower Montane-Foothill Shrubland	11,515	0.55
Rocky Mountain Foothill Limber Pine-Juniper Woodland	11,186	0.53
Western Great Plains Saline Depression Wetland	10,608	0.5
Recently Burned Forest	10,225	0.49
Western Great Plains Badland	7,606	0.36
Western Great Plains Open Freshwater Depression Wetland	7,231	0.34
Western Great Plains Sand Prairie	7,190	0.34
Inter-Mountain Basins Greasewood Flat	5,267	0.25
Rocky Mountain Aspen Forest and Woodland	5,095	0.24
Southern Rocky Mountain Montane-Subalpine Grassland	4,948	0.23
Western Great Plains Closed Depression Wetland	4,641	0.22
Other (Less Than 0.2 Percent)	18,949	0.9
Total	**2,097,382**	**100.0**

Table 3.6. Wyoming Natural Diversity Database: Plants Within the Study Area

Scientific Name	Common Name	Listing Status	Tracking Status
Aquilegia laramiensis	Laramie columbine		Tracked
Asplenium trichomanes	Maidenhair spleenwort		Tracked
Bromus pubescens	Hairy wood brome		Tracked
Carex emoryi	Emory's sedge		Tracked
Carex parryana var. unica	Halls sedge		Tracked
Celtis occidentalis	Common hackberry		Tracked
Cuscuta indecora var. neuropetala	Pretty dodder		Watched
Cuscuta megalocarpa	Big-fruited dodder		Tracked
Cuscuta plattensis	Wyoming dodder	Not Warranted	Tracked
Cyperus bipartitus	Shining flatsedge		Tracked
Dalea cylindriceps	Sandsage prairie-clover		Tracked
Dichanthelium linearifolium	Slim-leaf witchgrass		Tracked
Eriogonum pauciflorum var. nebraskense	Nebraska wild buckwheat		Tracked
Euphorbia exstipulata	Square-seeded spurge		Tracked
Euphorbia hexagona	Six-angle spurge		Tracked
Eustoma grandiflorum	Showy prairie-gentian		Tracked
Euthamia graminifolia var. major	Flat-top fragrant goldenrod		Tracked
Filago prolifera	Rabbit tobacco		Tracked
Hesperostipa neomexicana	New Mexico needlegrass		Tracked
Ipomopsis aggregata var. tenuituba	Slender-trumpet ipomopsis		Tracked
Lipocarpha drummondii	Dwarf rush		Tracked
Listera convallarioides	Broad-leaved twayblade		Tracked
Oxytropis nana	Wyoming locoweed		Tracked
Pectis angustifolia var. angustifolia	Lemon scent		Tracked
Pellaea suksdorfiana	Smooth cliff brake		Tracked
Polypodium saximontanum	Rocky Mountain polypody		Tracked
Potamogeton nodosus	Longleaf pondweed		Tracked
Sphaeromeria simplex	Laramie false sagebrush		Tracked
Triodanis holzingeri	Holzinger's Venus' looking-glass		Tracked

Table 3.7. State of Wyoming Designated and Prohibited Noxious Weeds

Scientific Name	Common Name
Hyoscyamus niger	Black Henbane
Cirsium arvense L.	Canada thistle
Arctium minus Hill Bernh.	Common burdock
Hypericum perforatum	Common St. Johnswort
Tanacetum vulgare	Common Tansy
Linaria dalmatica L. Mill.	Dalmatian toadflax
Centaurea diffusa Lam.	Diffuse knapweed
Isatis tinctoria L.	Dyers woad
Convolvulus arvensis L.	Field bindweed
Cardaria draba and Cardaria pubescens L. Desv.	Hoary cress (whitetop)
Cynoglossum officinale L.	Houndstongue
Euphorbia esula L.	Leafy spurge
Carduus nutans L.	Musk thistle
Chrysanthemum leucanthemum L.	Ox-eye daisy
Lepidium latifolium L.	Perennial pepperweed
Sonchus arvensis L.	Perennial sowthistle
Carduus acanthoides L.	Plumeless thistle
Lythrum salicaria L.	Purple loosestrife
Agropyron repens L. Beauv.	Quackgrass
Centaurea repens L.	Russian knapweed
Elaeagnus angustifolia L.	Russian olive
Tamarix spp.	Saltcedar
Onopordum acanthium L.	Scotch thistle
Franseria discolor Nutt.	Skeletonleaf bursage
Centaurea maculosa Lam.	Spotted knapweed
Linaria vulgaris L.	Yellow toadflax

Table 3.8. Albany County Declared Weeds

Scientific Name	Common Name
Bromus tectorum L.	Cheatgrass/downy brome
Oxytropis spp.	Locoweed
Delphinium geyeri Greene	Plains larkspur/Geyer larkspur

Table 3.9. Converse County Declared Weeds (Page 1 of 2)

Scientific Name	Common Name
Hypera postica Gyllenhal	Alfalfa weevil
Cirsium vulgare(Savi) Ten.	Bull thistle
Cichorium intybus L.	Chicory
Crupina vulgaris Cass.	Common crupina
Verbascum thapsus L.	Common mullein
Hesperis matronalis L.	Dames rocket
Galega officinalis L.	Goatsrue
Ulex europaeus L.	Gorse
Halogeton glomeratus (M. Bieb.) C.A. Mey.	Halogeton
Centaurea iberica Trev. ex Spreng.	Iberian starthistle
Carduus pycnocephalus L.	Italian thistle
Aegilops cylindrica Host.	Jointed goatgrass
Centaurea pratensis Thuill.	Meadow knapweed
Taeniatherum caput- medusae (L.) Nevski	Medusahead
Hieracium aurantiacum L.	Orange hawkweed
Delphiniumgeyeri Greene	Plains larkspur/Geyer larkspur
Centaurea calcitrapa L.	Purple starthistle
Chondrilla juncea L.	Rush skeletonweed
Cenchrus incertus Curtis	Sandbur
Matricaria perforata Merat.	Scentless chamomile
Cytisus scoparius (L.) Link	Scotch broom
Centaurea virgata Lam. ssp. squarrosa (Willd.) Gugler	Squarrose knapweed
Potentilla recta L.	Sulfur cinquefoil
Zygophyllum fabago L.	Syrian beancaper
Senecio jacobaea L.	Tansy ragwort
Dipsacus fullonum L.	Teasel
Glycyrrhiza lepidota Pursh	Wild licorice
Hieracium fendleri Sch. Bip.	Yellow hawkweed
Artemisia absinthium L.	Absinth wormwood
Gypsophila paniculata L.	Baby's breath
Chorispora tenella (Pallas) DC.	Musk mustard
Solanum rostratum Dunal	Buffalobur
Ceratocephala testiculata (Crantz) Roth	Bur buttercup
Xanthium strumarium L.	Common cocklebur
Helianthus annuus L.	Common sunflower

Table 3.9. Converse County Declared Weeds (Page 2 of 2)

Scientific Name	Common Name
Rumex crispus L.	Curly dock
Grindelia squarrosa (Pursh) Dunal	Curlycup gumweed
Bromus tectorum L.	Cheatgrass / downy brome
Conium maculatum L.	Poison hemlock
Tribulus terrestris L.	Puncturevine
Erodium cicutarium (L.) L'Her.ex Ait	Redstem filaree
Cirsium undulatum (Nutt.) Spreng.	Wavyleaf thistle
Lappula occidentalis (S. Wats.) Greene	Western sticktight

Table 3.10. Goshen County Declared Weeds

Scientific Name	Common Name
Tribulus terrestris L.	Puncturevine
Glycyrrhiza lepidota Pursh	Wild licorice

Table 3.11. Natrona County Declared Weeds

Scientific Name	Common Name
Solanum rostratum Dunal	Buffalobur
Poa bulbosa L.	Bulbous Bluegrass
Bromus tectorum L.	Cheatgrass/downy brome
Potentilla recta L.	Curlycup gumweed
Rumex crispus L.	Curly dock
Hesperis matronalis L.	Dames rocket
Hordeum jubatum L.	Foxtail barkley
Halogeton glomeratus (M. Bieb.) C.A. Mey	Halogeton
Tribulus terrestris L.	Puncturevine
Asclepias speciosa Torr.	Showy milkweed
Glycyrrhiza lepidota Pursh	Wild licorice
Centaurea solstitialis	Yellow starthistle

Table 3.12. Niobrara County Declared Weeds

Scientific Name	Common Name
Solanum rostratum Dunal	Buffalobur
Asclepias speciosa Torr.	Showy milkweed
Potentilla recta L.	Sulphur cinquefoil
Glycyrrhiza lepidota Pursh	Wild licorice

Table 3.13. Platte County Declared Weeds

Scientific Name	Common Name
Bromus tectorum L.	Cheatgrass / downy brome
Cichorium intybus L.	Chicory
Aegilops cylindrical Host	Jointed goatgrass
Tribulus terrestris L.	Puncturevine

3.3.4 Wetlands

Identifying existing wetlands and potential enhancement opportunities is critical in evaluating watershed function within the study area. A wetland is an area that is periodically inundated or saturated by surface or ground water on an annual or seasonal basis, displays hydric soils, and typically supports or is capable of supporting hydrophytic vegetation [Black, 1997]. Wetlands can enhance watershed function by accumulating rainfall or runoff and storing that water in diverse quantities and periods within the wetland's vegetation and soils. Throughout the watershed, wetlands located near waterbodies including springs, ponds, lakes, reservoirs, rivers, and creeks are often the only areas where healthy and vigorous vegetation occurs during dry periods or droughts. Depending on the characteristics of a wetland and its proximity and interconnection to a waterbody, a wetland can provide benefits within a watershed including aquifer recharge, flood control, sediment attenuation, streambank or shoreline stabilization, habitat diversity, and pollutant reduction.

The National Wetlands Inventory (NWI) was established by the USFWS to map existing wetlands based on vegetative, hydrologic, and soil features using aerial imagery and field verification within the United States. Hydric soils are discussed in Section 3.3.7. The NWI geospatial wetland data published in 2009 was obtained and mapped to identify approximately 28,006 acres of all wetland types, which cover approximately 1.3 percent of the study area and occur throughout the area. Wetlands and lake areas directly associated with Glendo Reservoir and Guernsey Reservoir account for approximately 14,152 acres (50.5 percent) of the wetlands within the study area.

The distribution of wetlands by type is shown in Figure 3.10 and listed in Table 3.14. Because the NWI wetlands are small in size and scarcely visible at the watershed scale, the mapped wetland polygons were outlined with a thicker border to increase their visibility as shown in Figure 3.11. Site-specific wetland inventories were not part of this study, and wetland delineations and inventories should be considered as part of the planning for any proposed project. The US Army Corp of Engineers (USACE) has developed watershed-level scale, hydrogeomorphic wetland classifications of the differing wetland types, which is included in Appendix B to assist with planning any future projects [Smith et al., 1995].

Approximately 11,698 acres (41.8 percent) and 4,329 acres (15.5 percent) of the NWI wetlands within the study area are located in the Glendo Reservoir–North Platte River and Sand Creek–North Platte River (HUC 10), respectively. Another 3,448 acres (12.3 percent), 1,623 acres (5.8 percent), and 1,022 acres (3.6 percent) of the NWI wetlands within the study area are located in the Middle Bear Creek–North Platte River, Muddy Creek, and La Bonte Creek Watershed (HUC 10), respectively. The NWI wetlands are also listed by watershed (HUC 10) in Table 3.15.

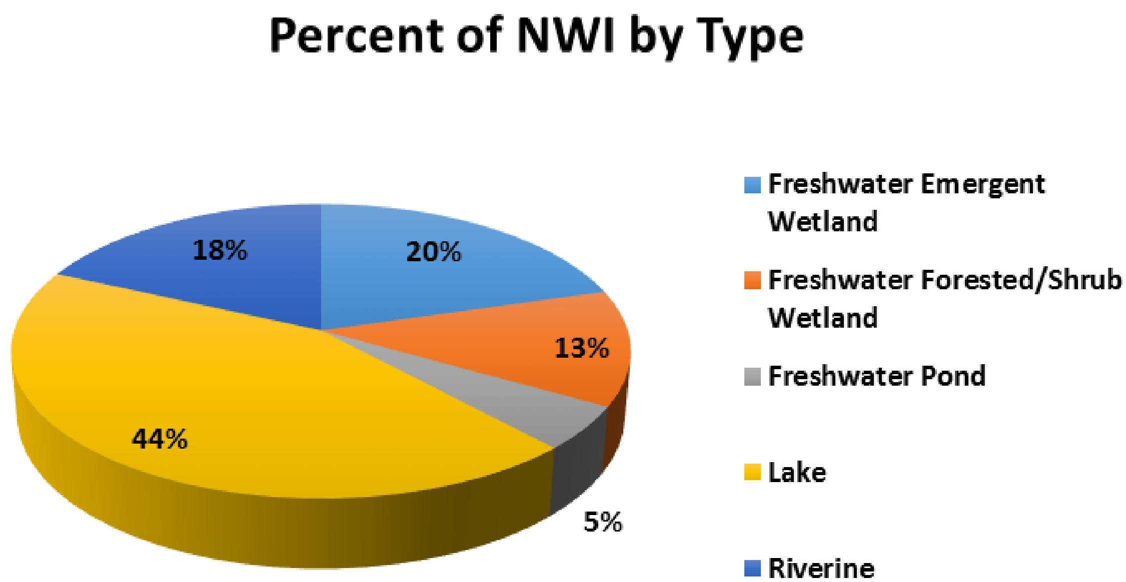


Figure 3.10. Percent Distribution of National Wetlands Inventory Wetland Types Within the Study Area.

Table 3.14. Summary of National Wetlands Inventory Wetland Types Within the Study Area

Wetland Type	Area (Acres)	Percent of NWI	Percent of Study Area
Lake (Including Reservoirs)	12,247	43.7	0.58
Freshwater Emergent Wetland	5,744	20.5	0.27
Freshwater Forested/Shrub Wetland	3,561	12.7	0.17
Freshwater Pond	1,356	4.9	0.07
Riverine	5,098	18.2	0.24
Total	**28,006**	**100.0**	**1.33**

The LANDFIRE EVT data were analyzed and riparian/wetland classifications are summarized in Table 3.16. The dominant riparian/wetland EVTs include Rocky Mountain Montane Riparian Systems (1.14 percent), Herbaceous Wetlands (0.64 percent), Western Great Plains Floodplain Systems (0.38percent), and Rocky Mountain Subalpine/Upper Montane Riparian Systems (0.21 percent). All of these EVTs cover approximately 2.37 percent of the watershed.

In 2009, The Nature Conservancy (TNC) in cooperation with the WGFD and USFWS delineated and prioritized wetland complexes throughout Wyoming [Copeland et al., 2010; Wyoming Joint Ventures Steering Committee, 2010]. Wetland complexes were delineated based on 5 spatial density criteria and identified 222 wetland complexes in Wyoming. The Wyoming Joint Ventures Steering Committee [2010] identified nine wetland complexes in which partners were encouraged to focus project implementation. The committee's criteria for selecting priority focus areas included a Shannon diversity rank of 5 or lower combined with "high" project opportunity and limited the number of primary focus areas to concentrate wetlands conservation efforts [Wyoming Joint Ventures Steering Committee, 2010].

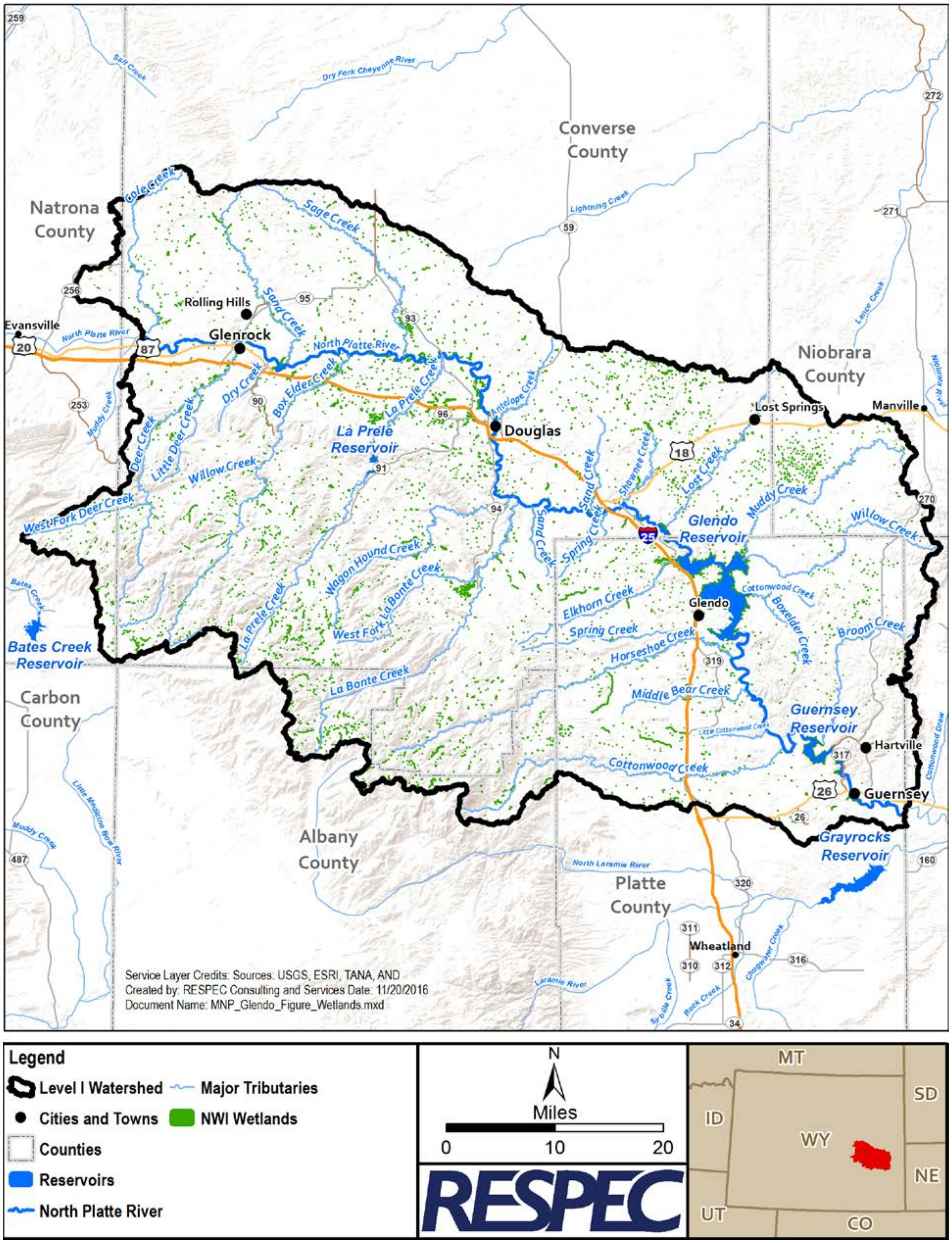


Figure 3.11. National Wetlands Inventory Wetlands Located Within the Study Area.

Table 3.15. National Wetlands Inventory Wetlands by Watershed Within the Study Area

Watershed (HUC 10)	Area (acres)	Percent of Total Wetland Area
Glendo Reservoir – North Platte River	11,698	41.8
Sand Creek – North Platte River	4,329	15.5
Middle Bear Creek – North Platte River	3,448	12.3
Muddy Creek	1,623	5.8
La Bonte Creek	1,022	3.6
Antelope Creek – North Platte River	855	3.0
Horseshoe Creek	807	2.9
La Prele Creek	753	2.7
Box Elder Creek	750	2.7
Deer Creek	745	2.7
Cottonwood Creek	474	1.7
Sage Creek	447	1.6
Shawnee Creek	399	1.4
Wagon Hound Creek	365	1.3
Lost Creek	222	0.8
Broom Creek	69	0.2
Total	**28,006**	**100.0**

Table 3.16. Riparian and Wetland Vegetation Types Within the Study Area

Existing Vegetation Type	Area (acres)	Percent of Study Area
Rocky Mountain Montane Riparian Systems	23,872	1.14
Herbaceous Wetlands	13,538	0.64
Western Great Plains Floodplain Systems	8,047	0.38
Rocky Mountain Subalpine/Upper Montane Riparian Systems	4,332	0.21
Western Great Plains Wooded Draw and Ravine	149	0.01
Recently Burned Herbaceous Wetlands	73	<0.1
Total	**50,011**	**2.38**

Portions of four wetland complexes are located within the watershed (based on data from Copeland et al. [2010]) and are illustrated in Figure 3.12. The Goshen Hole wetland complex was the only complex identified as one of the nine focus areas that is located in the study area and only contains the outlet of Guernsey Reservoir. The Goshen Hole wetland complex contains approximately 7,149 acres of wetlands with high waterfowl and waterbird production, migration stopover, and winter habitat [Wyoming Joint Ventures Steering Committee, 2010]; however, only 700 acres are located within the study area.

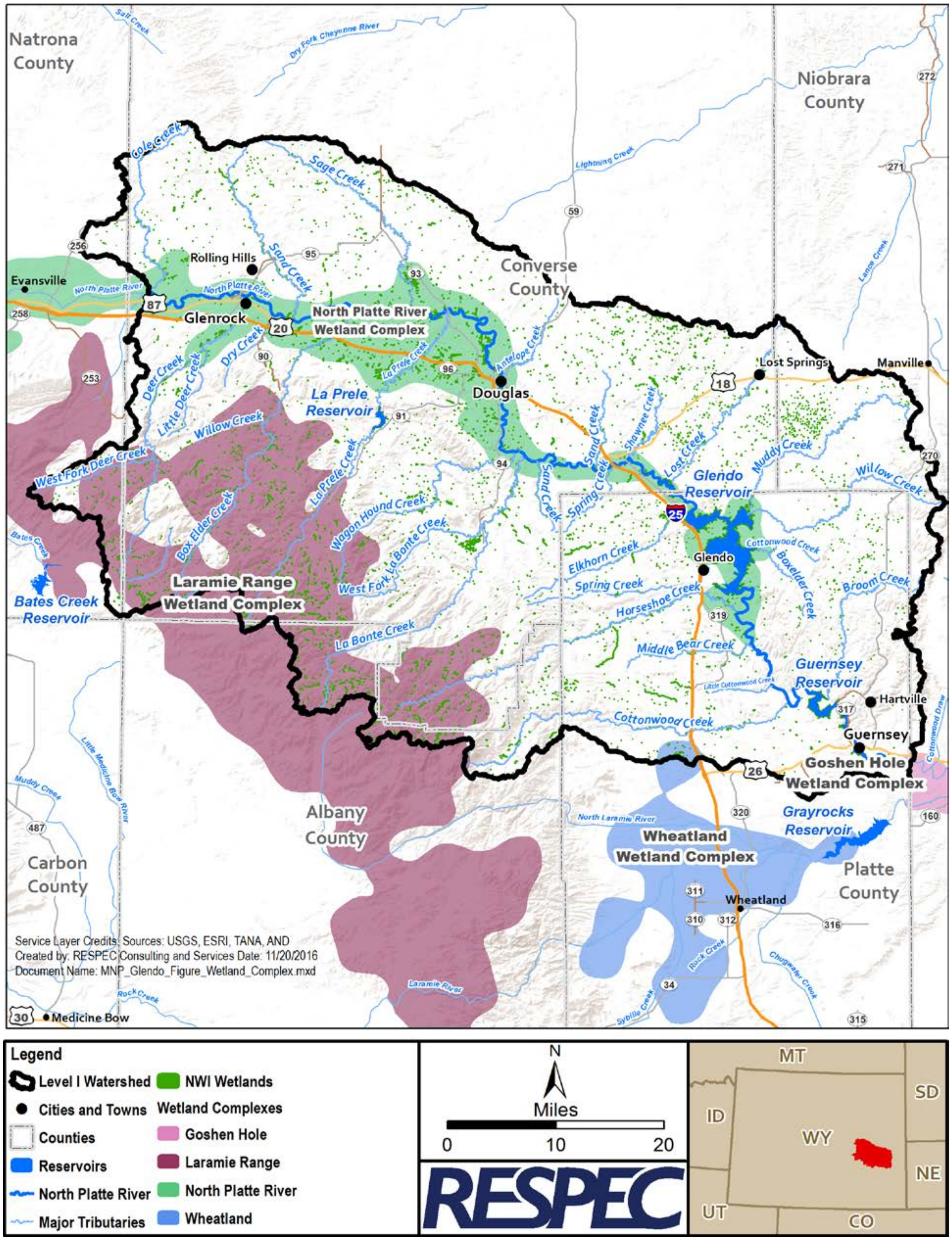


Figure 3.12. Wetland Complexes Within the Study Area [Copeland et al., 2010].

3.3.5 Geology

Geologic mapping information and data for the study area were obtained from the USGS and the WSGS. A variety of geological features and rocks occur within the study area that range from Precambrian igneous and metamorphic rocks to Quaternary alluvium along creeks. A stratigraphic chart of units present and approximate thickness within the area is provided in Table 3.17. The watershed encompasses the northern end of the Laramie Range, the Hartville Uplift, and a small portion of the southern Powder River Basin as shown in Figure 3.13. The area has a complex structural history with Laramide-age faulting and folding, which resulted in formations with steep dips as well as thick Cenozoic sedimentary units.

Table 3.17. General Stratigraphic Thicknesses Near Douglas (Modified From Weston [2015] and Rapp [1953])

Geologic Age	Formation Name	Formation Thickness (ft)
Quaternary	Alluvium and Terrace	0–20
Tertiary	Ogallala and Arikaree	0–400
	White River	0–1,500+
	Fort Union	0–2,800
Upper Cretaceous	Niobrara	740
	Frontier	880–1,200
	Mowry Shale	100–200
Lower Cretaceous	Muddy Sandstone	25
	Thermopolis Shale	146
	Cloverly	100–300
Jurassic	Morrison	175–200
	Sundance	350
Triassic	Chugwater	570–650
Permian	Goose Egg	300
Pennsylvanian	Casper	600–1,100
Mississippian	Madison Limestone	200
Devonian	Fremont Canyon Sandstone	100
Precambrian	Granite and Metamorphic	–

An in-depth discussion of the watershed's geology was beyond the scope of this study; however, general geologic maps and discussions are presented to define the formations present that could potentially affect development of improvement projects and reservoir storage.

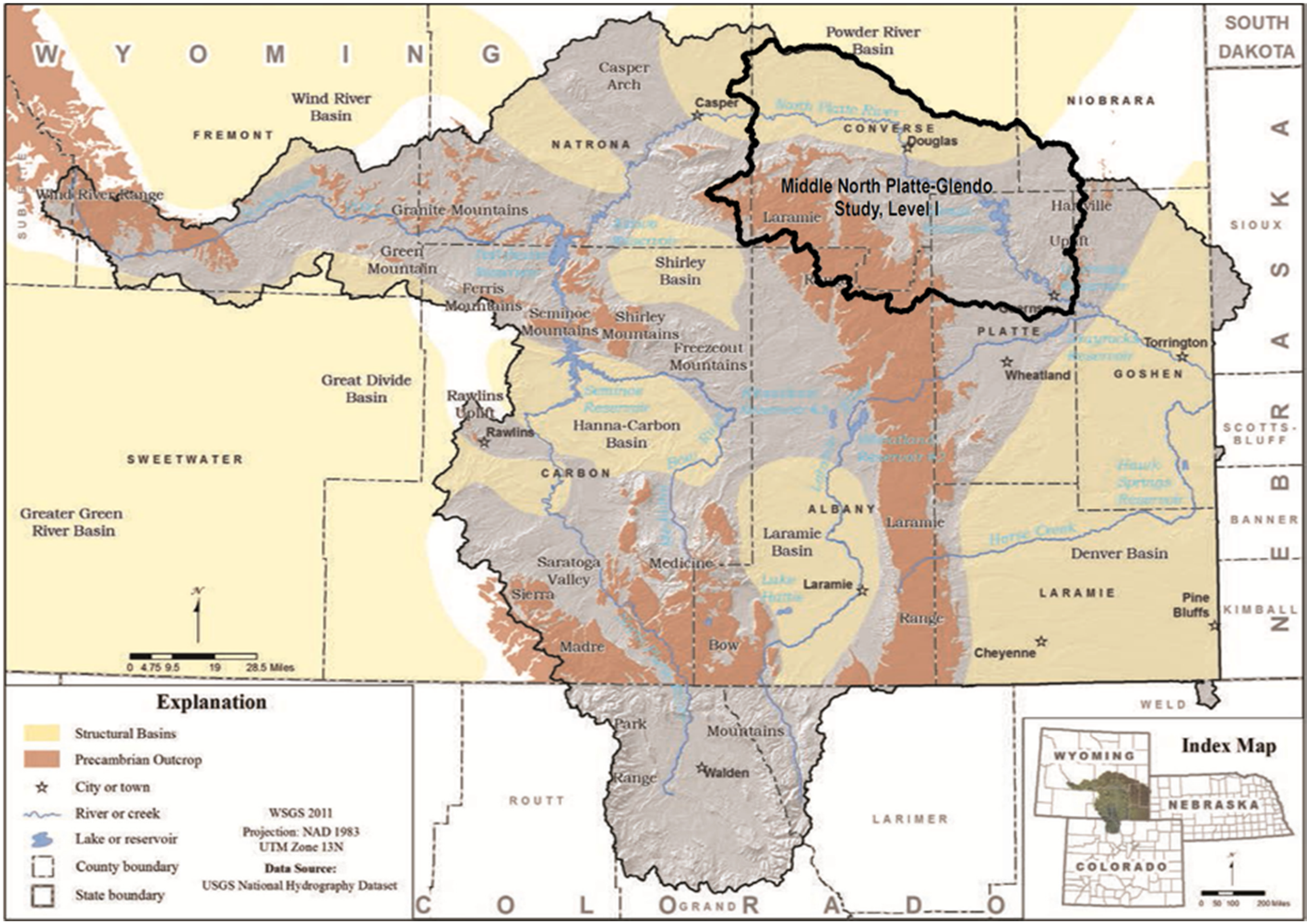


Figure 3.13. Major Basins and Ranges of the Platte River Basin [Taucher et al., 2013].

3.3.5.1 *Surficial Geologic Units*

Surficial geologic units influence the watershed by providing the parent material for the soil formations and plant communities; surficial deposits also impact stream morphology. Surficial geologic units are listed in Table 3.18 and shown in Figure 3.14. The predominant surficial geologic units in the watershed are residuum mixed (in-place decomposed rock mixed with alluvium, eolian, slopewash, grus, and/or bedrock), slopewash (soil and rock that has been moved downslope by gravity, possibly assisted by water), and bare bedrock. The residuum and slopewash are distributed throughout the watershed; although, the bedrock is concentrated where the Precambrian rocks outcrop in the Laramie Range. Additional surficial units include alluvium, alluvial fan, colluvium, eolian, terrace, grus, and landslide.

Table 3.18. Surficial Geologic Units Within the Study Area

Unit Name	Area (acres)	Percent of Study Area
Alluvium	30,564	1.5
Alluvium Mixed Terrace	65,005	3.1
Alluvial Fan	55,283	2.6
Bench or Mesa	13,682	0.7
Colluvium Mixed	99,443	4.7
Eolian	142,413	6.8
Terrace	110,647	5.3
Residuum Mixed with Bedrock	63,912	3.0
Residuum Mixed	534,729	25.5
Residuum Terrace	38,332	1.8
Slopewash	126,663	6.0
Slopewash Mixed	499,089	23.8
Grus Mixed	28,496	1.4
Bedrock	269,926	12.9
Landslide	2,697	0.1
Mined Areas	1,807	0.1
Lake/Water	13,118	0.6

3.3.5.2 *Bedrock Geologic Units*

The bedrock geologic units that underlie the watershed study area predominantly consist of Tertiary sedimentary units and Precambrian rock as shown in Figure 3.15 and listed in Table 3.19. Quaternary and Tertiary deposits cover over 65 percent of the watershed, and generally occur in the northeastern two-thirds of the watershed. The most expansive Tertiary formations include the White River, Fort Union, and Wasatch. Precambrian rocks cover approximately 20 percent of the watershed and are concentrated within the Laramie Range in the southwest corner of the watershed; Precambrian rocks include the Laramie Granite, older metamorphic rocks, and numerous intrusive pegmatite veins.

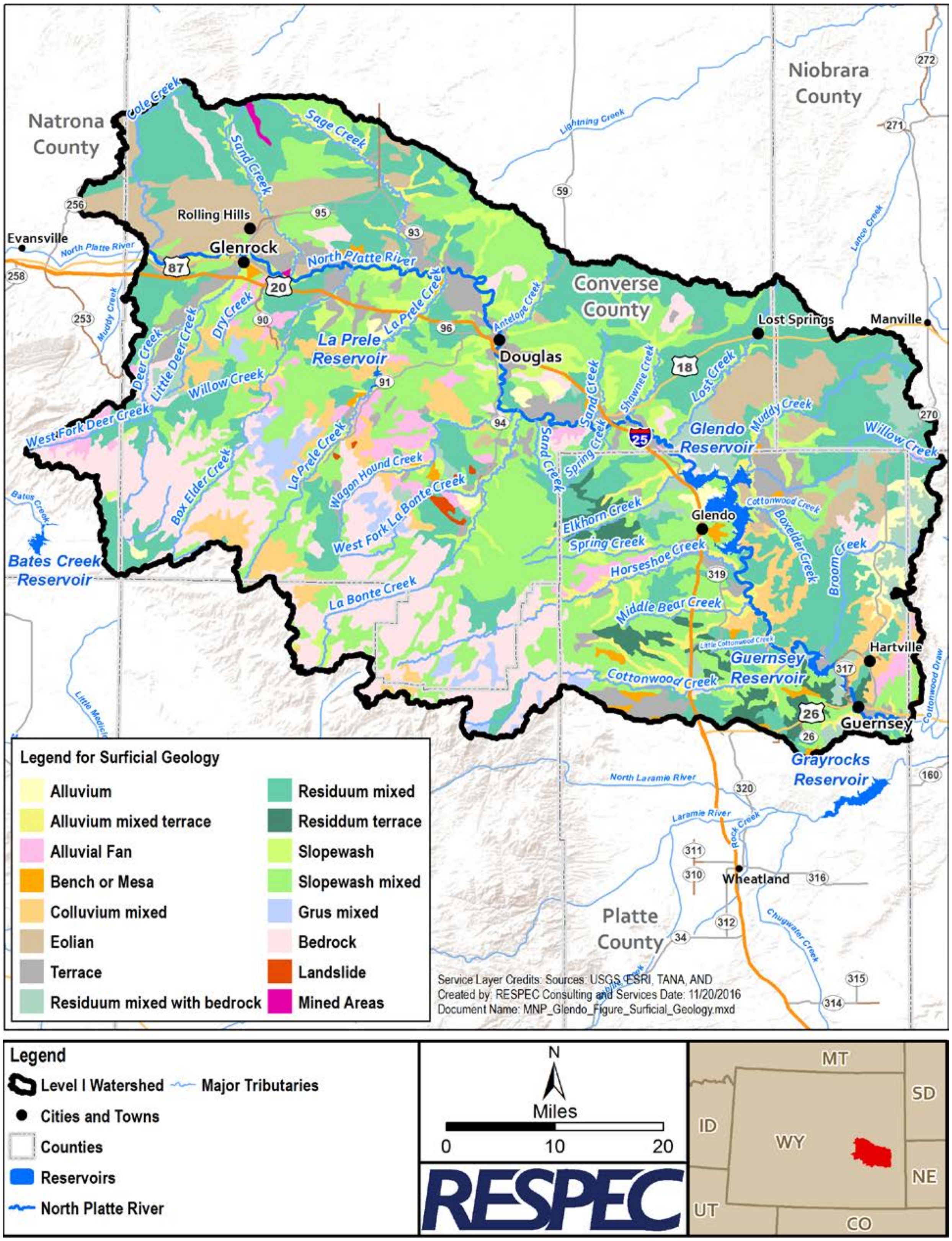


Figure 3.14. Surficial Geology of the Watershed.

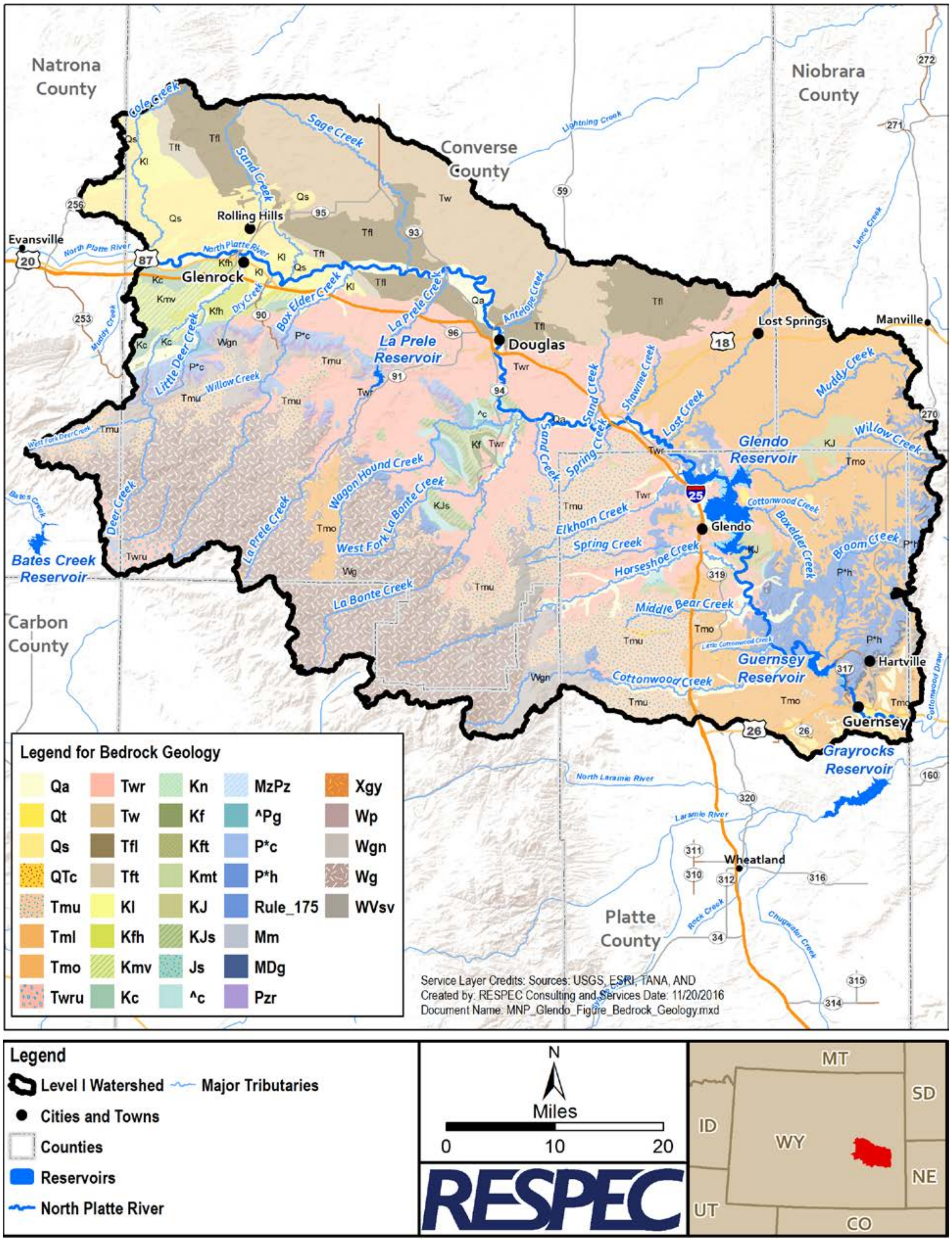


Figure 3.15. Bedrock Geology of the Watershed.

Table 3.19. Bedrock Geologic Units Within the Study Area (Page 1 of 2)

Unit Symbol	Geologic Unit Name	Area (acres)	Percent of Study Area
Qa	Alluvium and colluvium	85,525	4.1
Qt	Gravel, pediment, and fan deposits	1,951	0.1
Qs	Dune sand and loess	72,415	3.5
QTc	Conglomerate	949	< 0.1
Tmu	Upper Miocene sedimentary rocks	205,352	9.8
Tml	Lower Miocene sedimentary rocks	244	< 0.1
Tmo	Miocene/Oligocene (White River equivalent)	377,881	18.0
Twru	White River Formation, upper conglomerate member	13,404	0.6
Twr	White River Formation	312,334	14.9
Tw	Wasatch Formation	176,742	8.4
Tfl	Lebo Member of Fort Union Formation	132,928	6.3
Tft	Tullock Member of Fort Union Formation	13,670	0.7
Kl	Lance Formation	34,791	1.7
Kfh	Fox Hills Sandstone	14,155	0.7
Kmv	Mesaverde Group	18,744	0.9
Kc	Cody Shale	12,592	0.6
Kn	Niobrara Formation	891	< 0.1
Kf	Frontier Formation	3,192	0.2
Kft	Frontier Formation and Mowry and Thermopolis Shales	148	< 0.1
Kmt	Mowry and Thermopolis Shales	3,895	0.2
KJ	Cloverly and Morrison Formations	19,089	0.9
KJs	Cloverly, Morrison, and Sundance Formations	16,046	0.8
Js	Sundance Formation	1,619	0.1
Trc	Chugwater Formation or Group	10,168	0.5
MzPz	Mesozoic and Paleozoic (undeferentiated)	55	< 0.1
TrPg	Goose Egg Formation	8,249	0.4
PPc	Ten Sleep sandstone and Amsden Formation	27,064	1.3
PPh	Hartville Formation	86,246	4.1

Table 3.19. Bedrock Geologic Units Within the Study Area (Page 2 of 2)

Unit Symbol	Geologic Unit Name	Area (acres)	Percent of Study Area
PM	Casper Formation and Madison Limestone	8,944	0.4
Mm	Madison Limestone or Group	346	< 0.1
Mdg	Guernsey Formation	6,470	0.3
Pzr	Madison Limestone, Darby Formation, Bighorn Dolomite, Gallatin Limestone, Gros Ventre Formation, and Flathead Sandstone	10,063	0.5
Xgy	Precambrian granite	959	< 0.1
Wp	Peridotite intrusive	707	< 0.1
Wgn	Granite gneiss	57,156	2.7
Wg	Granitic rocks of 2,600 Ma age group	329,618	15.7
WVsv	Metasedimentary and metavolcanic rocks	14,406	0.7
H2O	Water	16,799	0.8
Total		**2,095,807**	**100.0**

Paleozoic and Cretaceous rocks outcrop primarily within the southern half of the watershed. The area near Glenrock has outcrops of many Cretaceous shale beds, while older Paleozoic rocks flank the Laramie Range and are exposed where Tertiary rocks have been eroded from anticlinal folds and other structural features.

East of Glendo, the Hartville Uplift has resulted in erosion of much of the White River Formation and exposed the underlying sandstone and carbonates of the Hartville Formation. While the Hartville Uplift represents over 8,000 feet of structural uplift, topographic relief across the area is relatively low. Groundwater aquifers are described in Section 3.6.1.

3.3.5.3 *Hazardous Geological Features*

Figure 3.16 displays the known faults and landslides within the watershed. Landslide deposits indicate that landslide activity has occurred in two primary areas within the watershed, including several slides approximately 16 miles southwest and south-southwest of Douglas; the largest slide in this area occurs on the northeast face of Manning Ridge where the Cloverly Formation forms the dip slope of the hogback.

Faults occur throughout the watershed. The largest fault zone separates the Laramie Range from the Powder River Basin and trends roughly east-west on the south side of the North Platte River between Glenrock and Douglas (Figure 3.16). This large fault may have up to 3,000 feet of vertical offset [Feathers et al., 1981]. A large north-northeast-trending fault runs along the eastern edge of the Hartville Uplift.

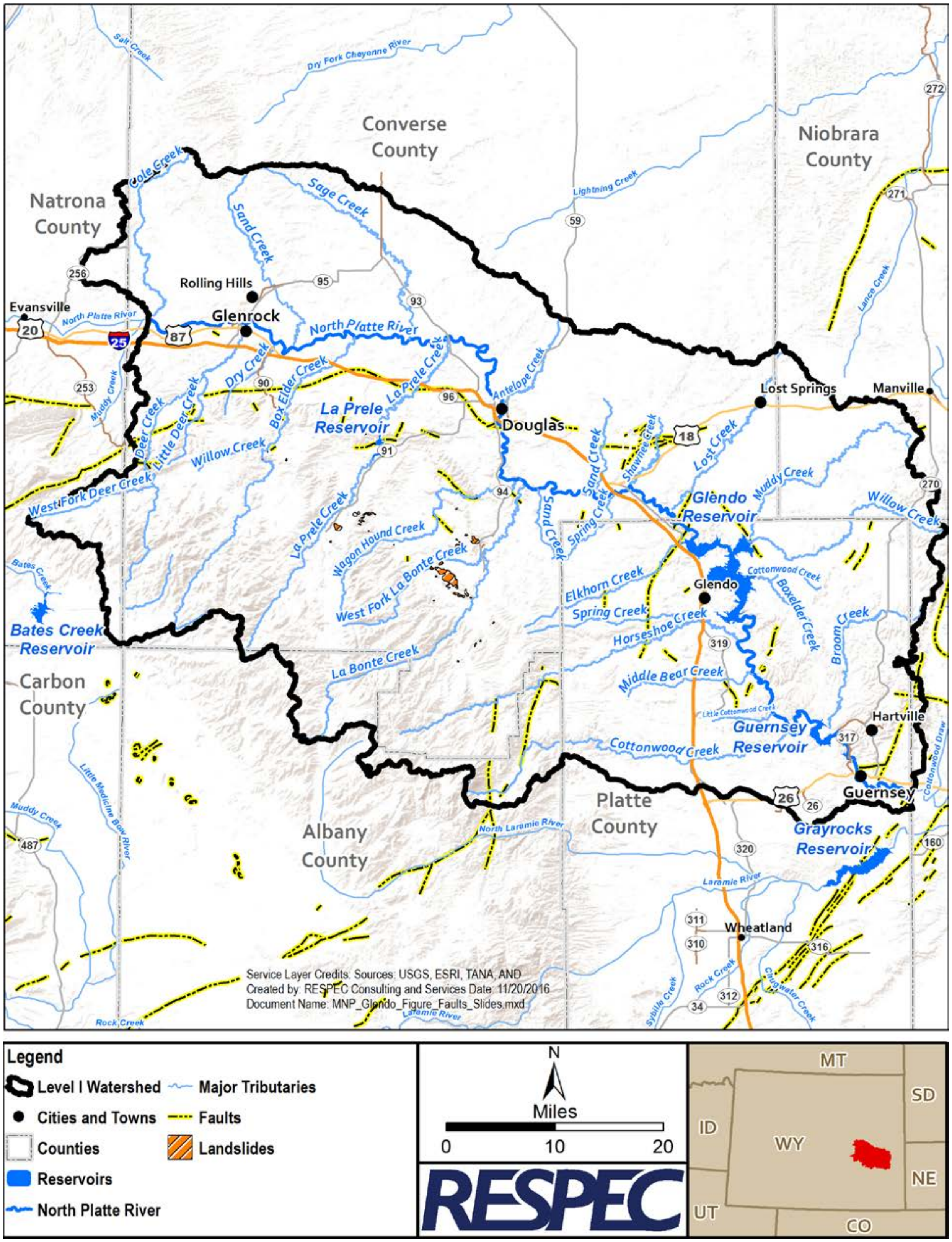


Figure 3.16. Faults and Landslides Within the Watershed.

3.3.6 Soils

Soils are somewhat diverse within the study area because of the watershed's geology, topography and elevation, climate, precipitation, and vegetation attributes. The available NRCS digitized soil survey spatial and tabular data were obtained from Soil Survey Geographic Database (SSURGO) for the portions of the watershed in Albany, Converse, Goshen, Niobrara, and Platte Counties [NRCS, 2015]. NRCS has published 7 soil surveys with SSURGO mapped soils that cover approximately 1,818,460 acres (86.8 percent) within the watershed and are listed in Table 3.20.

Table 3.20. Published Natural Resources Conservation District Soil Surveys Within the Study Area

Soil Survey Area Symbol	Soil Survey Name	Year Published	Area (acres)	Percent of Study Area
WY027	Niobrara County, Wyoming	2003	99,389	4.7
WY031	Platte County, Wyoming	2003	518,481	24.7
WY601	Albany County, Wyoming	1998	18,667	0.9
WY609	Converse County Area, Southern Part	2008	979,888	46.8
WY625	Natrona County Area, Wyoming	1997	38,391	1.8
WY709	Converse County, Northern Part	1988	143,416	6.8
WY715	Goshen County, Wyoming, Northern Part	1981	20,227	1.0
Total			**1,818,460**	**86.8**

Within the watershed, there are 459 soil map units with 318 unique and 141 comparable soil-map unit names, which were mapped as part of the seven NRCS Soil Surveys. There are other similar soils that exist between each of the soil surveys within the watershed and are evident along the county boundaries in Figure 3.17. Two of the largest soil map units cover approximately 7 percent of the study area. The Kishona-Cambria-Theedle loams, 3–20 percent slopes (WY609 189 and WY027 154) and the Theedle-Kishona-Shingle loams on 3–30 percent slopes (WY609 251 and WY027 206) cover approximately 73,206 acres (3.5 percent) and 72,819 acres (3.5 percent) of the study area, respectively, and are located within Converse and Niobrara Counties. Other major soil units include the Kishona-Cambria loams (WY609 187) on 0–6 percent slopes and the Rock outcrop-Cathedral complex (WY609 218) on 10–75 percent slopes that cover approximately 60,958 acres (2.9 percent) and 60,847 acres (2.9 percent) of the study area, respectively, and are located in Converse County. Figure 3.17 shows and Table 3.21 lists the 25 map units that cover approximately 1,818,460 acres within the watershed.

Four types of soil horizon textures exist on more than 52 percent of the watershed. Loam soils are the most common and occur on approximately 441,161 acres (21.1 percent) of the study area. Other predominant soil textures include fine sandy loam, which encompasses 409,499 acres (19.5 percent) and very gravelly sandy loam, which covers 140,753 acres (6.7 percent) of the study area. Bedrock outcrops on approximately 102,356 acres (4.9 percent). Figure 3.18 shows and Table 3.22 lists the 15 soil textures existing on approximately 1,723,203 acres (82 percent) of the watershed.

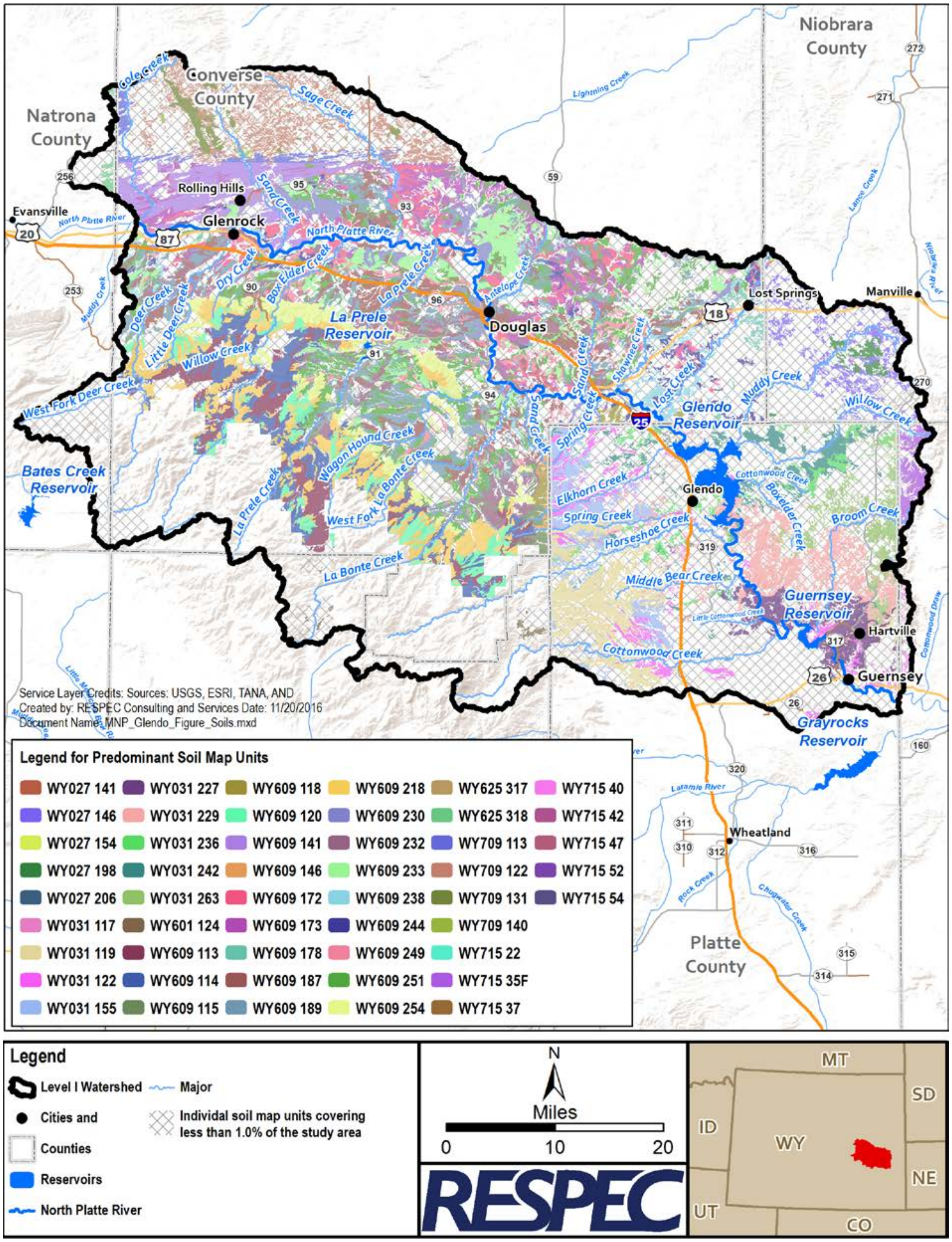


Figure 3.17. SSURGO Soils Map Units Within the Study Area.

Table 3.21. Summary of Predominant Soil Map Units Within the Study Area (Page 1 of 2)

Soil Survey Area and Map Unit	Soil Map Unit Name	Area (acres)	Percent of Study Area
WY609 189 WY027 154	Kishona-Cambria-Theedle loams, 3–20 percent slopes	73,206	3.5
WY609 251 WY027 206	Theedle-Kishona-Shingle loams, 3–30 percent slopes	72,819	3.5
WY609 187	Kishona-Cambria loams, 0–6 percent slopes	60,959	2.9
WY609 218	Rock outcrop-Cathedral complex, 10–75 percent slopes	60,847	2.9
WY609 141 WY709 113 WY625 318	Dwyer-Orpha loamy sands, 3–15 percent slopes	50,368	2.4
WY031 119 WY609 115 WY715 40	Brown-Featherlegs-Recluse complex, 5–40 percent slopes	46,800	2.2
WY609 233 WY625 317	Shingle-Taluce-Badland complex, 10–40 percent slopes	45,801	2.2
WY609 114 WY601 124 WY031 117	Boyle-Rock outcrop complex, 5–25 percent slopes	43,191	2.1
WY031 242 WY609 244 WY027 198	Taluce-Turnercrest-Keeline fine sandy loams, 3–20 percent slopes	39,399	1.9
WY609 173 WY027 141	Hiland-Bowbac fine sandy loams, 6–15 percent slopes	39,205	1.9
WY031 229 WY715 47	Sunup-Snavee-Rock outcrop complex, 0–30 percent slopes	39,140	1.9
WY609 232	Shingle-Taluce complex, 6–40 percent slopes, cobbly	37,894	1.8
WY709 122	Hiland-Bowbac complex, 6–15 percent slopes	36,796	1.8
WY609 254	Tyzak-Rock outcrop complex, 6–70 percent slopes	34,286	1.6
WY609 172	Hiland-Bowbac fine sandy loams, 0–6 percent slopes	31,727	1.5
WY609 113	Boyle-Lininger loams, 1–15 percent slopes	30,801	1.5
WY031 155 WY609 146 WY715 54	Featherlegs-Recluse loams, 3–15 percent slopes	28,327	1.3
WY609 120	Cathedral-Rock outcrop complex, 6–75 percent slopes	28,295	1.3
WY031 263 WY715 35F	Wendover-Rock outcrop complex, 10–60 percent slopes	27,005	1.3

Table 3.22. Summary of Predominant Soil Map Units Within the Study Area (Page 2 of 2)

Soil Survey Area and Map Unit	Soil Map Unit Name	Area (acres)	Percent of Study Area
WY031 122 WY609 118 WY715 37	Cascajo-Taluce-Badland complex, 6–40 percent slopes	26,088	1.2
WY609 230 WY709 131	Shingle-Badland-Samday complex, 10–30 percent slopes	25,172	1.2
WY031 227 WY715 42	Storsun-Sunup-Rock outcrop complex, 3–50 percent slopes	24,569	1.2
WY609 249 WY709 140	Theedle-Kishona loams, 0–6 percent slopes	23,142	1.1
WY609 238 WY031 236 WY715 52	Taluce-Badland-Turnercrest complex, 6–50 percent slopes	22,976	1.1
WY027 146 WY609 178	Jayem-Phiferson-Trelona fine sandy loams, 3–10 percent slopes	20,470	1.0
	Map units that cover < 1.0 percent of the study area	849,176	40.5
Total		**1,818,460**	**86.8**

The loam and sandy loam textured soils cover approximately 1,227,053 acres (58.5 percent) of the watershed. These loam and sandy loam soils are indicative of A and B hydrologic soil groups (HSGs), which have low or moderately low runoff potential, unimpeded water transmission, and minor clay content and are well to excessively drained. The remaining soils within the study area are also loam and sandy loam soils but are comprised of very fine, fine, gravelly, cobbly, and channery soil textures.

These soils influence the stream channels and associated riparian areas because of their productivity, permeability, texture, aggregate stability, strength, and erodibility. The interrelationships between the study area's soil, precipitation, topography, drainage pattern, geology, and vegetation cumulatively influence a stream's channel slope, meander pattern, cross-sectional dimensions, and bed and bank composition. Soil productivity is also significant because it affects the amount and type of vegetation that covers the soil surface and provides forage for livestock grazing and habitat for wildlife within the watershed. Overall, the watershed's soils are low in productivity, but more productive soils are found in alluvial valleys and floodplains, which is also why most of the irrigation and hay production occurs in these areas. Some portions of the study area have soluble salts that affect the soil's productivity, infiltration rate, water and nutrient availability, and vegetative cover.

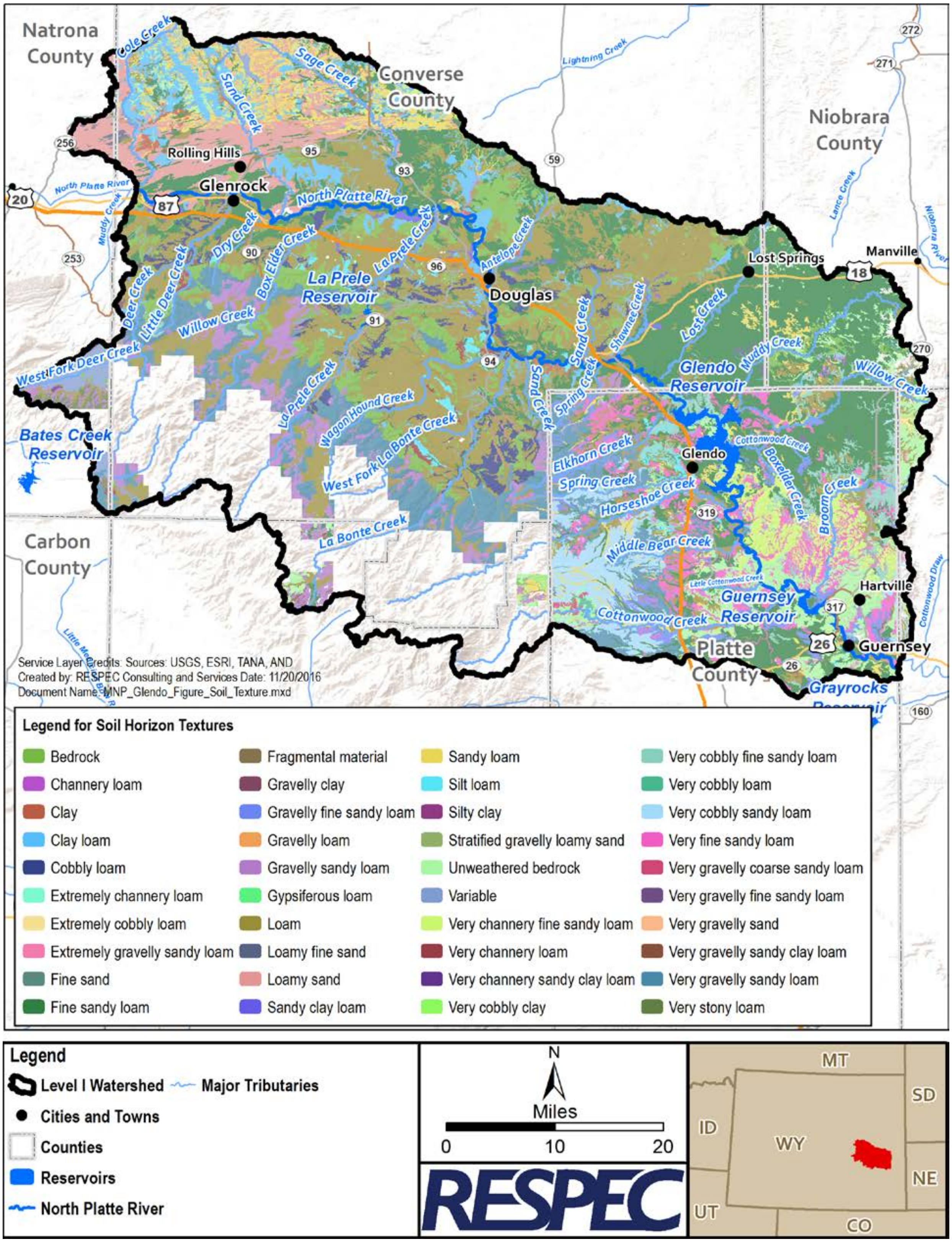


Figure 3.18. SSURGO Soil Horizon Textures Within the Study Area.

Table 3.22. Summary of Predominant Soil Horizon Textures Within the Study Area

Soil Horizon Texture	Area (acres)	Percent of Study Area
Loam	441,162	21.1
Fine sandy loam	409,499	19.5
Very gravelly sandy loam	140,753	6.7
Bedrock	102,356	4.9
Loamy sand	78,876	3.8
Sandy loam	77,888	3.7
Unweathered bedrock	76,168	3.6
Clay loam	74,014	3.5
Very fine sandy loam	73,889	3.5
< 1.4 percent of study area	65,753	3.1
Gravelly sandy loam	61,948	3.0
Very cobbly sandy loam	43,277	2.1
Very channery fine sandy loam	39,140	1.9
Cobbly loam	38,227	1.8
Very cobbly fine sandy loam	36,734	1.8
Gravelly fine sandy loam	29,272	1.4
Total	1,788,956	85.4

3.4 LAND USES AND ACTIVITIES

3.4.1 Land Ownership

Land ownership within the watershed is predominantly private, at 2,472 square miles, or 75.5 percent of the watershed. Of the private land, approximately 2,248 square miles (91.0 percent) consist of range and forest grazing land. Only 54.7 square miles (2.2 percent) of the private lands are irrigated, but this represents 97 percent of all irrigated land in the watershed. The grazing and irrigated private lands within the watershed, consisting of parcels greater than 160 acres, are owned by approximately 350 to 400 individuals or entities.

The state of Wyoming owns 393 square miles (12.0 percent) of the watershed, and 371 square miles (11.3 percent) are federal lands under management of the BLM, USFS, and the Department of Defense. Nearly 375 square miles of State land consists of range and forest grazing land, while federal agencies manage approximately 365 square miles for grazing. Neither the state nor the federal agencies control a significant amount of irrigated land, at a combined total of less than two square miles. More in-depth discussions of land management for irrigation and grazing are given in the following sections.

Categories of surface land ownership and management by type within each county are shown in Table 3.23. Because of the scale of the land management spatial data, the total estimated areas and corresponding percentages have been rounded up to the nearest square mile. In addition to the land ownership and management, the BLM's surface management data and county parcel data from Albany, Converse, Goshen, Niobrara, and Platte Counties were collected and included in the study's GIS. Figure 3.19 displays the surface ownership categories within the watershed.

Table 3.23. Land Ownership by County Within the Study Area

County	Federal		Private		State		Local		Water		Total	
	Sq. Mi.	%	Sq. Mi.	%	Sq. Mi.	%	Sq. Mi.	%	Sq. Mi.	%	Sq. Mi.	%
Albany	72.6	2.2	66.1	2.0	11.5	0.4					150	4.6
Converse	189.8	5.8	1,611.2	49.2	244.7	7.5	3.3	0.1	9.2	0.3	2,058	62.9
Goshen	3.6	0.1	27.6	0.8	0.3	0.01			0.001	< 0.01	32	0.9
Natrona	10.9	0.3	43.5	1.3	14.7	0.4					69	2.1
Niobrara	0.6	0.0	138.3	4.2	16.3	0.5					155	4.7
Platte	93.6	2.9	585.1	17.9	105.0	3.2			26.8	0.8	811	24.8
Total	**371**	**11.3**	**2,472**	**75.5**	**393**	**12.0**	**3**	**0.1**	**36**	**1.1**	**3,275**	**100.0**

Since private lands comprise significant portions of the grazing and irrigated lands within the study area, the management of grazing animals, the development of watering facilities, and the operation and maintenance of irrigation infrastructure facilities are the responsibility of individual landowners and lessees. The capital necessary for developing and operating these facilities on private land often involves additional revenue input from other land use activities such as oil and gas production, mineral extraction, wind energy generation, hunting/recreational opportunities, and small acreage development. While private landowners typically control the land surface, there are some private lands where the mineral estate is owned by the federal government and administered by the BLM.

Grazing on state and federal lands is essential to livestock operations within the study area. Although, the landowners' use of public grazing lands differs between operations, most use some public land grazing as part of their operations. Within the watershed, a number of livestock operations have their livestock on private lands during the fall, winter, and spring and then move their livestock to higher elevation intermixed public and private grazing lands during the summer. This grazing use pattern typically provides the necessary amount of rest and recovery for dominant vegetative communities on the private and public grass and shrub lands within the study area.

This land ownership pattern of predominantly private lands interspersed with state and federal lands affects livestock management because of the variability of forage conditions and availability of dependable watering sources. Grazing on public allotments are curtailed when drought conditions persist in the watershed and shift more grazing use onto private lands for perhaps longer periods. Those conditions could cause adjusting grazing schedules and developing additional water sources along with modifying herd size, securing additional pasture, or weaning calves early.

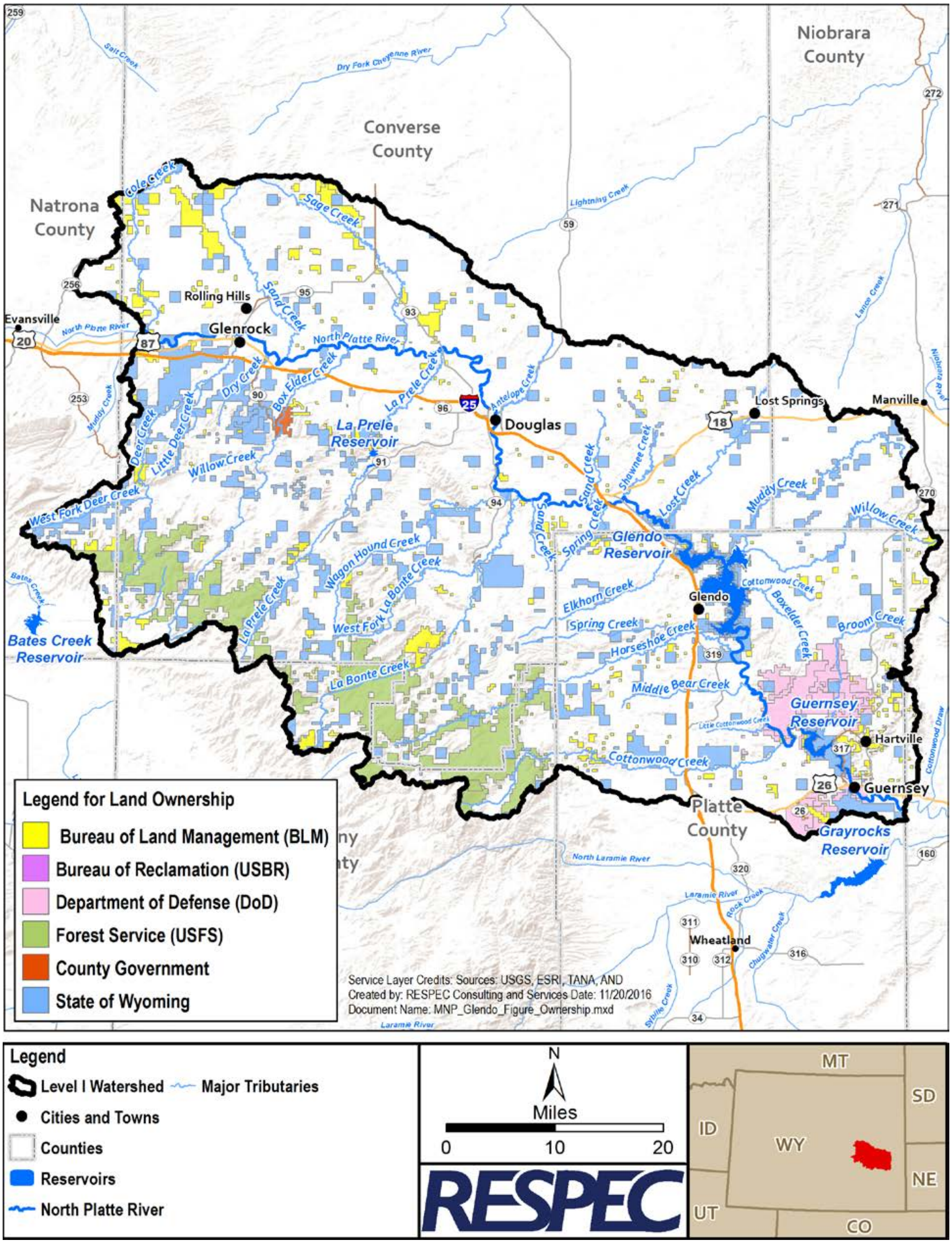


Figure 3.19. Categories of Land Ownership Within the Study Area.

3.4.2 Transportation and Energy Infrastructure

Transportation and energy corridors are concentrated in the watershed along Interstate 25 (I-25) between Glendo and Glenrock, US Highway 26 from Guernsey to Glendo, and US Highway 18 from Orin Junction to Lusk, as shown in Figure 3-20. State Highway 59 extends north from Douglas to Gillette along with other local roads and unimproved trails in the study area. The Colorado and Wyoming Railroad extends from Hartville to Guernsey. The Burlington Northern is located along US Highway 18 from Lost Springs through Douglas and Glenrock along I-25 and north along State Highway 59 within the watershed. Major roads and railroads in the watershed are also shown on Figure 3.20.

Power and energy development within the watershed includes hydropower facilities and wind power complexes with several power transmission lines located throughout the study area. Two hydropower facilities are located in the western portion of the study area: one at the outlet of Glendo Reservoir and the other below Guernsey Dam on Guernsey Reservoir. In 2014, the USGS mapped 276 industrial wind turbine locations on 6 wind farms within the study area as shown in Figure 3.21. These maps of the power lines that traverse the study area are general estimates of the locations and alignment. Information about oil-and-gas development within the watershed is located in Section 3.4.11.

In addition, several energy pipelines are located within the study area; however, information about current pipeline locations and operations should be obtained by accessing the US Department of Transportation's (DOT) National Pipeline Mapping System (NPMS) Pipeline Information Management and Mapping Application (PIMMA). PIMMA is a web-based mapping application that can be accessed on the DOT's website (*https://www.npms.phmsa.dot.gov/)* and is designed to assist federal, state and local government officials and pipeline operators with displaying and querying data related to gas transmission and hazardous liquid pipelines, liquefied natural gas plants, and breakout tanks under the DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) jurisdiction [DOT, 2015]. Access to NPMS data is limited by user type such as private or governmental with several restrictions in place for data viewing or downloading. Information and maps from PIMMA must be treated as DOT proprietary information with only NPMS staff having the right to redistribute maps or information from the NPMS [DOT, 2015].

The Wyoming Pipeline Authority (WPA) also has a comprehensive pipeline database for the state of Wyoming, which is available by contacting the WPA by telephone (307.237.5009) or visiting their website (*https://www.wyopipeline.com/web-based-interactive-map/)*. The dataset includes statewide coverage of major oil, gas, carbon dioxide, water, and product pipelines. Because of the restrictions regarding pipeline data, pipeline locations were not included in map figures within the final report; although publicly available data are included in the project's GIS.

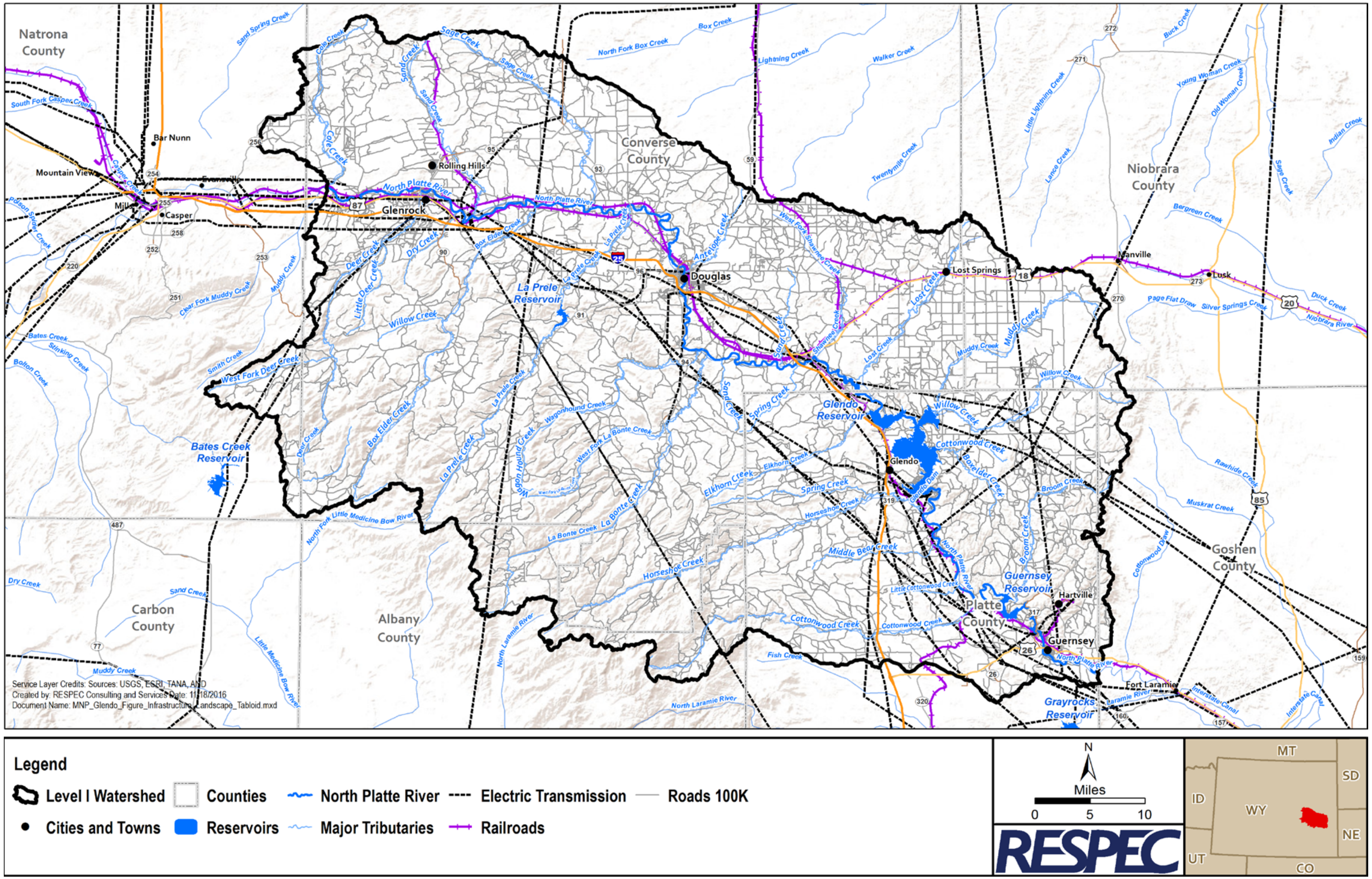


Figure 3.20. Infrastructure Features in the Study Area.

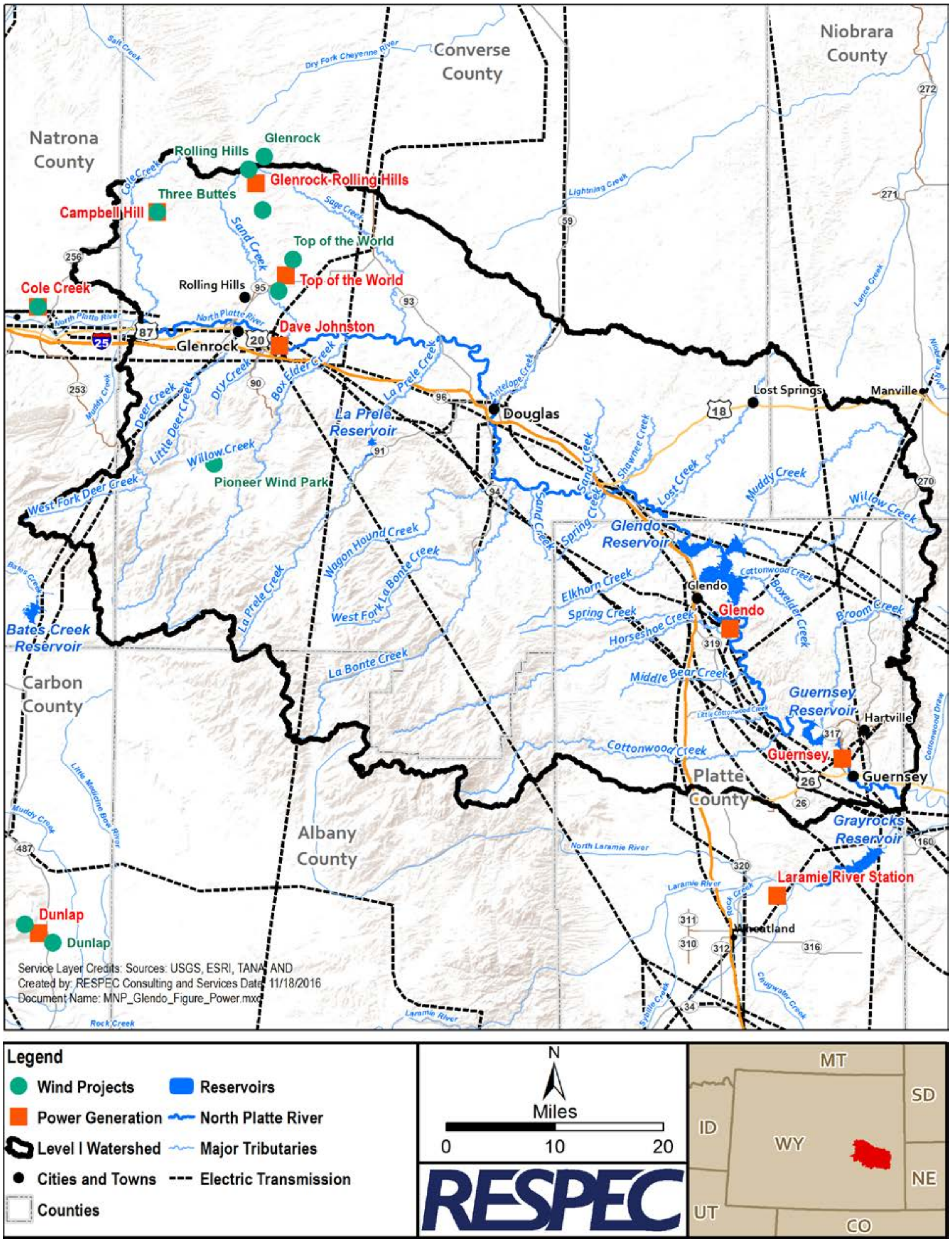


Figure 3.21. Power Generation and Transmission Lines in the Study Area.

3.4.3 Irrigation

Irrigation is primarily used by agricultural producers for livestock forage production within the watershed. Irrigation has occurred in the watershed since the 1880s with territorial water rights dating back to 1884. Grass and alfalfa hay are predominantly grown on the irrigated lands within the study area. In 2006, approximately 55,150 acres of irrigated acres were identified within the study area, which comprised 2.6 percent of the watershed. In 2012, there were approximately 36,112 acres of irrigated land identified in the watershed, which occurred because of the severe drought within the Platte Basin.

The majority of the irrigated lands and irrigation infrastructure is situated between the Laramie Range and the North Platte River, as shown in Figure 3.22. Approximately 85 percent of the irrigated lands are located along the North Platte River, Deer, La Bonte, La Prele, and Wagon Hound Creeks. Additionally, 97 percent (35,023 acres) of the 36,112 irrigated acres is located on private lands within the watershed.

The irrigation season is defined as a period from May 1 to September 30 in the 2001 North Platte Modified Decree [Supreme Court of the United States, 2001]. In the watershed, the irrigation season typically begins in early May and ends in early July, depending on snow pack, water availability, and weather [Western Water Consultants (WWC), 2007]. Stream flows from snowmelt runoff provides the majority of irrigation water in May and June and typically decreases in July, August, and September, which results in late season irrigation shortages within the study area.

3.4.4 LaPrele Irrigation District

The LaPrele Irrigation District (LID) distributes water to 103 users who irrigate 11,462 acres west of Douglas and covers approximately 0.6 percent of the watershed, as illustrated in Figure 3.23 [WWDC, 2015b]. The LID is the only irrigation district located within the study area. The LID distribution system is supplied with water from La Prele Creek and includes LaPrele Dam and Reservoir, the Main Canal Diversion, the West Side Ditch Diversion, intermediate regulating reservoirs, and over 94 miles of canals and laterals. LaPrele Reservoir is owned and operated by the LID and has a permitted capacity of 21,000 acre-feet for irrigation, domestic, and industrial uses [WWDC, 2015b]. LaPrele Dam is located on La Prele Creek in Section 21 of Township 32 North, Range 73 West in the foothills of the Laramie Range.

3.4.4.1 *History*

The LaPrele Project was first planned in 1905 and was intended to irrigate 27,000 acres. The LaPrele Dam, which is a hollow, reinforced concrete structure, and its distribution system were constructed in 1909. The Douglas Reservoirs Water Users Association (now organized as the LID) acquired the system and began operating in 1923, at which point the project was accepted as complete under the Carey Act by the Federal Government [SEO, 1971]. The LaPrele Dam had leakage issues from the beginning of reservoir operation, which coupled with deterioration of the dam, prevented full use of the reservoir.

In the 1950s, the USBR began investigating rehabilitation of the LaPrele Project. In 1969, the USBR released a report that included plans for a new dam with a 43,000-acre-foot storage capacity, construction of a drainage system, and rehabilitation of the distribution system, which would provide supplemental water to 7,230 acres. However, the USBR determined the project to be economically infeasible and unjustified [SEO, 1971].

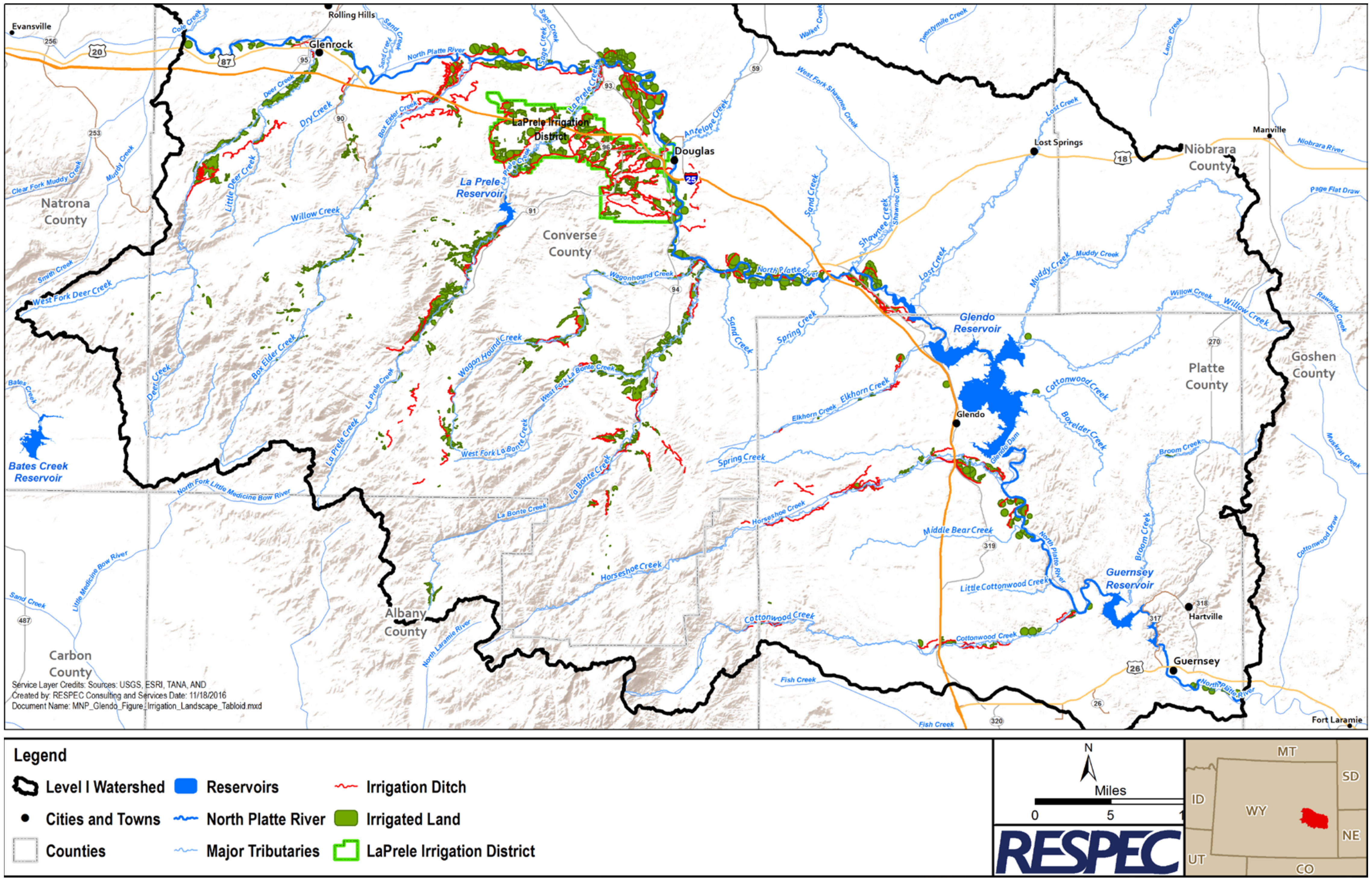


Figure 3.22. Irrigation Ditches and Irrigated Lands Within the Watershed.

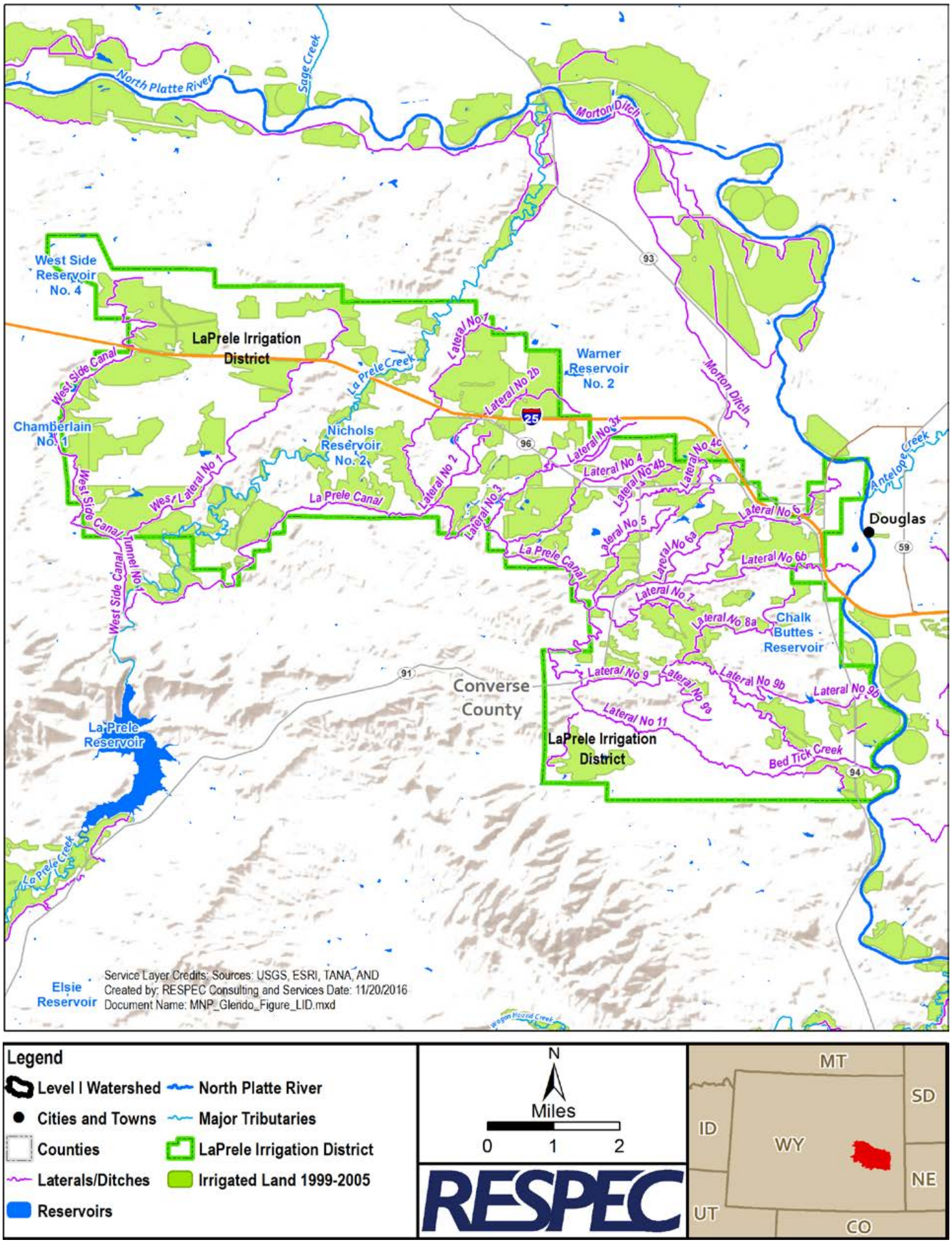


Figure 3.23. Irrigation Laterals and Irrigated Lands Within and Surrounding the LaPrele Irrigation District.

In 1970, a flood on La Prele Creek nearly overtopped the dam, which raised concerns about the dam's spillway capacity. This concern, combined with the questionable integrity of the dam itself, led the State Engineer to restrict storage within the reservoir [SEO, 1971]. In 1975, the Panhandle Eastern Pipeline Co. agreed to fix the dam in return for water shares to be used in a proposed coal gasification project. The dam was rehabilitated and storage restrictions were lifted in 1983, but the Panhandle Eastern Pipeline Co. eventually abandoned their coal gasification project [SCS, 1990].

3.4.4.2 *Past Investigations*

The LID has had water supply, storage, distribution, drainage issues, and several investigations into the LID infrastructure and operations have been conducted. Investigations completed on behalf of the WWDC are summarized below:

- *Phase II Report for the Chamberlain Reservoir Rehabilitation Project Level II,* prepared by Western Water Consultants, Inc., June 1990.
- *Phase I Report for the Chamberlain Reservoir Rehabilitation Project Level II,* prepared by Western Water Consultants, Inc., March 1990.
- *A Report to the Douglas Reservoir Water Users Association and WWDC, Priority Improvements of the LaPrele Irrigation Project*, prepared by James J. Jacobs, University of Wyoming, November 1983.
- *LaPrele Irrigation Project, Section I Soils and Drainage, Section II Seepage and Water Loss Study, and Section III Hydrology Study*, prepared by Nelson Engineering, September 1983.
- *LaPrele Level III Development Plan, Interim Report,* prepared by Nelson Engineering, November 1982.

In 1982, Nelson Engineering produced an Interim Report for a Level III Development Plan for the LID. Then in 1983, Nelson Engineering studied water losses and inefficiencies within the LID, and determined that the distribution system was approximately 55 percent efficient with inherent losses caused by seepage, evaporation, and transpiration and other losses caused by management. Combining field measurements and projections, Nelson estimated the average inherent losses from canals over a 90-day period to total 4,600 acre-feet, as shown in Table 3.24. These inherent losses were estimated as representing 65 percent of all losses within the system, with the remaining 35 percent caused by inaccurate flow measurements and restrictions to proper system management [Nelson, 1983].

Nelson determined that the greatest return on investment would be realized by improving system management rather than reducing inherent losses. Thus, Nelson recommended constructing flow-measuring and control devices and maintenance roads along the canals at an estimated 1983 construction cost of $673,000. Nelson [1983] estimated that these projects would increase system efficiency from 55 to 70 percent, which resulted in an increased average annual per-acre supply to producers from 0.83 to 1.02 acre-feet. The University of Wyoming (UW) evaluated the potential economic benefits to producers from estimated increases in system efficiencies. The UW assessment concluded that the improvements would be economically viable if the costs were amortized over 50 years at an interest rate of 6 percent or less, but the projects were never constructed [UW, 1983].

Table 3.24. Estimated 90-Day Losses From the LaPrele Irrigation District Distribution System From Nelson Engineering [1983]

CANAL	Length Studied (miles)	Seepage (ac-ft)	Surface Evaporite (ac-ft)	Phreatophyte Transpiration (ac-ft)	Total Losses (ac-ft)	Average Loss Rate (ac-ft/mi/day)
Main Canal	15.7	1,978	26	24	2,028	1.40
Lateral No. 1	4.3	328	3	3	334	0.84
Lateral No. 2	2.7	73	1	1	75	0.30
Lateral No. 4	2.8	341	2	2	345	1.35
Lateral No. 5	2.0	59	1	1	61	0.33
Lateral No. 6, 6b	4.5	295	3	3	301	0.73
Lateral No. 7	1.9	113	1	1	115	0.67
Lateral No. 8	2.2	130	1	1	132	0.67
Lateral No. 9, 9a, 9b	6.5	375	4	4	383	0.64
Lateral No. 11	4.2	115	3	2	120	0.30
West Side Canal	8.3	321	6	6	333	0.43
West Side Lateral	7.0	365	4	4	373	0.58
Total	**62.0**	**4,493**	**55**	**52**	**4,600**	**0.81**

ac-ft = acre per foot

ac-ft/mi/day = acre per foot per mile per day.

In 1964, Chamberlain No. 1 Reservoir was constructed adjacent to the LID's West Side Ditch to provide additional water storage to producers, with an adjudicated water right for 504.83 acre-feet in total storage. From construction, the dam experienced issues with seepage and eventually had a slump failure on the downstream dam face. In 1986, the State Engineer restricted the storage level in the reservoir because of safety concerns. In 1989, rehabilitating the Chamberlain Dam and Reservoir was authorized by the Wyoming Legislature. In 1990, WWC evaluated rehabilitation alternatives, made recommendations, and prepared cost estimates in Phase I and Phase II reports for the Level II project. The chosen alternative included lowering the dam crest and principle spillway elevation, which ultimately reduced the storage capacity of Chamberlain Reservoir to 255 acre-feet [WWC, 1990a; 1990b]. Rehabilitation of the Chamberlain Reservoir was completed in 1996.

3.4.4.3 *Current State*

The state of the LID distribution system at the time of this study seemed to be much the same as described in past investigations. Infrastructure components are aged and in need of rehabilitation; most canals and laterals are in need of maintenance; and efficient management of the system is hindered by the lack of access and flow-measurement devices. Some specific components of the system were inventoried as part of this study and are discussed in subsequent sections, but the entire system is too vast to characterize within the scope of this study. In general, RESPEC recommends that the LID submit an application to the WWDC for consideration of completing an Irrigation Master Plan and investigate the feasibility of replacing and/or rehabilitating the Main Canal Diversion and the Westside Canal Diversion structures.

3.4.5 Irrigated Lands

Irrigated lands within the watershed consist mainly of flood-irrigated meadows and pastures that consist of various cool season native and adapted grasses, which are managed to produce hay and forage to feed livestock during the winter. These irrigated lands are mostly located on alluvium- and colluvium-derived soils found on the valleys along a river or creek. Also, irrigated lands are located near the Laramie Range where irrigation occurs on uplands with moderately steep slopes and narrow valleys.

The SEO conducts field investigations to determine the intentionally acres irrigated during a specific year and then the irrigated lands polygons derived from the investigation were overlaid onto the National Agriculture Imagery Program (NAIP) aerial imagery [WWC, 2007; SEO, 2015; Cowley, 2016]. In 2006, approximately 55,150 acres of irrigated land were identified within the study area, which comprised 2.6 percent of the total area. In 2012, that number dropped to 36,112 irrigated acres, indicating an estimated 34.5 percent reduction from 2006. This was the result of a reduced runoff period and low streamflows caused by below-average precipitation and snowpack within the Platte Basin during the 2012 water year. A description of the climatic conditions in 2012 was written by Brian Pugsley, Water Division I Superintendent in Torrington, Wyoming, and contained in the SEO's *2012 Annual Report* [SEO, 2012]:

> *Hydrographers within Division I reported that with snowpack levels being what it was and with little to no precipitation throughout the spring and summer months, their creeks and streams saw very little water and in some cases they went completely dry in some areas. Along with the lack of early spring moisture, extremely hot temperatures and strong winds, area producers had to start their irrigation early in order to get moisture to the seeds that had been planted so they could germinate. Some appropriators in the higher elevations weren't quite ready when the runoff began and by the time they were ready the runoff had come and gone or the creek had diminished to point that regulation was invoked, and senior appropriators were all that were in priority for the stream flows that remained. There were several areas where only single appropriations could be delivered and appropriators with post 1945 rights didn't see any water in there ditches this year.*

The location of irrigated lands within the study area have been categorized by county, HUC 10 watershed, and river or creek valley. Of the 36,112 total irrigated acres, the majority (88.5 percent) are located within Converse County. Another 10.9 percent are located within Platte County, with very little irrigated land within Albany County (< 0.6 percent) and Natrona County (< 0.1 percent).

By HUC 10 watershed, the largest portion (24.0 percent) is located within the Antelope Creek–North Platte River Watershed, which encompasses the area around Douglas. Considering irrigated land location relative to river and creek valleys, the majority (52.4 percent) lies along the North Platte River within the study area. Another 13.2 percent of the irrigated lands are situated along La Prele Creek, with 7.0 percent, 6.0 percent, and 6.0 percent along Deer Creek, La Bonte Creek, and Wagon Hound Creek, respectively. Table 3.25 shows the location of irrigated lands by county, Table 3.26 shows the locations by HUC 10 watershed, and Table 3.27 shows locations by river and creek valley.

Table 3.25. Irrigated Lands by County Within the Study Area

County	2012 Estimated Area (acres)	2012 Irrigated Acres (%)
Albany	209	0.6
Converse	31,975	88.5
Natrona	9	0.0
Platte	3,919	10.9
Total Acres	**36,112**	**100.0**

Table 3.26. Irrigated Lands by HUC 10 Watershed Within the Study Area

Watershed (HUC 10)	2012 Estimated Area (acres)	2012 Irrigated Acres (%)
Antelope Creek – North Platte River	8,661	24.0
La Prele Creek	4,756	13.2
Glendo Reservoir – North Platte River	4,431	12.3
Sand Creek – North Platte River	4,383	12.1
La Bonte Creek	3,944	10.9
Deer Creek	2,526	7.0
Wagon Hound Creek	2,158	6.0
Box Elder Creek	1,629	4.5
Middle Bear Creek-North Platte River	1,590	4.4
Horseshoe Creek	1,194	3.3
Cottonwood Creek	699	1.9
Muddy Creek	86	0.2
Broom Creek	37	0.1
Sage Creek	18	<0.1
Total Estimated Acres	**36,112**	**100.0**

Table 3.27. Irrigated Lands by River or Creek Valley Within the Study Area

River or Creek Valley	2012 Estimated Area (acres)	2012 Irrigated Acres (%)
North Platte River	18,930	52.4
La Prele Creek	4,756	13.2
Deer Creek	2,526	7.0
La Bonte Creek	2,165	6.0
Wagon Hound Creek	2,158	6.0
West Fork La Bonte Creek	1,779	4.9
Box Elder Creek	1,629	4.5
Horseshoe Creek	1,194	3.3
Cottonwood Creek	751	2.1
Other Tributaries	224	0.6
Total	**36,112**	**100.0**

3.4.6 Irrigation Infrastructure

A total of 69 irrigation ditches within the study area carry 5 cfs or more of fully adjudicated water rights, which total approximately 233.6 miles of conveyance. Of these, 33 ditches with a total of approximately 94.3 miles of conveyance (approximately 40 percent) are located within the LID. For the study, the 5 cfs irrigation ditches were also segmented at watershed (HUC 10) boundaries and listed by length within each watershed. Antelope Creek–North Platte River Watershed (HUC 101800801) contains the majority of the 5 cfs irrigation ditches, with 34 ditches that total approximately 81 miles. Figure 3.24 shows the 5 cfs irrigation ditches within the study area, and Table 3.28 lists the ditches by watershed.

The irrigation ditches were delineated using existing digitized flowline data from the National Hydrography Dataset (NHD) and confirmed with 2015 NAIP aerial imagery, ESRI World Imagery Service, USGS topographic maps, and SEO Linen Plats. The delineated, existing ditch flowlines were then cross-referenced with water-rights information from the SEO e-Permit online database (*http://seoweb.wyo.gov/e-Permit*) to determine the status of water rights and the name of the ditch. Because existing NHD flowlines were used, these mapped ditches are a general estimate of actual alignments and lengths.

The inventory efforts of this Level I study focused on assessing current irrigation infrastructure needs and potential system improvements within the watershed. Irrigation-system field evaluations were conducted at the request of landowners or irrigators. Specific irrigation systems components that were identified by the participating landowner or irrigator were field inventoried and evaluated. The landowners typically accompanied field personnel during the field inventories and evaluations.

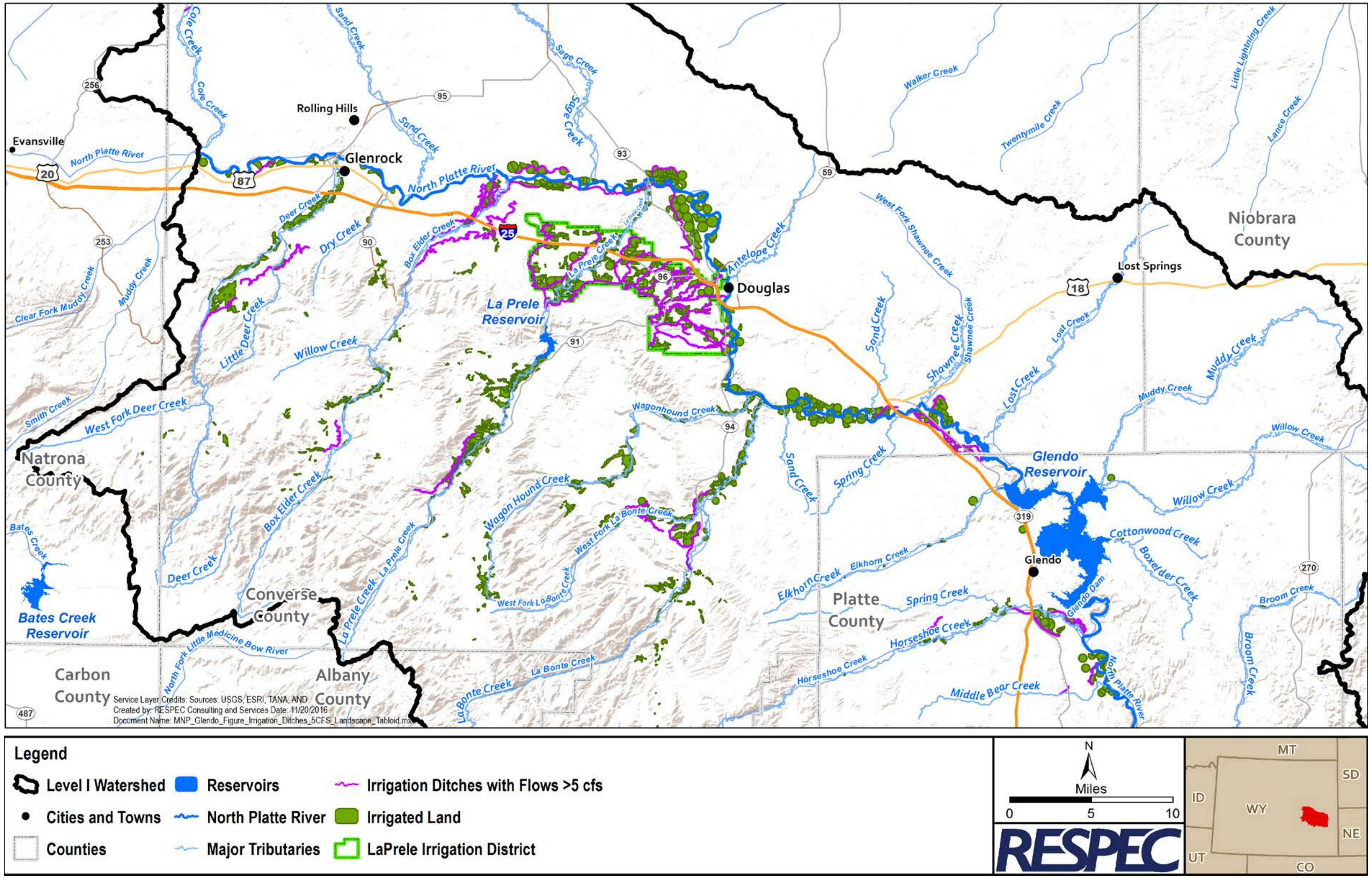


Figure 3.24. Irrigation Ditches With Flows Greater Than 5 Cubic Feet per Second and Irrigated Lands Within the Watershed.

Table 3.28. Irrigation Ditches With Flow Greater Than 5 Cubic Feet per Second by Watershed (HUC 10) Within the Study Area (Page 1 of 3)

Watershed (HUC 10 Code)	Name	Length (feet)	Length (miles)	Township	Range	Section
Sand Creek-North Platte River (1018000709)	Carey Box Elder Creek Ditch No. 4	6,088	1.15	33N	74W	12
	Carey Box Elder No. 1 Ditch	2,334	0.44	33N	74W	12
	Carey Box Elder No. 2 Ditch	3,306	0.63	33N	74W	12
	Douglas Canal	32,259	6.11	33N	72W	7
	Enl. Slichter Ditch	9,645	1.83	33N	73W	8
	Lake Supply Ditch	2,207	0.42	35N	77W	14
	Running Dutchman Ditch Enlargement	23,129	4.38	33N	73W	4
	Valentine Ditch	11,288	2.14	33N	76W	3
	West Lateral No. 1	29,581	5.60	32N	73W	2
	West Side Ditch	42,508	8.05	32N	73W	5
	Subtotal	**162,345**	**30.75**			
Deer Creek (1018000710)	Enl. Tolland Co. No. 1 Ditch	24,824	4.70	33N	76W	36
	Tolland Co. No. 1 Canal	40,516	7.67	32N	76W	3
	Subtotal	**65,340**	**12**			
Box Elder Creek (1018000711)	Carey Box Elder Creek Ditch No. 4	10,839	2.05	33N	74W	12
	Carey Box Elder No. 1 Ditch	16,130	3.05	33N	74W	14
	Carey Box Elder No. 2 Ditch	39,629	7.51	33N	74W	22
	Carey Reservoir Ditch	43,228	8.19	33N	74W	28
	Carey Reservoir Ditch Enlargement	44,364	8.40	33N	74W	24
	Carey Slichter Box Elder Creek No. 5 Ditch	8,339	1.58	33N	74W	13
	Enl. Slichter Ditch	11,062	2.10	33N	73W	7
	Hiser Snow-Shoe Creek Ditch	19,778	3.75	31N	75W	32
	Subtotal	**193,369**	**37**			
La Prele Creek (1018000713)	Douglas Canal	2,969	0.56	33N	72W	10
	Dry Laprele Ditch	16,535	3.13	30N	74W	17
	Enl. Fritts Ditch Acipt	22,631	4.29	31N	74W	33
	LaPrele Main Canal	35,521	6.73	32N	73W	11
	Laprele High Line Ditch	11,500	2.18	30N	74W	9
	Lateral No. 1	6,426	1.22	32N	72W	6
	West Lateral No. 1	4,599	0.87	33N	72W	30
	West Side Ditch	4,058	0.77	32N	73W	16
	Subtotal	**104,239**	**20**			

Table 3.28. Irrigation Ditches With Flow Greater Than 5 Cubic Feet per Second by Watershed (HUC 10) Within the Study Area (Page 2 of 3)

Watershed (HUC 10 Code)	Name	Length (feet)	Length (miles)	Township	Range	Section
Antelope Creek-North Platte River (HUC 1018000801)	Bed Tick Creek	14,205	2.69	32N	71W	32
	Douglas Canal	30,367	5.75	33N	72W	14
	Enlarged Brewer Ditch	11,583	2.19	33N	72W	2
	Fivemile Creek	11,356	2.15	32N	72W	3
	LaPrele Main Canal	41,042	7.77	32N	72W	15
	Lateral No. 1	17,326	3.28	33N	72W	32
	Lateral No. 11	15,176	2.87	32N	72W	26
	Lateral No. 11B	7,989	1.51	32N	71W	31
	Lateral No. 2	20,734	3.93	33N	72W	34
	Lateral No. 2B	1,726	0.33	33N	72W	33
	Lateral No. 3	6,153	1.17	32N	72W	8
	Lateral No. 3B	3,672	0.70	32N	72W	4
	Lateral No. 3X	3,081	0.58	32N	72W	3
	Lateral No. 4	19,575	3.71	32N	72W	10
	Lateral No. 4B	7,804	1.48	32N	72W	3
	Lateral No. 4C	7,342	1.39	32N	72W	2
	Lateral No. 5	14,532	2.75	32N	72W	10
	Lateral No. 5X	2,400	0.45	32N	72W	11
	Lateral No. 6	31,728	6.01	32N	72W	14
	Lateral No. 6A	11,456	2.17	32N	72W	11
	Lateral No. 6B	18,622	3.53	32N	71W	18
	Lateral No. 7	16,328	3.09	32N	72W	14
	Lateral No. 8A	19,093	3.62	32N	72W	23
	Lateral No. 9	8,964	1.70	32N	72W	22
	Lateral No. 9A	8,924	1.69	32N	72W	26
	Lateral No. 9B	15,909	3.01	32N	71W	30
	Lateral No. 9C	4,917	0.93	32N	71W	30
	Little Bed Tick Creek	15,556	2.95	32N	72W	25
	Sixmile Creek	8,373	1.59	32N	72W	11
	Warner Ditch	10,470	1.98	32N	71W	32
	Unknown1	5,865	1.11	32N	72W	11
	Unknown2	3,389	0.64	32N	71W	19
	Unknown3	1,712	0.32	32N	72W	28
	Unknown4	10,478	1.98	33N	72W	36
	Subtotal	**427,847**	**81**			

Table 3.28. Irrigation Ditches With Flow Greater Than 5 Cubic Feet per Second by Watershed (HUC 10) Within the Study Area (Page 3 of 3)

Watershed (HUC 10 Code)	Name	Length (feet)	Length (miles)	Township	Range	Section
La Bonte Creek (HUC 1018000803)	Darlington Ditch	10,130	1.92	29N	72W	2
	Darlington Ditch Left Branch	15,857	3.00	30N	72W	27
	Darlington Ditch Right Branch	9,251	1.75	30N	72W	25
	Enl. Canon Ditch	11,803	2.24	30N	72W	20
	South Side Enl. Extension Canon Ditch	21,375	4.05	30N	72W	21
	Wagon Hound No. 1 Ditch ACIPT C. J. No. 1 Ditch	15,187	2.88	30N	72W	13
	Subtotal	**83,603**	**16**			
Glendo Reservoir–North Platte River (HUC 1018000804)	Gray No. 1 Ditch	36,545	6.92	31N	69W	34
	Hart Ditch	9,936	1.88	31N	70W	24
	Platte Valley Ditch Number 1	34,798	6.59	31N	69W	28
	Wilson No. 2 Ditch	8,612	1.63	31N	69W	16
	Subtotal	**89,891**	**17**			
Middle Bear Creek–North Platte River (HUC 1018000808)	Bear Creek Ditch No. 2	3,949	0.75	28N	68W	15
	Johnson Pump Lift ACT Cassa Ditch	10,088	1.91	28N	68W	12
	Subtotal	**14,037**	**3**			
Horseshoe Creek (HUC 1018000809)	Hoffman Ditch	12,856	2.43	29N	68W	26
	J A Moran Ditch	23,087	4.37	29N	69W	31
	Laughlin Ditch ACT Shives and Walker No. 1 Ditch	20,724	3.93	29N	68W	28
	Walker No. 1 Ditch Via Shives and Walker No. 1 Ditch	16,761	3.17	29N	68W	21
	Walker No. 3 Ditch	19,573	3.71	29N	68W	26
	Subtotal	**93,001**	**18**			

Field personnel evaluated the structural components by interviewing the water user, visually assessing the structure's physical condition, determining the structure's functionality, documenting the structure's appearance, and mapping the structure's location. Typical problems with the irrigation diversions and ditches within the watershed included deteriorated control structures, excessive bank erosion or siltation, and conveyance seepage loss. Some of these irrigation system components were failing or not functioning and had surpassed their practical life expectancy. A summary of the conditions of the inventoried structures within the study area such as irrigation diversions, headgates, and ditch conveyances and related photographs of these components are included in following sections.

3.4.7 Irrigation Inventory

The inventory efforts of this Level I study focused on assessing current irrigation infrastructure needs and potential improvements within the study area. Specific structures, inventories, and evaluations were conducted at the request of irrigators and water users. In general, each landowner or water user identified the structures to be evaluated during the field visit. Typically, the landowners accompanied field personnel during the inventory. Tasks completed during this effort included the following:

- Interviewing landowner/water user
- Preliminary field assessment of irrigation structures
- Photographic documentation of structures
- Location of structures using GPS technology

This inventory included assessing structures within the LID as well as multiple privately owned systems. Summaries of the irrigation structure inventories are included in Sections 3.4.7.1 through 3.4.7.15.

3.4.7.1 *LaPrele Main Canal Diversion*

The LaPrele Main Canal Diversion is a concrete structure across La Prele Creek approximately 1.6 miles downstream from the LaPrele Reservoir. The diversion is located in Section 21 of Township 32 North, Range 73 West in Converse County near the Ayres Natural Bridge Park. The diversion is operated and maintained by the LID and is composed of 103 water users that irrigate approximately 11,462 acres [WWDC, 2015b]. The diversion structure lies roughly perpendicular to the channel of La Prele Creek within the canyon and spans a total of 100 feet across the 160-foot wide canyon floor.

The structure consists of a 5-foot tall, 75-foot long weir, and a 25-foot wide headgate structure that abut the east wall of the canyon. Two 3-foot by 6-foot openings through the headgate structure are operated with identical rectangular slide gates. A 12-inch pipe through the weir is used to control low flows to the creek and is operated with a slide gate. The main diversion and headgate structures are shown in Figures 3.25 through 3.30.

The LaPrele Main Canal Diversion is functional but is in need of rehabilitation or replacement because of multiple issues. The integrity of the concrete is failing, as evidenced by a crack through the weir at the bypass pipe, spalling in several locations, and portions of concrete that have broken loose from the main headgate structure and concrete apron. These issues are shown in Figures 3.25 and 3.26. Significant scour has also occurred next to the diversion in multiple locations. The creek bed at the downstream face of the weir has scoured to an elevation lower than the concrete apron, as shown in Figure 3.27, and the creek side of the Main Canal’s berm has severely eroded on the back side of the headgate structure, as illustrated in Figure 3.30.

Figure 3.25. LaPrele Main Canal Diversion Weir and Bypass Pipe (Middle).

Figure 3.26. Concrete Spalling (Lower Left), Crack (Middle, Below Slide Gate Handwheel), and Broken Apron (Upper Right) on the LaPrele Main Canal Diversion Weir.

Figure 3.27. LaPrele Creek Bed Scoured Below the Main Canal Diversion Weir Apron (Right Middle).

Figure 3.28. LaPrele Main Canal Diversion Headgate Structure and Slide Gates.

Figure 3.29. Broken Concrete (Middle) on the LaPrele Main Canal Diversion Headgate Structure.

Figure 3.30. Scour of the LaPrele Main Canal Berm (Middle) Behind the Headgate Structure (Right).

3.4.7.2 *LaPrele Main Canal*

The LaPrele Main Canal delivers approximately 25–120 cfs of water through approximately 14.5 miles of earthen canal to 22 laterals and over 9,000 irrigated acres. The canal is also operated and maintained by the LID. Seepage, evaporation, sedimentation, vegetative transpiration, erosion, and encroachment issues exist along the canal. Figure 3.31 is a view of the SEO's hydrology station on the canal. Figure 3.32 is the view downstream from the station's weir. Figures 3.33 and 3.34 depict the changes in the canal before and after maintenance was performed by the LID.

3.4.7.3 *LaPrele Lateral No. 1*

The LaPrele Lateral No. 1 headgate structure is located in Section 7 of Township 32 North, Range 72 West in Converse County. The lateral delivers approximately 5.2 cfs through almost 3.3 miles of earthen ditch, which is operated and maintained by the LID. Issues with sedimentation, bank and bed erosion, and leakage have occurred along the lateral. Figure 3.35 is an example of the erosion that has occurred on Lateral No. 1. Figures 3.36 and 3.37 show the headgate structures for Lateral No. 1 and Lateral No. 2.

3.4.7.4 *East Side No. 3 Reservoir on LaPrele Lateral No. 2*

The East Side No. 3 Reservoir (Grabow Reservoir) consists of an earthen dam with a storage capacity of 116.7 acre-feet. The reservoir is located in Section 5 of Township 32 North, Range 72 West in Converse County and is operated and maintained by the LID. The dam lies across the LaPrele Lateral No. 2 and provides storage capacity to downstream irrigated acres. Issues have occurred with the outlet facilities of the reservoir along with shoreline erosion as shown in Figures 3.38 and 3.39.

3.4.7.5 *LaPrele Westside Diversion and Canal*

The LaPrele Westside Canal delivers approximately 10-60 cfs of water through approximately 14.5 miles of earthen canal to two laterals and approximately 2,000 irrigated acres. The canal is also operated and maintained by the LID. The Westside Canal Diversion, as shown in Figures 3.40 through 3.44, is a concrete structure across La Prele Creek downstream from the LaPrele Main Canal Diversion and is located in Section 16 of Township 32 North, Range 73 West in Converse County. Issues have occurred with erosion at the diversion structure; seepage, evaporation, sedimentation, vegetative transpiration, bank and bed erosion, and encroachment have occurred along the canal.

3.4.7.6 *Lateral No. 9A Sublaterals*

The Lateral No. 9A sublaterals, as shown in Figures 3.45 and 3.46, divert water from Lateral No. 9A in Section 23 of Township 32 North, Range 72 West in Converse County. The Lateral No. 9A sublaterals are earthen ditches, total approximately 8,850 feet (1.7 miles), and deliver water to hay fields along a minor tributary to Little Bed Tick Creek.

3.4.7.7 *Lateral No. 4 Sublateral*

The Lateral No. 4 sublateral, as shown in Figures 3.47 and 3.48, diverts water from Lateral No. 4 in Section 3 of Township 32 North, Range 72 West in Converse County. Lateral No. 4 is approximately 17,034 feet (3.2 miles) long and diverts water from the Main Canal of the LID. The Lateral No. 4 sublateral consists of an earthen ditch totaling approximately 1,355 feet (0.3 mile) and delivers water to hay fields along a minor drainage tributary to Fivemile Creek.

Figure 3.31. Upstream View of LaPrele Main Canal at the SEO Hydrology Station 0120ETMD.

Figure 3.32. Downstream View of LaPrele Main Canal at SEO Hydrology Station 0120ETMD.

Figure 3.33. LaPrele Main Canal Before Maintenance at Station 309+70 From Nelson [1983].

Figure 3.34. LaPrele Main Canal After Maintenance at Station 309+70 From Nelson [1983].

Figure 3.35. Eroding Section of the LaPrele Lateral No. 1.

Figure 3.36. Lateral No. 1 From the Main Canal Near the Division Box for Laterals No. 1 and No. 2.

Figure 3.37. LaPrele Lateral No. 1 Near the Main Canal Headgate.

Figure 3.38. Existing Outlet Works for the East Side No. 3 Reservoir.

Figure 3.39. Outlet Pipe From East Side No. 3 Reservoir Into Lateral No. 2.

Figure 3.40. LaPrele Westside Canal Diversion Weir and Bypass Pipe (Middle).

Figure 3.41. Downstream View of the SEO Hydrology Station 0120WTSD on the LaPrele Westside Canal.

Figure 3.42. LaPrele Westside Canal Diversion Weir and Bypass Pipe (Middle).

Figure 3.43. LaPrele Westside Canal Diversion Headgate Structure and Slide Gates.

Figure 3.44. LaPrele Westside Canal Slide Gate and Entrance Into Tunnel No. 1.

Figure 3.45. View of a Lateral No. 9A Sublateral From the Headgate.

Figure 3.46. View of a Lateral No. 9A Sublateral Headgate Structure.

Figure 3.47. Upstream View of Lateral No. 4 at the Headgate for the Lateral No. 4 Sublateral.

Figure 3.48. Downstream View of Lateral No. 4 Sublateral From the Headgate on Lateral No. 4.

3.4.7.8 *Lateral No. 2A Sublateral*

The Lateral No. 2A sublateral, as shown in Figures 3.49 and 3.50, diverts water from Lateral No. 2A in Section 5 of Township 32 North, Range 72 West in Converse County. Lateral No. 2A is 5,615 feet (1.1 miles) long and diverts water from Lateral No. 2, which diverts water from the Main Canal of the LID. The Lateral No. 2A sublateral consists of an earthen ditch that totals approximately 1,614 feet (0.3 mile) and delivers water to hay fields along a minor tributary to Fivemile Creek.

Figure 3.49. Upstream View of Lateral No. 2A at the Headgate for the Lateral No. 2A Sublateral.

Figure 3.50. Downstream View of Lateral No. 2A Sublateral From the Headgate on Lateral No. 2A.

3.4.7.9 *J A Moran Ditch Irrigation Water Re-Regulation*

The J A Moran Ditch is located in Section 21 of Township 29 North, Range 69 West in Platte County. The J A Moran Ditch is approximately 23,090 (4.37 miles) long and diverts water from Horseshoe Creek in Section 36 of Township 29 North, Range 70 West. The project currently irrigates hay fields along minor drainages tributary to Horseshoe Creek through a series of field ditches and gated pipe. This ditch is currently unable to fully use the extra irrigation water appropriated during spring runoff with the existing irrigation system; the ditch has no reservoir to regulate the irrigation water for application in later months. The end of the J A Moran Ditch is shown in Figure 3.51.

Figure 3.51. End of the J A Moran Ditch.

3.4.7.10 *Walker No. 3 Ditch*

The Walker No. 3 Ditch diverts water from Horseshoe Creek in Section 22 of Township 29 North, Range 68 West in Platte County. The ditch is used to irrigate hay fields along Horseshoe Creek, stretches for 19,570 feet (3.71 miles), and consists of both earthen ditch and pipe sections. The ditch also serves as a livestock watering source. The Walker No. 3 Ditch diversion is functional and appears stable. The first 3,600 feet (0.68 mile) of Walker No. 3 is earthen ditch through hay fields. This section experiences periodic damage from livestock (which requires repair), sends excess sediment down the ditch, and causes inconsistencies in irrigation. At the downstream end of these fields, the ditch enters a 1,080-foot (0.21-mile) section of 18-inch pipe, which is shown in Figure 3.52.

Figure 3.52. Pipe Inlet on the Walker No. 3 Ditch. The open ditch upstream from this point experiences periodic damage from cattle.

3.4.7.11 *Hoffman Ditch and Diversion*

The Hoffman Ditch diverts water from Horseshoe Creek in Section 22 of Township 29 North, Range 68 West in Platte County. The ditch is approximately 12,860 feet (2.43 miles) long and is used to irrigate hay fields along Horseshoe Creek. The Hoffman Ditch Diversion lies on a meandering section of Horseshoe Creek. In recent years, the creek has cut the diversion off from the Hoffman Ditch, which required the diversion to be relocated and repaired. The diversion is in poor condition, and the headgate is at risk of being cut off once again. Three additional meandering sections of Horseshoe Creek are threatening the Hoffman ditch itself, downstream from the diversion. During the field evaluation, one actively cutting bank was measured within 30 feet of the ditch, while the other two threatened sections were identified using areal imagery. The Hoffman Ditch diversion is shown in Figure 3.53.

Figure 3.53. Hoffman Ditch Diversion (Left Middle).

3.4.7.12 *Johnson Pump Lift ACT Cassa Ditch and Irrigation Water Regulation*

The Johnson Pump Lift as changed to (ACT) Cassa Ditch diverts water directly from the North Platte River in Section 12 of Township 28 North, Range 68 West in Platte County; the ditch is approximately 10,090 feet (1.91 miles) long. The diversion consists of a vertical turbine pump elevated over a concrete diversion box on the riverbank.

Irrigation water is pumped through a 740-foot (0.14-mile) section of 15-inch plastic irrigation pipe to an open, concrete-lined ditch. The open ditch runs the remaining 9,350 feet (1.77 miles) and delivers water to two different irrigation regulation reservoirs used for center-pivot and sideroll sprinklers, as well as directly to field ditches for flood irrigation. The existing concrete ditch has accumulated significant amounts of sediment and vegetation growth, and the existing irrigation-regulating reservoirs experience significant seepage and evaporation. The Johnson Pump Lift ACT Cassa Ditch is shown in Figure 3.54.

3.4.7.13 *Wright No. 2 Ditch*

The Wright No. 2 Ditch and headgate are located on Cottonwood Creek in Section 28 of Township 27 North, Range 68 West in Platte County. The diversion consists of a rock weir and concrete headgate structure and supplies irrigation water to hay fields along Cottonwood Creek. The rock weir has deteriorated and is unable to divert sufficient water through the headgate to meet irrigation demands. The weir is shown in Figure 3.55, and the headgate is shown in Figure 3.56.

Figure 3.54. Johnson Pump Lift ACT Cassa Ditch With Accumulated Sediment and Vegetation Growth.

Figure 3.55. Wright No. 2 Ditch Rock Weir.

Figure 3.56. Wright No. 2 Ditch Diversion and Headgate Structure.

3.4.7.14 *Wright No. 2 Ditch Enlargement*

The Wright No. 2 Ditch Enlargement is located on Cottonwood Creek in Section 28 of Township 27 North, Range 68 West in Platte County. The diversion consists of a rock cross-vane weir and sheet piling with a steel headgate and bypass structure; this structure supplies irrigation water to hay fields along Cottonwood Creek. The rock weir was scattered during high flow, which also scoured the left streambank. The structure is unable to divert sufficient water through the headgate to meet irrigation demands. The weir is shown in Figure 3.57, and the headgate/bypass structure is shown in Figure 3.58.

Figure 3.57. Wright No. 2 Ditch Enlargement Cross-Vane Weir (Middle) and Bank Scour (Upper Right).

Figure 3.58. Wright No. 2 Ditch Enlargement Headgate and Bypass Structure.

3.4.7.15 *Seepage Saddle Ditch and Diversion*

The Seepage Saddle Ditch diversion is located on Hunton Creek in Section 35 of Township 33 North, Range 75 West in Converse County. The diversion consists of a concrete structure and supplies irrigation water to hay fields along a tributary to East Fork Dry Creek. The fields are irrigated by a combination of flooded field ditches, gated pipe, and sideroll sprinkler. High flows on Hunton Creek have caused significant scour around the diversion structure. The existing system of ditches and gated pipe is difficult to manage and control, which results in inefficient application of irrigation water. The concrete diversion structure shown in Figure 3.59 and Figure 3.60 shows part of the existing delivery system.

3.4.7.16 *Carey Ditch No. 2*

The Carey Ditch No. 2 diversion is on Deer Creek in Section 9 of Township 33 North, Range 75 West in Converse County. Carey Ditch No. 2 is approximately 13,100 feet (2.5 miles) long. The original appropriation for the ditch is 3.06 cfs that irrigates 214 acres. Seepage, evaporation, sedimentation, vegetative transpiration, erosion, and encroachment issues occur all along Carey Ditch No. 2. The Carey Ditch No. 2 diversion dam is functioning and constructed of heavy-gage steel sheet piling. The headgate consists of a concrete structure with wood framing, and the original slide gate is no longer operational, so improvised methods have been in use. Figure 3.61 shows the Carey Ditch No. 2 headgate.

Figure 3.59. Seepage Saddle Ditch Concrete Diversion Structure on Hunton Creek.

Figure 3.60. Seepage Saddle Ditch and Delivery System.

Figure 3.61. Carey Ditch No. 2 Diversion and Headgate Structure.

Carey Ditch No. 2 consists of several different sections of pipe, open ditch, and culvert road crossings. The ditch is earthen for approximately 2,100 feet (0.4 mile) downstream from the diversion, then enters a corrugated metal pipe (CMP) that is approximately 1,800 feet (0.3 mile) long buried under residential areas on the east side of Glenrock. Figure 3.62 shows the outlet of the CMP. Downstream from the CMP, five 10-inch plastic irrigation pipelines (PIPs) have been laid parallel on the bottom of the earthen ditch for approximately 660 feet (0.1 mile). After the 10-inch PIP, the ditch passes through a length of reinforced concrete pipe. The remainder of the ditch is approximately 7,600 feet (1.4 miles) of earthen ditch routed to an irrigation-regulating reservoir on the northwest side of Glenrock in Section 6 of Township 33 North, Range 75 West. The slope of the existing ditch is between 5 and 6 feet per mile (approximately 0.001 foot per foot). Figure 3.63 shows the 10-inch PIPs, and Figure 3.64 shows the earthen ditch.

In 2005, the NRCS investigated the ditch and evaluated alternatives for lining or piping the remaining sections of earthen ditch (between 9,000 feet and 10,000 feet in total). A temporary solution that used 10-mil, 18-inch diameter tubing was offered, but the report identified that a permanent solution should be sought to keep the original 1885-dated appropriation amount. Permanent alternatives ranged from $100,000 for a concrete lining to $245,000 for 24-inch corrugated high-density polyethylene (HDPE) (in 2005 dollars). The final recommendation of the report was to investigate the integrity and remaining life expectancy of the existing CMP before investing in permanent solutions [NRCS, 2005].

Figure 3.62. Carey No. 2 Ditch Outlet From Corrugated Metal Pipe Into Ditch With 10-Inch Plastic Irrigation Pipeline Laid on the Bottom.

Figure 3.63. Carey No. 2 Ditch With 10-Inch Plastic Irrigation Pipeline Laid on the Bottom.

Figure 3.64. Earthen Section of Carey Ditch No. 2.

3.4.8 Grazing

Grazing is the predominant land use in the watershed. Other land uses, such as irrigated pasture and hay forage, oil and gas production, wind energy generation, wildlife habitat, and recreation are also often components of the agricultural operations within the watershed. Livestock use is primarily cattle, and less than 10 percent of leases are authorized for sheep, horses, bison, and goats. Because of the importance of the livestock grazing and ranching within the watershed, rangelands and forestlands provide the foundation for this land use. Frequently, these operations will manage their livestock, pasture and hay forage, mineral and energy, wildlife, and water resources in conjunction with hunting and other recreational uses.

3.4.8.1 *Range and Forestlands*

Approximately 1.92 million acres of rangelands and forestlands are located within the watershed and cover more than 92 percent of the study area. Rangeland acres were approximated by using the shrub/scrub, and grassland herbaceous vegetative cover types; the forestland acres were approximated by using the deciduous, evergreen, and mixed forest vegetative cover types from the NLCD. The NLCD is a 16-category land-cover classification method that is applied across the US by using Landsat imagery.

Approximately 1.64 million acres of grass and shrub lands comprise most of the rangelands located in the watershed. Almost 1,290,139 acres (79 percent) of the 1.64 million acres of rangelands are privately owned. Almost 212,194 acres (approximately 13 percent) are owned by the state of Wyoming;

132,750 acres (8 percent) of the 1.64 million acres of rangelands are managed by federal agencies, of which, the BLM manages approximately 61,132 acres (3.7 percent) and the USFS manages 35,613 acres (2.2 percent). The remaining 41,255 acres (2.5 percent) of rangelands are managed by other agencies, including the USBR, Department of Defense, and local entities as displayed in Table 3.29.

Table 3.29. Rangelands by Ownership or Management Within the Study Area

Land Ownership or Management	Rangeland Acres	Rangeland Acres (%)
Private	1,290,139	78.7
State of Wyoming	212,194	12.9
BLM	61,132	3.7
USFS	35,613	2.2
Other (USBR, DoD, and County government)	41,255	2.5
Total	**1,640,333**	**100.0**

In addition to the rangelands in the watershed, forestlands cover approximately 279,089 acres (13.1 percent). Private land encompasses approximately 148,811 acres (53.3 percent) of the forestlands within the study area. The USFS manages approximately 84,242 acres (30.2 percent), the BLM manages approximately 11,933 acres (4.3 percent), and the state of Wyoming owns 27,912 acres (10 percent) of the forestlands within the watershed. The remaining 6,191 acres (2.2 percent) of the forestlands in the study area are managed by the USBR, DOD, and local government, as shown in Table 3.30.

Table 3.30. Forestlands by Ownership or Management Within the Study Area

Land Ownership or Management	Forestland Acres	Forestland Acres (%)
Private	148,811	53.3
State of Wyoming	27,912	10.0
BLM	11,933	4.3
USFS	84,242	30.2
Other (USBR, DoD, local government)	6,191	2.2
Total	**279,089**	**100.0**

3.4.8.2 *Federal Grazing Allotments*

An allotment generally consists of federal rangelands and forestlands, but could also include private and/or state parcels. The BLM and the USFS stipulate the number of livestock and season of use for each allotment on federal lands under their permitting procedures. There are grazing allotments on an estimated 957,533 acres of federal rangelands and forestlands within the watershed, which are primarily administered by the BLM. The BLM has 167 grazing allotments that encompass approximately 1,089,211 acres, including all land-uses.

These BLM allotments consist of state and federal lands intermingled with private lands, which are typically managed under an Allotment Management Plan (AMP) or a Coordinated Resource Management Plan (CRMP). An AMP or CRMP usually involves collaborative resource planning between the agency and permittees to create a livestock grazing management plan specifying the land areas, animal units, grazing schedule, and needed improvements in order to achieve multiple use resource management objectives and grazing land health standards.

Some of these allotments are situated in neighboring watersheds but extend into the study area. The BLM Casper Field Office administers 97.7 percent of the BLM allotments, and the BLM Rawlins Field Office administers 2.3 percent of these allotments, which are illustrated in Figure 3.65 and summarized in Table 3.31. The BLM allotments are administered by the BLM's Casper and Rawlins Field Offices under the respective Record of Decisions and approved 2008 Rawlins Resource Management Plan (RMP) and the 2007 Casper RMP.

Grazing management on BLM land is conducted in accordance with the Federal Land Policy and Management Act of 1976 and the Taylor Grazing Act of 1934. Policies and procedures for managing grazing on BLM lands are outlined in the BLM's regulations, which were revised in 1995 to sustain or improve rangeland health. Grazing activities on BLM lands in the state of Wyoming must meet the requirements specified in *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands* [BLM, 1997]. More information about the BLM's grazing management standards and guidelines can be found online (*http://www.blm.gov/wy/st/en/programs/grazing.html)*. The BLM's grazing management guidelines pertinent to this study include the following summaries:

- Support infiltration, maintain soil moisture, stabilize soils, and provide sufficient water to maintain system function and soil permeability
- Restore, maintain, or improve riparian plant communities to sustain adequate residual plant cover for sediment capture and groundwater recharge
- Implement riparian improvements to maintain or enhance stream channel morphology
- Develop springs, seeps, reservoirs, wells, or other water development projects in a manner that protects watershed ecological and hydrological functions
- Implement range improvements away from riparian areas to avoid conflicts in achieving or maintaining riparian function
- Adopt management practices and implement range improvements that protect vegetative cover and, thereby, maintain, restore, or enhance water quality.

In addition to the BLM allotments within the watershed, the USFS administers 39 grazing allotments that encompass approximately 213,541 acres of rangeland and forestland that consists of private, state, and federal lands. The USFS Douglas Ranger District: Laramie Peak administers these grazing allotments under their respective Record of Decisions and the 2003 Revised Land RMP [USFS, 2003]. These USFS allotments are also shown in Figure 3.65 and summarized in Table 3.32.

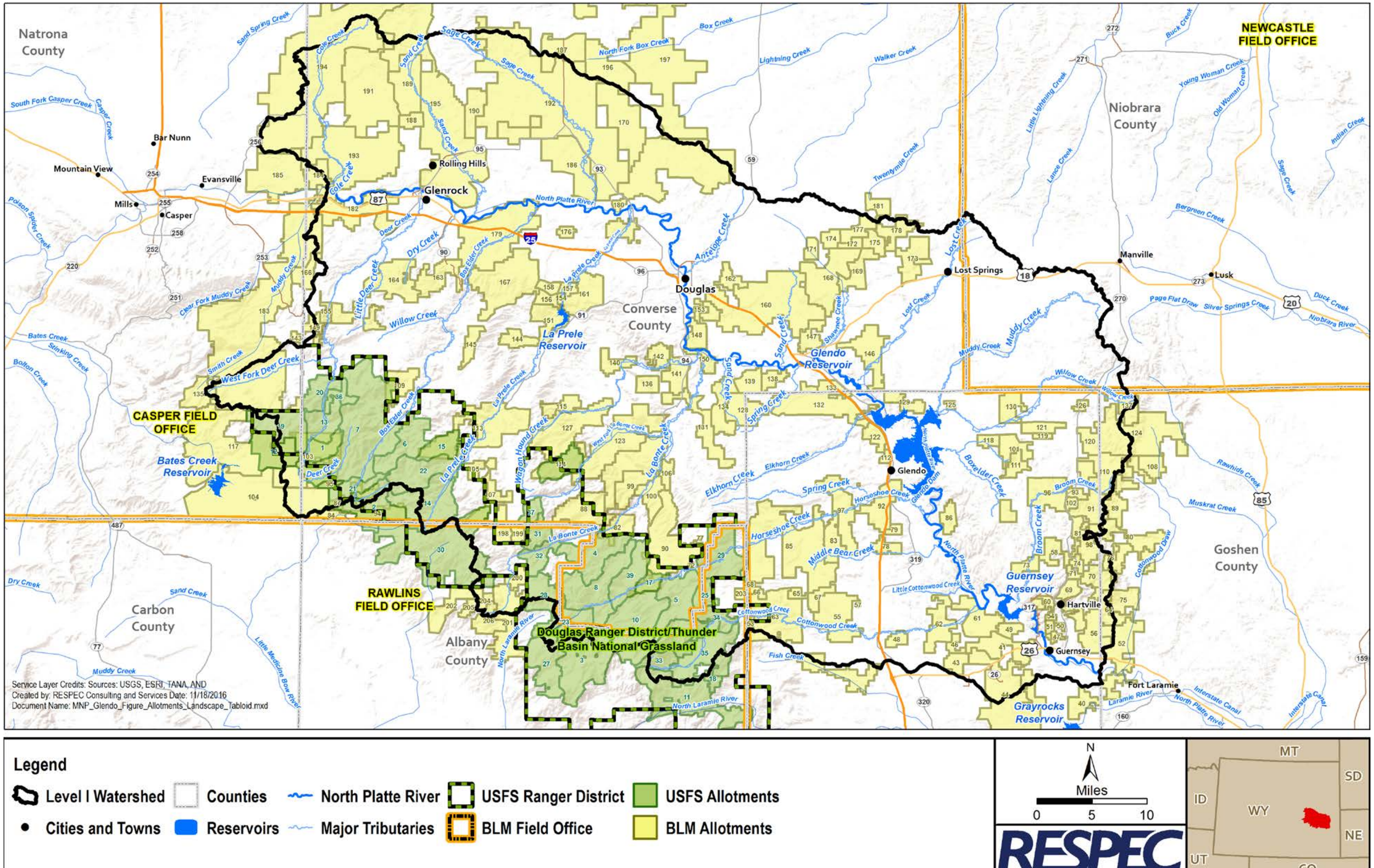


Figure 3.65. Federal Grazing Allotments in the Study Area.

Table 3.31. Bureau of Land Management Allotments in the Study Area (Page 1 of 3)

Allotment Number	Allotment Name	Area (acres)	Allotment Number	Allotment Name	Area (acres)
Casper Field Office			Casper Field Office		
176	BOX ELDER CREEK	18,394	359	MUDDY WAGON HOUND	3,184
187	MILL CREEK	1,601	362	OLD HOLT PLACE	2,187
225	MEADOWDALE	2,351	365	SIMPSON DRAW	1,446
226	TWIN HILLS	4,987	367	CONVERSE 3	1,679
231	FLAT TOP	3,694	368	SAGE CREEK	10,569
233	WHALEN CANYON	981	376	BOWMAN DRAW	32,179
237	DUFF	2,119	377	HOGBACK	2,310
239	HUGH DUNCAN	5,447	382	LA PRELE CREEK 3	362
240	LA BONTE CREEK	3,246	389	SHAWNEE CREEK 2	2,834
245	SHAWNEE CREEK	2,135	390	NUNN RANCH	6,406
246	HARTVILLE CANYON	135	391	HARTVILLE CANYON	273
248	CONVERSE 2	1,978	392	BROOM CREEK	7,758
249	MEDICINE BOW 2	108	393	BOX ELDER CREEK 2	3,476
251	WAGON HOUND CREEK	3,924	394	SPRING CANYON CRE	1,537
256	EMIGRANT TRAIL	8,417	398	PAYNE PLACE	3,565
257	WHALEN CANYON 2	6,344	399	DAGLEY CREEK	766
258	WILDCAT HILLS	5,709	439	NORTH PLATTE 4	960
268	ESTERBROOK	47	452	LA PRELE CREEK 4	14,978
271	CAMP GUERNSEY	420	463	PATTEN CREEK	4,615
273	VAL DITCH NO. 1	1,803	464	WEBB CANYON	1,768
274	BRIGHTON CANYON	14,671	465	QUARRIES	506
276	NORTH PLATTE 3	2,703	468	CROW CREEK	242
277	WATKINS DRAW	478	469	RAGAN DRAW	2,143
278	HAYSTACK RANGE	6,629	471	HIGHLAND FLATS	9,466
280	TWIN PINE	12,798	473	MEDICINE BOW	7,100
281	DRY CREEK 2	133	480	RED BUTTE	45,452
282	SHEEP MOUNTAIN	2,095	481	MANNING RIDGE	10,454
288	MIDDLE FORK SHAWN	1,040	485	MANNING RIDGE 2	13,638
291	POWERS PLACE	1,594	486	WAGON HOUND CREEK	2,458
292	ROBINSON PLACE	3,381	488	PARK	4,000
295	GOSHEN 2	2,676	489	COTTONWOOD CREEK	1,428

Table 3.31. Bureau of Land Management Allotments in the Study Area (Page 2 of 3)

Allotment Number	Allotment Name	Area (acres)	Allotment Number	Allotment Name	Area (acres)
	Casper Field Office			**Casper Field Office**	
297	NORTH BEAR CREEK	775	494	RATTLESNAKE HILL	2,642
308	MIDDLE BEAR CREEK	1,874	498	BOWEN PLACE	680
343	FISH CANYON	753	499	HESS DRAW	662
344	DEADMANS GULCH	627	696	PLATTE 4	72
348	LA PRELE CREEK 2	1,125	734	PLATTE 5	1,081
354	TAYLOR	1,474	10003	BATES CREEK	28,701
10005	BONER	24,882	10320	SIBLEY PEAK	5,649
10023	DALY	5,103	10325	HARTVILLE CANYON	581
10038	STARK	4,937	10327	SOUTH CARI CREEK	3,450
10042	ICE CAVE MOUNTAIN	27,759	10331	FETTERMAN CREEK	48,625
10051	DEER CREEK	9,908	10401	MARY COOPER CREEK	15,119
10075	TEXAS CREEK	679	10403	BALDY RIDGE	4,216
10083	SMITH CREEK	60,780	10405	GREY HILLS	6,873
10085	CLEMONS	3,923	10406	MUSKRAT CANYON	15,062
10087	COLE CREEK	59,800	10407	PIN TOP	567
10098	HAYSTACK RANGE 3	3,517	10415	MANEATER CREEK	12,104
10099	LEMAN	2,544	10420	EAST ANTELOPE CRE	2,188
10116	WEBB CANYON 2	745	10422	RED CANYON	2,481
10117	HENRIE	7,977	10423	WEBB CANYON 3	934
10136	WERNER	2,914	10432	HORSESHOE CREEK	25,630
10138	CONVERSE 4	1,254	10435	SEIDEL	1,757
10146	INDIAN CREEK	10,974	10441	SMITH 2	1,129
10147	SMITH	61,471	10444	SNOWSHOE CREEK	8,816
10151	VALENTINE	20,901	10449	FETTERMAN CREEK 2	751
10152	BIG MUDDY	8,009	10451	GEARY DOME	11,590
10155	BOX CREEK	12,041	11546	WHALEN CANYON 3	1,820
10156	MARTIN	4,242	20201	MIDDLE BEAR CREEK	3,665
10157	ALCOVA LAKE	9,174	20203	FISH CREEK	6,371
10164	V R	12,039	20204	SPRING CREEK 2	5,224
10170	DEER CREEK 2	1,095	20205	CROW CREEK 2	8,550
10172	COATES 2	5,156	20206	GRAY ROCKS 4	17,670

Table 3.31. Bureau of Land Management Allotments in the Study Area (Page 3 of 3)

Allotment Number	Allotment Name	Area (acres)	Allotment Number	Allotment Name	Area (acres)
Casper Field Office			**Casper Field Office**		
10174	NEGRO BABY CREEK	4,381	20210	WINDER	859
10175	WILDCAT HILLS 2	5,655	20212	TRAVNICK	1,793
10187	WARBONNET RANCH	4,157	20215	HARRIS CREEK	6,621
10191	WINDY RIDGE	2,398	20216	POWDERHORN	15,544
10195	MUSKRAT CREEK 2	3,522	20217	BUCKSHOT CREEK	4,704
10197	BANNER MOUNTAIN	1,907	20218	INDIAN CREEK 2	3,798
10198	INEZ	935	20220	GLENDO	575
10199	LATHAM CREEK	4,948	20221	COTTONWOOD CREEK	1,338
10213	BETTELYOUN FLATS	5,133	20224	ETCHEMENDY	2,106
10307	PATTEN CREEK 2	1,922	20504	CONVERSE 5	1,435
10312	CURRY CREEK	1,026	20506	COTTONWOOD DRAW	6,918
10315	NORTH PLATTE 2	3,110	20510	CACHE CREEK	1,444
10319	MUDDY CREEK	2,974	**Rawlins Field Office**		
20511	PREACHER CREEK	518	452	LA PRELE CREEK 4	1,598
20513	HORNER	2,616	289	WHEATFIELD	1,294
20524	ROCK CREEK	5,874	9010	SQUAW RANCH	1,721
20527	GUERNSEY UNIT	5,855	9014	BELL-OTTE RANCH	9,016
20533	MIDDLE FORK SHAWN	10,686	9133	GREEN CREEK	4,732
30507	HORSESHOE CREEK 2	7,150	399	DAGLEY CREEK	704
31003	WILLOW CREEK 2	374	9135	BADGER CREEK	929
31501	BRICKMAN	5,361	9135	BADGER CREEK	1,149
20207	ELKHORN	2,144	9027	WOODROW BROW	3,399

Table 3.32. US Forest Service Medicine Bow Routt National Forest Ranger District Allotments Within the Study Area

Allotment Number	Allotment Name	Area (acres)
6600	Albany Peak	11,747
6602	Bar M	8,854
6603	Bates Creek	8,536
6604	Bear Creek	16,308
6606	Boundary	2,322
6607	Boxelder	31,723
6608	Buck Peak	7,698
6612	Curtis Gulch	3,169
6613	Deer Creek	6,141
6614	Eagle Peak	2,973
6615	Fltecher Park	1,338
6620	Harris Creek	4,630
6621	Harris Park	2,942
6622	Haystack	1,154
6623	Held Creek	2,854
6624	Horse Creek	5,589
6625	Horseshoe	13,502
6627	Indian Flat	3,829
6628	LaBonte Canyon	3,862
6629	LaPrele	12,567
6630	Laramie Peak	3,036
6631	Latham Creek	4,739
6633	Meadow Creek	10,172
6635	North Laramie River	15,865
6636	Pasture	4,112
6639	Roaring Fork	12,501
6640	Rock Creek	9,547
6641	Sagebrush	6,953
6642	Saltlick	5,285
6643	Sawtooth	9,629
6644	Curry Creek	4,293
6646	Soldier Creek	9,936
6648	Texas Creek	689
6650	Warbonnet	28,358
6653	Windy Mountain	5,141
6656	Trail Creek	2,074
6657	Aunt AG	2,269
6658	John Creek	7,177
6660	Ashenfelder	9,244

3.4.8.3 *State of Wyoming Lands*

State land encompasses approximately 212,194 acres (12.9 percent) of the rangelands and approximately 27,912 acres (10 percent) of the forestlands within the study area. Most of the state lands within the watershed are leased to private landowners for grazing. These leases are issued by the Wyoming State Board of Land Commissioners (SBLC) and administered by the Wyoming Office of State Lands and Investments (OSLI). State grazing and agricultural leases allow lessees to construct lease-related improvements on state land, subject to Board approval. Grazing management and the operation of installed improvements on state grazing leases are usually implemented by the lessee. Upon transferring a state grazing lease, the new lessee reimburses the previous lessee for improvements.

3.4.8.4 *Private Lands*

Private land encompasses approximately 1,290,139 acres (78.7 percent) of the rangelands and approximately 148,811 acres (53.3 percent) of the forestlands within the study area. Grazing practices on private lands are established by the landowner and/or manager and often with technical assistance from the local NRCS Field Office or a range consultant. Management practices and improvements on private lands are implemented and owned by the landowner or manager. Landowners and managers who voluntarily participate in Farm Bill programs may be required to follow NRCS standards and specifications or an approved grazing plan included in a conservation plan that was developed for the enrolled property or applicable Farm Bill program. Private grazing lands are often managed for multiple uses, including mining, oil-and-gas production, wildlife habitat, and recreation. Public land management policies directly affect the management of the private grazing lands, because public leases and federal allotments are integral components of a typical private grazing operation within the study area.

3.4.8.5 *Existing Livestock/Wildlife Water Supply and Development*

A dependable water supply is the foundation for grazing management because it is essential to provide adequate amounts of suitable-quality water for grazing animals to maintain herd health, to distribute grazing uniformly, and to maintain or improve resource conditions. Many upland water sources currently exist within the watershed, and many rangeland improvements and grazing projects have developed existing water sources such as springs, wells, and perennial streams. These projects often included storage tanks, ponds, reservoirs, pumping plants, and spring developments with pipelines carrying livestock and wildlife water to remote water tanks.

Existing water sources on properties of participating landowners and managers were mapped within the study area. Participating landowners' properties covered approximately 22,830 acres (10.9 percent) of the study area. Mapping was not completed for the majority of private lands in the watershed, because many landowners or managers did not participate in the study; thus, permissions were not obtained for collecting any resource data.

The mapping is not a complete account of all viable water sources but serves as a starting point for estimating livestock and wildlife water needs within the watershed. Mapping of viable water sources within the watershed included the following items:

- Maps of springs were created from the NHD data, BLM data, and USGS topographic maps.
- Maps of stock wells were created by using data obtained from the SEO and Wyoming Water Development Office (WWDO).
- Interviews with landowners were conducted during study meetings and field visits.
- Maps were developed of existing stock ponds and reservoirs, wells, and springs from inventoried locations during field visits with participating landowners and by using aerial imagery, topographic maps, and hydrography datasets within the study's GIS.

Well viability was determined by field inventory and discussions with participating landowners about the condition and function of the water wells. Wells were considered nonviable when they no longer provided the necessary amount of water for current use or could not pump any water at all. Wells that were located on properties owned or managed by landowners who did not participate in the study were designated as unevaluated wells.

Stock ponds and reservoirs were also evaluated as livestock/wildlife sources during field inventories and discussions with participating landowners. Additionally, stock ponds and reservoirs were examined using high-resolution aerial imagery within the study's geodatabase. The stock pond/reservoir structures that contained water and showed no breaches of the dam or spillway were determined to be viable water sources. The stock ponds and reservoirs that showed evidence of dam and spillway breaches were determined to be nonviable. Other ponds and reservoirs that were observed to be dry were designated as intermittent but viable water sources. An example of the viable and nonviable pond and reservoir evaluation mapping is shown in Figure 3.66, which shows a breached, nonviable stock reservoir in the top image and a functioning, viable reservoir in the bottom image.

The results of this viable source evaluation for existing stock ponds and reservoirs, wells, and springs indicated that 82 wells, 11 springs, and 423 stock ponds and reservoirs that are viable sources within the watershed. These sources are presented in Figure 3.67, which does not include sources such as streams and breached or nonviable ponds and reservoirs.

On participants' properties within the watershed, a total of 57 viable wells, 11 nonviable wells, and 10 viable springs were inventoried. Also, the mapping indicated the existence of 47 stock ponds and reservoirs and 11 springs located on participating landowners' properties. Of these 47 ponds and reservoirs, 10 were dry and held no water, while 2 of the facilities had breached dams, and 3 more facilities were at risk of being breached because of headcuts below the dam and spillway.

3.4.8.6 *Ecological Site Descriptions*

Information regarding soils and rangeland sites within Albany, Converse, Goshen, Natrona, Niobrara, and Platte Counties is available in seven NRCS published soil surveys in the study area that cover almost 87 percent of the watershed. Similar to the soils within the watershed, the ecological sites are also somewhat diverse because of the area's geology, topography and elevation, climate, precipitation, and vegetation attributes. The ecological site description (ESD) is a characterization of range and forest sites based on site-specific soils, topography, and climate attributes. Landowners and managers could use an

Figure 3.66. Example of a Nonviable Reservoir (Top) and Viable Reservoir (Bottom).

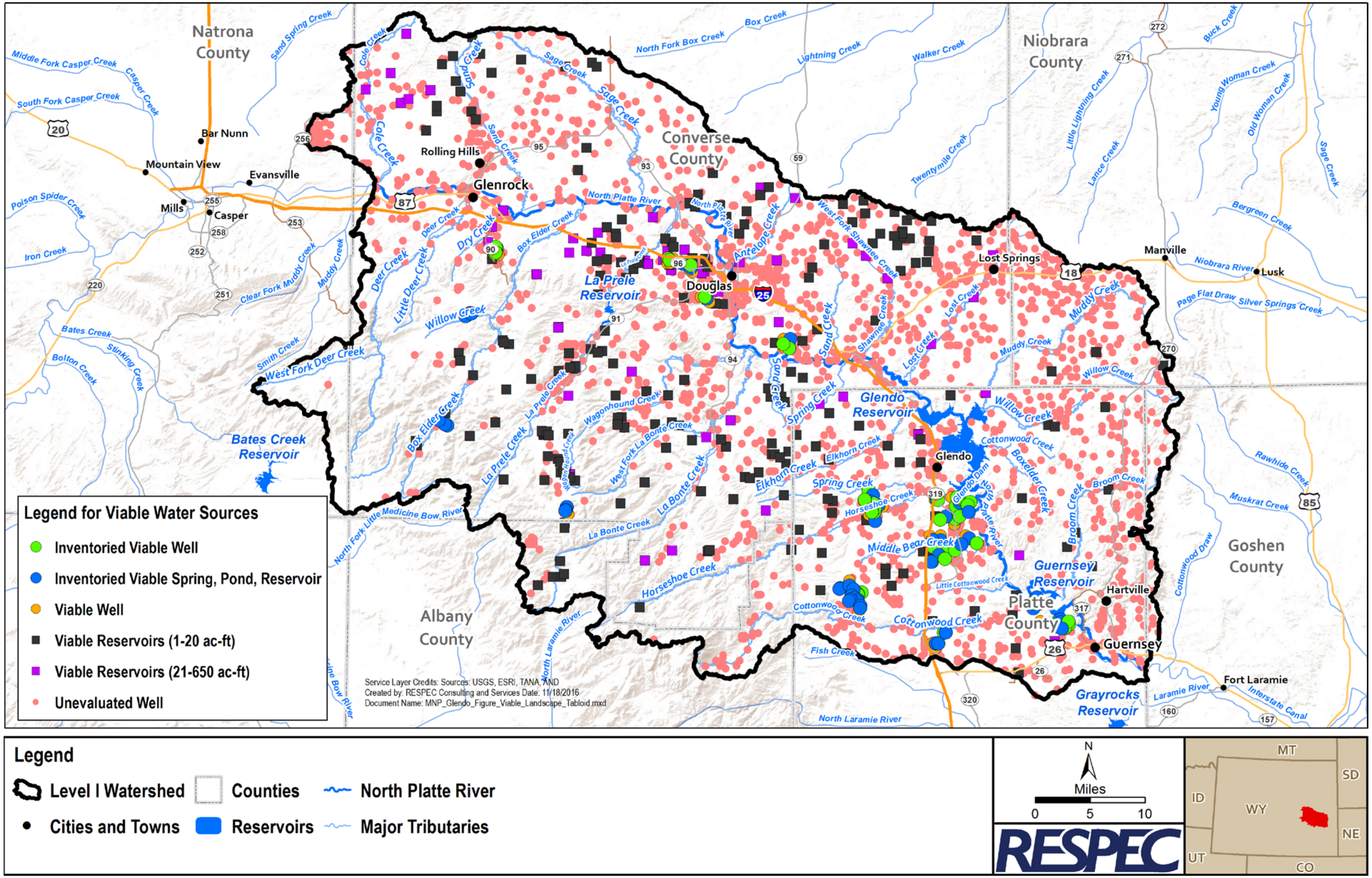


Figure 3.67. Known Viable Water Sources Within the Study Area.

ESD along with field monitoring to evaluate the condition of a range or forest site by comparing the current growth to what the site is capable of growing. ESDs can also help identify areas where developing viable water sources would support grazing improvements by providing dependable amounts of suitable-quality water to livestock and wildlife on private and public lands. An ESD includes interpretations about the land uses that a specific ecological site can support and management alternatives for achieving objectives. The ecological sites and associated descriptions were developed over many years of data collection and are dependent on the location of a site within defined precipitation zones and existing soil characteristics. ESDs are available from the NRCS via the website (*https://esis.sc.egov.usda.gov)*.

The NRCS ESDs are available in Albany, Converse, Natrona, Niobrara, and Platte Counties, which cover almost 75 percent of the study area. Figure 3.68 shows the major ecological sites for the completed soil surveys within the watershed. Three ESDs cover over 30 percent of the watershed and are listed in Table 3.33. The most predominant ESD is the Loamy (Ly) 10- to 14-inch Northern Plains Precipitation Zone (PZ) site (R058BY122WY), which covers approximately 347,793 acres (16.6 percent) of the study area. The second and third predominant ESDs are the Sandy (Sy) 10-14-inch Northern Plains PZ site (R058BY150WY) and the Shallow Loamy (SwLy) 10-14-inch Northern Plains PZ (R058BY162WY) site that cover approximately 177,038 acres (8.4 percent) and 113,626 acres (5.4 percent) of the study area, respectively. The ESDs that cover less than 0.1 percent of the watershed are also listed in Table 3.33.

3.4.8.7 *Range Conditions and Needs*

Range conditions depend on many factors, including but not limited to climate and precipitation, soil and water, plants and animals, topography and geology, and natural disturbances. Range condition goals, objectives, and actions for BLM-or USFS-managed allotments within the study area are detailed in the BLM's proposed RMPs and associated environmental impact statement (EIS) documents for the Casper, Newcastle, and Rawlins field offices and the USFS Forest Plan and amendments and associated EIS documents for the USFS Douglas Ranger District-Laramie Peak. Grazing permits or leases for a particular allotment, however, are not included within the RMP, Forest Plan, or EIS. Grazing leases and permits frequently include an AMP, coordinated RMP, or similar agreement that outlines a grazing plan and is prepared in cooperation with the permittees or operators. These plans often include goals and objectives, management indicators, use patterns, desired conditions, and progress measures.

In 2007, the BLM's Casper Field Office proposed a RMP and a final EIS for most of Natrona County and all of Converse, Goshen, and Platte Counties. Approximately 10 percent of public lands were assessed for rangeland heath. By the 2004 fiscal year (FY), 50 allotments (477,824 acres) were assessed within the area. Only 26 of the 50 allotments were found to meet the 6 rangeland health standards. The standards included the following resources: watershed, riparian/wetland, upland vegetation, wildlife/threatened and endangered species habitat, fisheries habitat, weeds, water quality, and air quality [BLM, 2007].

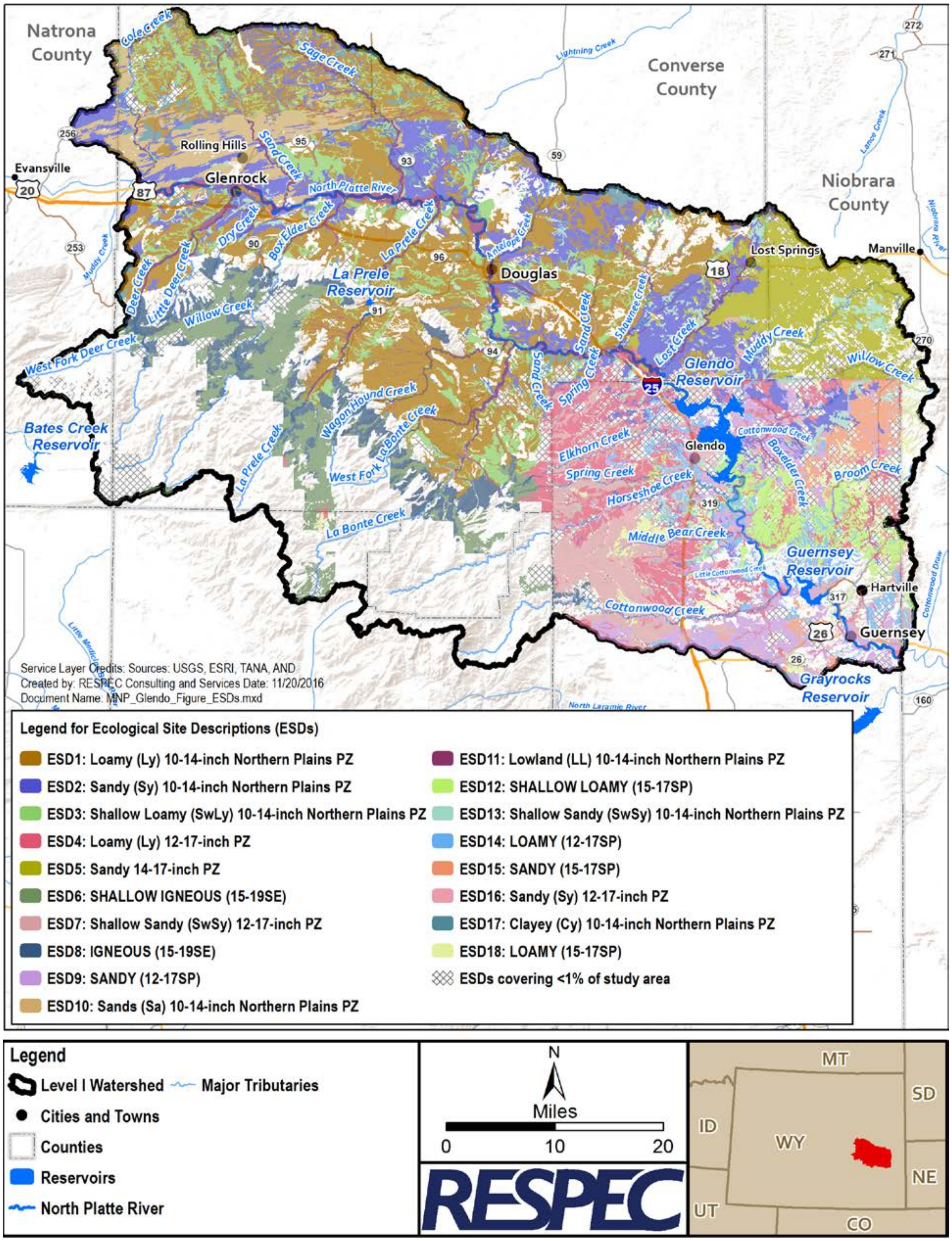


Figure 3.68. Predominant Ecological Site Descriptions Within the Study Area.

Table 3.33. Ecological Site Descriptions Within the Study Area

Ecological Site I.D.	Description	Area (acres)	Percent of Study Area
R058BY122WY	Loamy (Ly) 10–14 inch Northern Plains PZ	347,793	16.6
R058BY150WY	Sandy (Sy) 10–14-inch Northern Plains PZ	177,038	8.4
R058BY162WY	Shallow Loamy (SwLy) 10–14 inch Northern Plains PZ	113,626	5.4
R067AY122WY	Loamy (Ly) 12–17 inch PZ	97,491	4.7
R064XY011NE	Sandy 14–17-inch PZ	86,245	4.1
R049XY160WY	Shallow Igneous (15–19SE)	81,035	3.9
R067AY166WY	Shallow Sandy (SwSy) 12–17-inch PZ	66,406	3.2
R049XY116WY	Igneous (15–19SE)	62,344	3.0
R067XY150WY	Sandy (12–17SP)	58,399	2.8
R058BY146WY	Sands (Sa) 10–14 inch Northern Plains PZ	56,903	2.7
R058BY128WY	Lowland (LL) 10–14 inch Northern Plains PZ	46,696	2.2
R067XY262WY	SHALLOW LOAMY (15–17SP)	39,576	1.9
R058BY166WY	Shallow Sandy (SwSy) 10–14 inch Northern Plains PZ	36,005	1.7
R067XY122WY	Loamy (12–17SP)	31,686	1.5
R067XY250WY	Sandy (15–17SP)	27,803	1.3
R067AY150WY	Sandy (Sy) 12–17 inch PZ	26,002	1.2
R058BY104WY	Clayey (Cy) 10–14 inch Northern Plains PZ	24,976	1.2
R067XY222WY	Loamy (15–17SP)	20,733	1.0
	ESDs covering < 1 percent of watershed	162,326	15.5
Total		**1,563,083**	**74.6**

The final EIS and proposed Casper RMP planning area encompassed this Level I study area and provide descriptions of similar resources and conditions within the study area. The Casper planning area and the study area include comparable areas of the 10180007–Middle North Platte–Casper and 10180008–Glendo Reservoir sixth order HUCs. In 2007, the BLM-Casper's EIS stated that grasslands and sagebrush were the most common vegetation types in the planning area with vegetative cover and litter on upland sites variable because of soil type, slope, aspect, elevation, and precipitation [BLM, 2007]. Wyoming big sagebrush and grassland is the most common community in south-central Wyoming and typically grows below 7,000 feet. These vegetation types are common in drier areas on shallow to deep soils. Above 6,000 feet, mountain big sagebrush becomes more prominent and is found in areas with deeper soils, which receive greater moisture. At higher elevations, plant cover is usually higher because of increased moisture and plant density [BLM, 2007]. In general, the overall ground cover appears good, but most grassland and communities within the Casper planning area have been influenced by surface disturbing activities, livestock grazing, fire or fire suppression, and invasive, nonnative plant species. These areas can still be improved by using BMPs [BLM, 2006].

3.4.9 Cultural Resources

The Wyoming State Historic Preservation Office (SHPO) maintains a database of inventoried historic sites within the state. The SHPO makes a spatial data file available that generalizes the cultural resource inventory to the section level. This level of locating archaeological data protects the sites from unauthorized disturbance. The attributes recorded for each section include the site count, inventory acres, report numbers, and eligible site number.

Figure 3.69 displays the SHPO cultural resource inventory results graphically. Sections within the study area have been color-coded based on the number of inventoried sites that are determined to be eligible for inclusion in the National Register of Historic Places. The National Register of Historic Places, our nation's official list of cultural and historic sites, is administered by the National Park Service and managed within the state by the Wyoming SHPO.

There are 46 historical monuments and markers located within the study area. The most prevalent historic sites are the Pioneer Trails and Fort Fetterman. The historical Pioneer Trails in that traverse through the watershed and include the Bozeman Trail, Oregon-California-Mormon, Oregon-California-Mormon-Pony Express, and Rock Creek-Fort Fetterman Stage Road. Fort Fetterman was established in 1867 and is located north of Douglas on a plateau above the valleys of LaPrele Creek and the North Platte River. Fort Fetterman was a base for military expeditions throughout the 1870s until the fort was abandoned in 1882. Subsequently, the abandoned fort served as a supply location for the area's ranchers and travelers until the city of Douglas was founded nearby in 1886. Today, the Fort Fetterman Historic Site is operated by the State of Wyoming and has restored original buildings, remnant building foundations, interpretive exhibits and trails, picnic and camping areas. Figure 3.69 also displays the historic trails, sites listed on the National Registry of Historic Places, and historic monuments and markers within the State of Wyoming.

3.4.10 Mining and Mineral Resources

While the watershed has few active mines, historic mining operations have left a mark on the landscape. The WDEQ's Abandoned Mine Lands (AML) Division oversees reclaiming abandoned mine lands within the state of Wyoming and there are ongoing initiatives to restore these lands to safe conditions. The WDEQ's AML Division has worked with land management agencies, private landowners, and contractors to reclaim abandoned coal, bentonite, and uranium mines across the state and place them back into productive land uses. Dozens of abandoned mine sites are located in the watershed, as shown in Figure 3.70. Detailed information for each of these sites was outside the scope of this study, but additional information may be obtained by contacting the AML.

Mining within the watershed first dates to the Paleoindian Period (12,000–8,000 before present, BP); a site near the city of Hartville indicates that Paleo-Indians mined ochre for paints and orthoquartzite for tools, which makes it one of the oldest mining sites in North America [Humstone and Meadows, 2005]. In the same area, copper mining occurred from 1880 to 1887 and resulted in the founding of the towns of Sunrise and Hartville [Sutherland, 2016]. The Sunrise Iron Ore Mine (near Hartville) mined hematite from Precambrian rocks from 1898 to 1980 [Humstone and Meadows, 2005], first as a surface mine and later as an underground operation. Many buildings, a sinkhole, the glory hole and Chicago pits, and tailing piles are still visible at what is now the Sunrise Mine Historic District as shown in Figure 3.71.

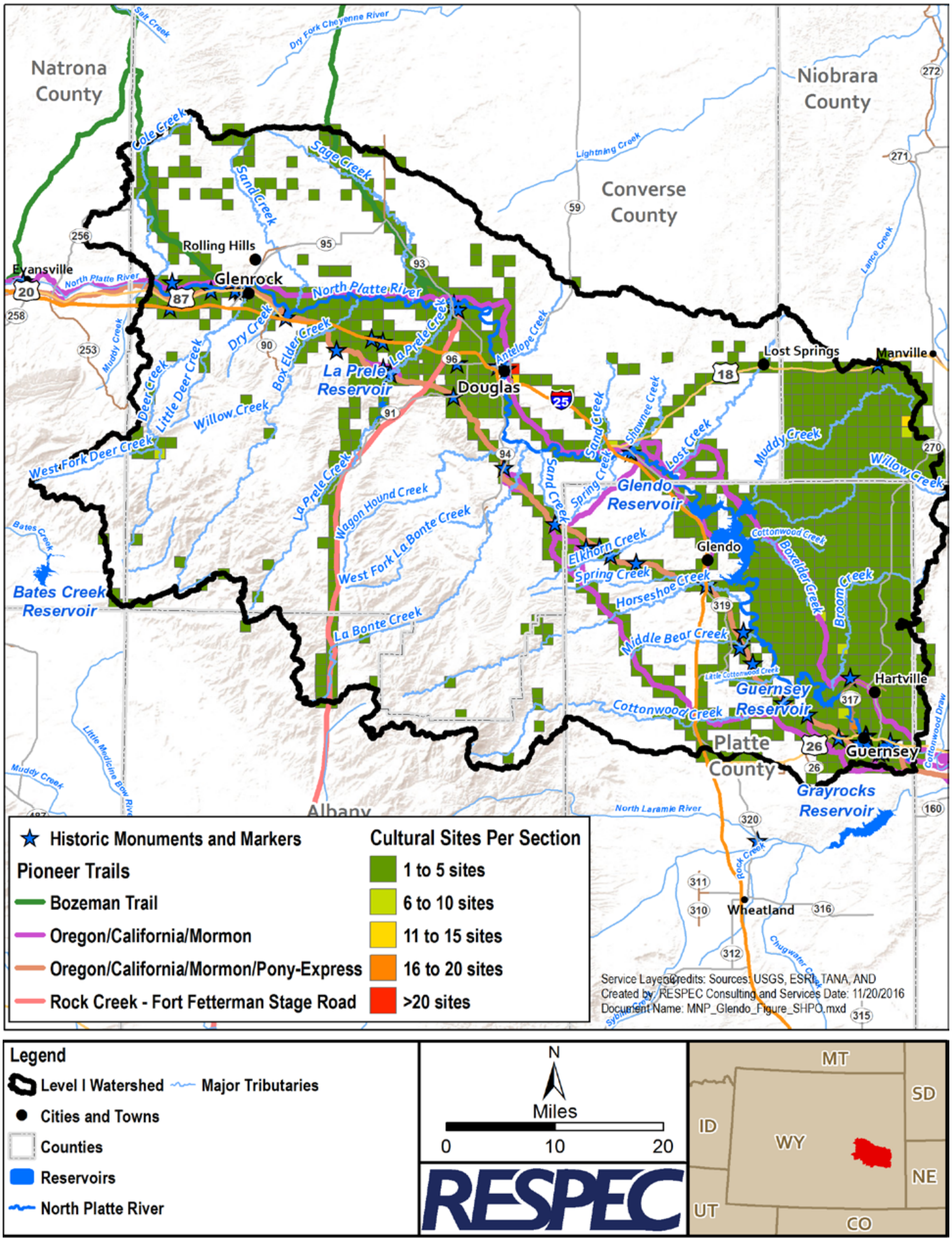


Figure 3.69. Historic Sites, Pioneer Trails, and Cultural Sites per Section Within the Study Area.

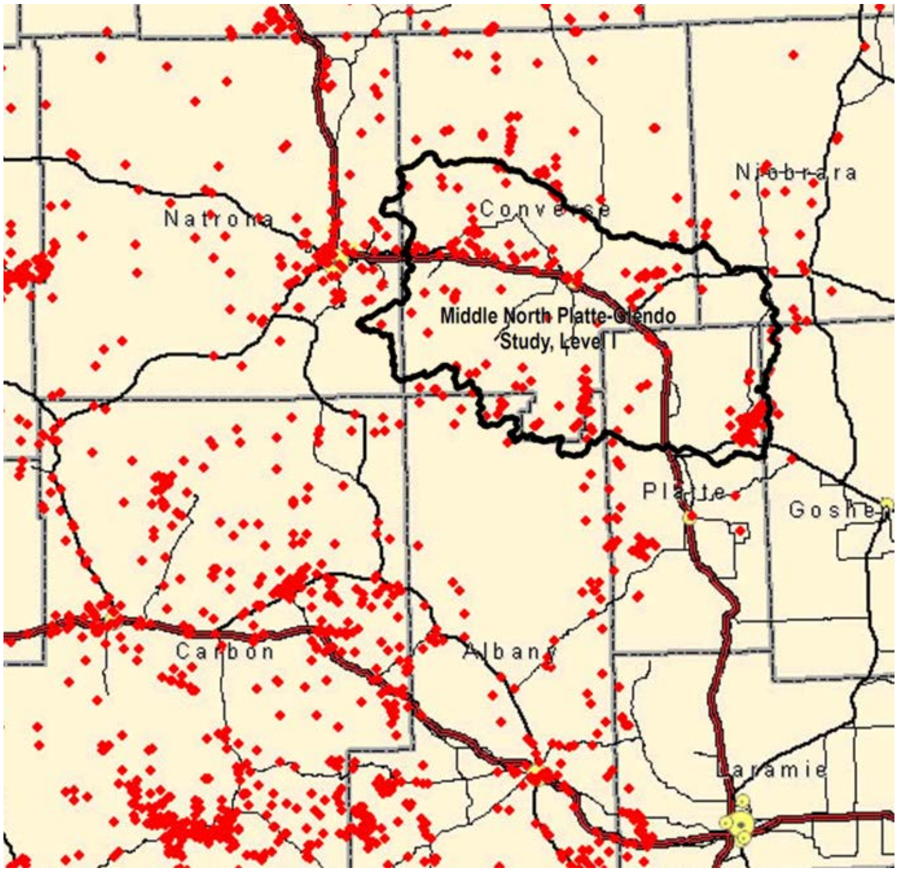


Figure 3.70. Abandoned Mine Sites in Wyoming.

Figure 3.71. Abandoned Sunrise Mine Near Hartville, Wyoming [Voight, 2016].

The northernmost edge of the watershed includes a portion of the Glenrock coal field and an even smaller portion of the Lost Spring coal field within the southwestern part of the Powder River Basin [Osmonson et al., 2011]. Within the study area, coal occurs within the Eocene Wasatch Formation and the underlying Paleocene Fort Union Formation. Coal mining within the Powder River Basin began near Glenrock and Douglas in 1883, though the only significant production in the study area occurred at the Dave Johnston Coal Mine. As of 2016, no active coal mines exist within the study area, and the depth to coal beds makes coal mining sub-economical under present conditions.

The Dave Johnston Coal Mine consisted of approximately 4,000 acres and operated from 1958 to 2000. The 9-mile-long mine straddled the watershed boundary north of Glenrock, illustrated on Figure 3.72. Reclamation was conducted from 1999 to 2005 that serves as an example for coal mine reclamation and has earned several reclamation awards from federal and state agencies [Pacificorp, 2016]. The reclaimed land provides grazing and wildlife habitat through native vegetation and six man-made springs that were created to provide water for wildlife [Pacificorp, 2016]. The site is also home to three wind energy projects, which were the first to be installed at a former coal mine [Pacificorp, 2016]. The Dave Johnston Power Plant still operates, but uses coal railed in from other Wyoming mines.

The study area contains over 40 operating non-coal mines. Information about these mines was obtained from the WDEQ and is also summarized in Table 3.34 and Figure 3.72. The largest and most notable non-coal operation within the study area is the Smith-Highland Uranium Mine, which is operated by Cameco Resources on over 30,000 acres. Sand/gravel mines comprise the majority of permitted mine operations within the study area. Other minerals mined include feldspar and limestone.

3.4.11 Oil-and-Gas Production and Resources

Oil-and-gas development is an important industry in the watershed, but has less development than other watersheds within the Powder River Basin. In 2015, oil-and-gas fields within (in whole or part) the study area produced approximately 825,000 barrels (bbls) of oil, 2 million cubic feet (mcf) of natural gas, and 6.7 million bbls of water [Wyoming Oil and Gas Conservation Commission, 2016]. Approximately 126,300 acres of oil-and-gas fields and hundreds of miles of pipelines are within the watershed [Energy Information Administration, 2008]. Production by field is summarized in Table 3.35. Field locations and pipelines are shown in Figure 3.73.

Fields primarily occur in the northern half of the watershed within Converse County; the larger fields are concentrated west of Glenrock, near Douglas, and west of Lost Springs. The majority of these fields are/were producing from Cretaceous-age formations (including the Frontier, Niobrara, Sussex, and Dakota) and the Tertiary White River Group. Reservoirs such as the Sussex are becoming more attractive reservoir targets because improved drilling technologies (including horizontal drilling and fracking) allow for increased oil and gas recovery, hence improving the economics of producing from a formation that previously would have been less productive and less economical. Scott Field produced nearly one-quarter of all of the oil in the study area and was also the largest producer of natural gas. The largest water production occurred at Sussex and Glenrock South Fields, with combined production around 5 million gallons of water in 2015 (approximately 10 gallons per minute [gpm]), or 75 percent of the oil-/gas- produced water within the study area. Impacts to groundwater that are associated with oil-and-gas development are discussed in Section 3.6.1.

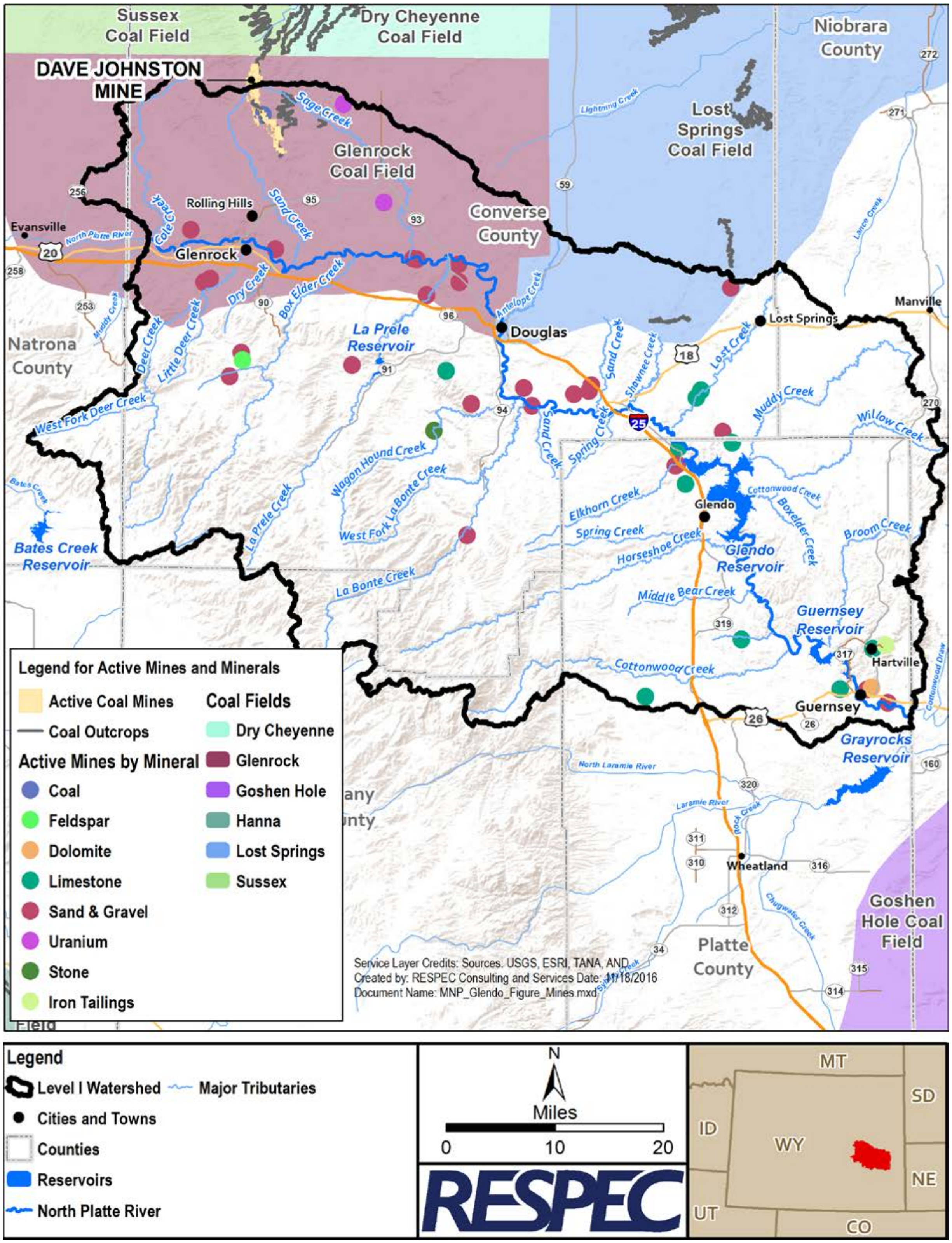


Figure 3.72. Permitted Mines Within the Watershed.

Table 3.34. Current Mineral Resource Mines Within the Study Area (Page 1 of 2)

Permit I.D.	Permitted Mine	Permittee	Commodity	Mine Area (acres)
PT0633	Smith Ranch/Highland	Cameco Resources	Uranium	16,687
PT0684	VR Mine	Knife River (JTL Group Inc DBA)	Sand/Gravel	1,120
PT0242	Guernsey Stone	Martin Marietta Materials	Dolomite	939
SP0707	Willis Pit	Croell Redi Mix Inc	Sand/Gravel	690
PT0559	Glenrock Pit	Knife River (JTL Group Inc DBA)	Sand/Gravel	238
PT0756	Frederick Quarry	McMurry Ready Mix Co	Limestone	197
PT0320	Hartville-Ingleside	Pete Lien & Sons Inc	Limestone	106
SP0580	Fetterman Pit	Croell Redi Mix Inc	Sand/Gravel	102
SP0641	Carmin Pit	Croell Redi Mix Inc	Sand/Gravel	94
SP0785	Boner Pit	Mobile Concrete Inc	Sand/Gravel	89
SP0749	Fish Creek Quarry	Alexander Const Co	Limestone	40
RD0010	N Platte Project	Uranium Resources & Development	Uranium	36
SP0800	Quarry No. 2	Strid Marble & Granite Co	Stone	35
ET1577	Bright	K & M Mining, LLC	Limestone	20
ET1554	New Sunrise	New Sunrise LLC	Iron	10
ET0486	Red Rock Pit	Wyoming Red Rock LLC	Sand/Gravel	10
ET0749	Valentine Pit	Valentine Const Inc	Sand/Gravel	10
ET1120	Larsen	71 Const	Sand/Gravel	10
ET1287	Strock	Basic Energy Serv LP	Sand/Gravel	10
ET1452	Cole Lumber	Randy Cole	Sand/Gravel	10
ET1484	Tillard	Mobile Concrete Inc	Sand/Gravel	10
ET1500	Diamond Ranch	Signet Stone & Soil LLC	Gravel	10
ET1517	Grant	Laser Aggregates, David L Banzhaf	Gravel	10
ET1520	Hout	Hout Fencing of WY Inc	Sand/Gravel	10
ET1552	River Pit	Wagonhound Land & Livestock	Sand/Gravel	10
ET1553	Morton Pit	Wagonhound Land & Livestock	Sand/Gravel	10
ET1559	Strock Pit	Magna Energy Services, LLC	Sand/Gravel	10
ET1474	Strock	Quality Agg & Const Inc	Sand/Gravel	10
ET0148	Luhr	David & Winiactiveed Prewitt	Sand/Gravel	10
ET0897	Guernsey Pit	Imerys Marble Inc	Sand/Gravel	10
ET1154	Elkhorn Pit	Jay B Collins	Sand/Gravel	10
ET1562	Collins Pit	Croell Redi Mix	Sand/Gravel	10
ET1578	Reese	Reese, Brad R	Sand/Gravel	10
SP0796	Douglas Quarry	Pinnacle Materials Inc	Limestone	10
ET1535	Bright	Basic Energy Serv LP	Limestone	10
ET1054	Gray	Rissler & McMurry Co	Limestone	10
SP0804	Collins Quarry	Jay B Collins	Limestone	10
SP0811	Shawnee	Pinnacle Materials Inc	Limestone	10
ET1478	Brose Pit	Wagonhound Land & Livestock	Gravel	9
ET1604	Etchemendy	Dan Hart Patrol Service LLC	Sand/Gravel	5

Table 3.34. Current Mineral Resource Mines Within the Study Area (Page 2 or 2)

Permit I.D.	Permitted Mine	Permittee	Commodity	Mine Area (acres)
ET1555	Shawnee #1	Western Sunset LLC	Sand/Gravel	4
ET0641	Valentine Feldspar Quarry	Valentine Const Inc	Feldspar	2
ET1511	Cundall	Jerry Cundall	Limestone	1
PT0261	Lovitt Gravel Pit	County Of Converse	Sand/Gravel	unknown

Table 3.35. 2015 Oil and Gas Production by Field

Oil or Gas Field	Oil (bbls)[(a)]	Gas (mcf)[(b)]	Water (bbls)[(a)]
Bed Tick	161	0	80
Big Muddy	14,796	0	325,055
Big Muddy East	8,368	0	37,821
Blizzard	2,484	2,107	526
Blue Hill	3281	0	145
Brooks Ranch	40,922	0	22,858
Cole Creek©	31,885	0	30,838
Cole Creek South	15,505	0	643,519
Deer Creek	481	0	0
Derrick Draw	11,854	88,589	1,128
Douglas South	1,382	0	0
Fetter	7,243	105,629	13,134
Flat Top	14,614	198,411	20,115
Flat Top East	0	0	0
Glenrock	4,116	0	22,275
Glenrock South	33,192	0	2,140,852
Joss	2,339	1,381	907
Martin Springs[(c)]	5,625	0	18,120
Morton	2,112	0	6
Orpha	30,774	84,839	32,265
Popskull	6,932	3874	0
Purple Sage	47,426	239,696	5,249
Sand Dunes[(c)]	38,991	254,159	6,796
Scott	215,752	391,261	198,653
Shawnee	42,740	148,296	9,601
Sussex	69,658	60,362	2,974,499
Thunder Creek	3,164	113,417	612
Tick	815	0	0
V-Two Draw	21,913	6,891	361
Well Draw[(c)]	146,814	295,547	176,254

(a) One barrel equals 42 (US) gallons of liquid at 60°F at atmospheric pressure.
(b) 1,000 cubic feet of natural gas.
(c) Only a small portion of field extends into the watershed.

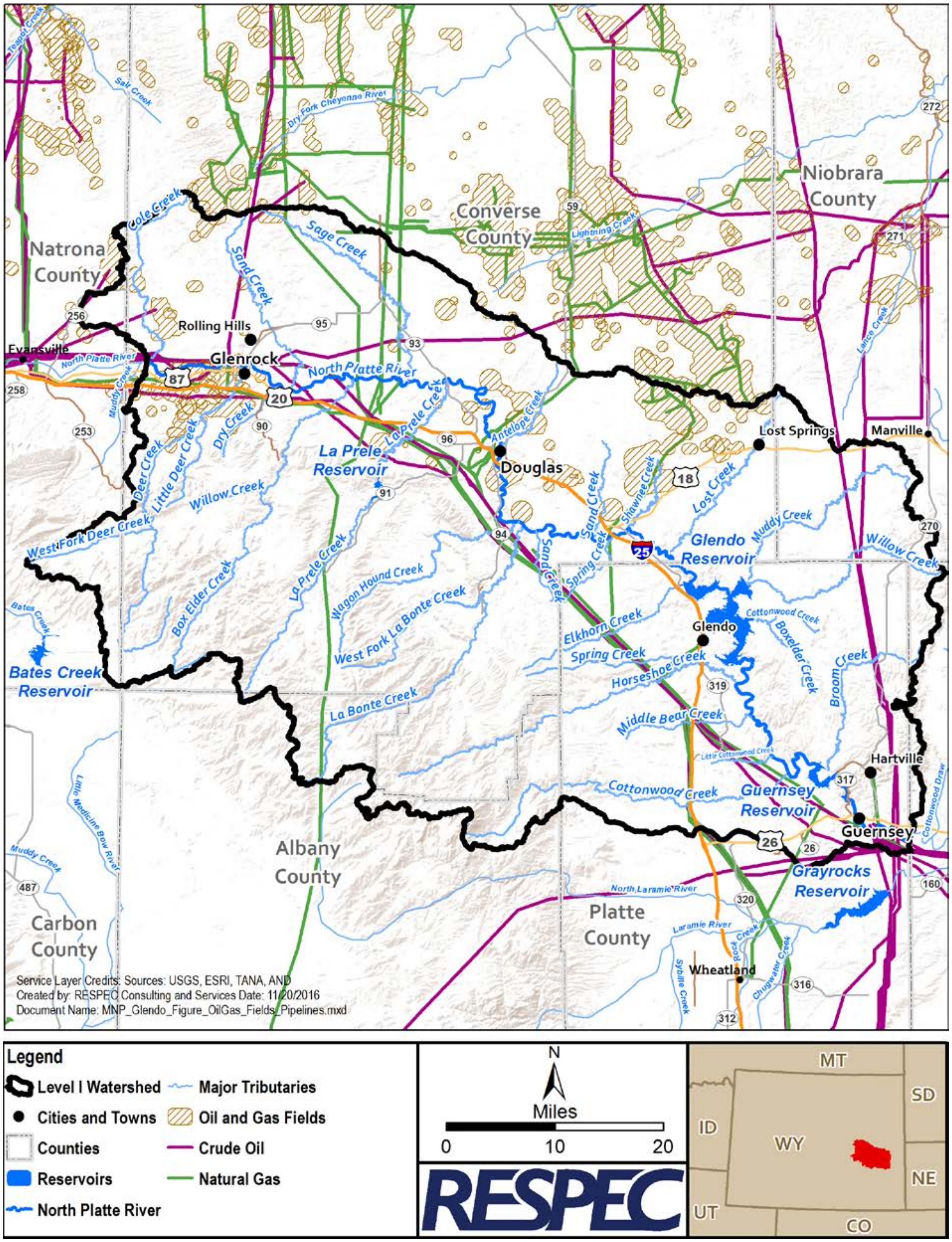


Figure 3.73. Oil-and-Gas Fields and Pipelines Within the Watershed.

Locations of the active oil and gas wells and permanently abandoned wells are displayed in Figure 3.74. As of September 2015, the watershed had approximately 129 active oil wells, 27 active gas wells, and 1,685 plugged and abandoned wells [Wyoming Oil and Gas Conservation Commission, 2015]. The greatest concentration of active oil wells occurs within the Cole Creek South Field near Rolling Hills and the Glenrock Field. Current gas-production wells are concentrated in the Flat Top Field northwest of Rock Springs and the Fetter Field near Douglas. Additional information and data for fields and specific oil-and-gas wells can be obtained from the WOGCC by communicating with WOGCC staff and by accessing their website (*http://wogccms.state.wy.us/*). A group of oil-and-gas operators have proposed to drill an additional 5,000 oil-and-gas wells within Converse County in the next 5 years [ICF, 2014]. A draft EIS for the project is in progress at the completion of this document and not available for review.

3.5 FISH AND WILDLIFE

Wyoming's waters and landscapes support over 800 species of wildlife with 120 species of mammals, 426 species of birds, 12 species of amphibians, 27 species of reptiles, 78 species of fish, several thousand species of invertebrates, and over 13,100 species of plants [WGFD, 2010]. The WGFD provides a system of control, propagation, management and protection, and regulation of all wildlife in Wyoming. The WGFD monitors and maintains big game, small game, nongame, and fish populations through studies, surveys, and habitat analysis. The WGFD has developed geodata that shows big game areas, ranges, and routes. Additionally, the WGFD has developed geodata that shows crucial stream corridors, blue ribbon streams, key nongame areas, and habitat priority areas within the state of Wyoming.

3.5.1.1 *Fish*

Fish habitats within the study area include perennial and intermittent streams, springs, lakes, ponds, and reservoirs that support fish through at least a portion of the year with aquatic habitat quality that varies by location, landforms, and vegetation [BLM, 2007]. Current aquatic conditions on the Medicine Bow National Forest lands in the study area vary depending on the magnitude and type of disturbances in each watershed and the inherent resistance and resiliency of the aquatic systems [USFS, 2003].

Fisheries within the study area are most recognized for various species of trout, which have all been introduced into streams and ponds for recreational use [BLM, 2013]. Known recreational fisheries within the study area include but are not limited to the North Platte River, Glendo Reservoir, Guernsey Reservoir, Deer Creek, Horseshoe Creek, Ashenfelder Creek, La Bonte Creek, Porcupine Creek, North Horseshoe Creek, Big Bear Creek, and Curtis Gulch as shown in Figure 3.75. Specifically, the North Platte River, Glendo Reservoir, Deer Creek, and La Bonte Creek receive significant use in the study area and are a priority for the WGFD, BLM, USFS and cooperating agencies [USFS, 2003; WGFD, 2010; BLM, 2013].

A total of 25 fish species that are considered native to the North Platte River drainage have been collected in Wyoming [USFS, 2003]. A total of 19 fish species, including all existing trout, were introduced into the drainage; 8 of these species have been found on the Medicine Bow National Forest [USFS, 2003]. Native fish species that exist or likely exist in the North Platte River drainage on the Medicine Bow National Forest include white sucker, longnose sucker, longnose dace, creek chub, stonecat, hornyhead chub, and common shiner [USFS, 2003]. Nonnative fish species that exist or likely exist in the drainage on the Forest include brook trout, brown trout, rainbow trout, cutbow trout, brook stickleback, and Colorado River cutthroat trout.

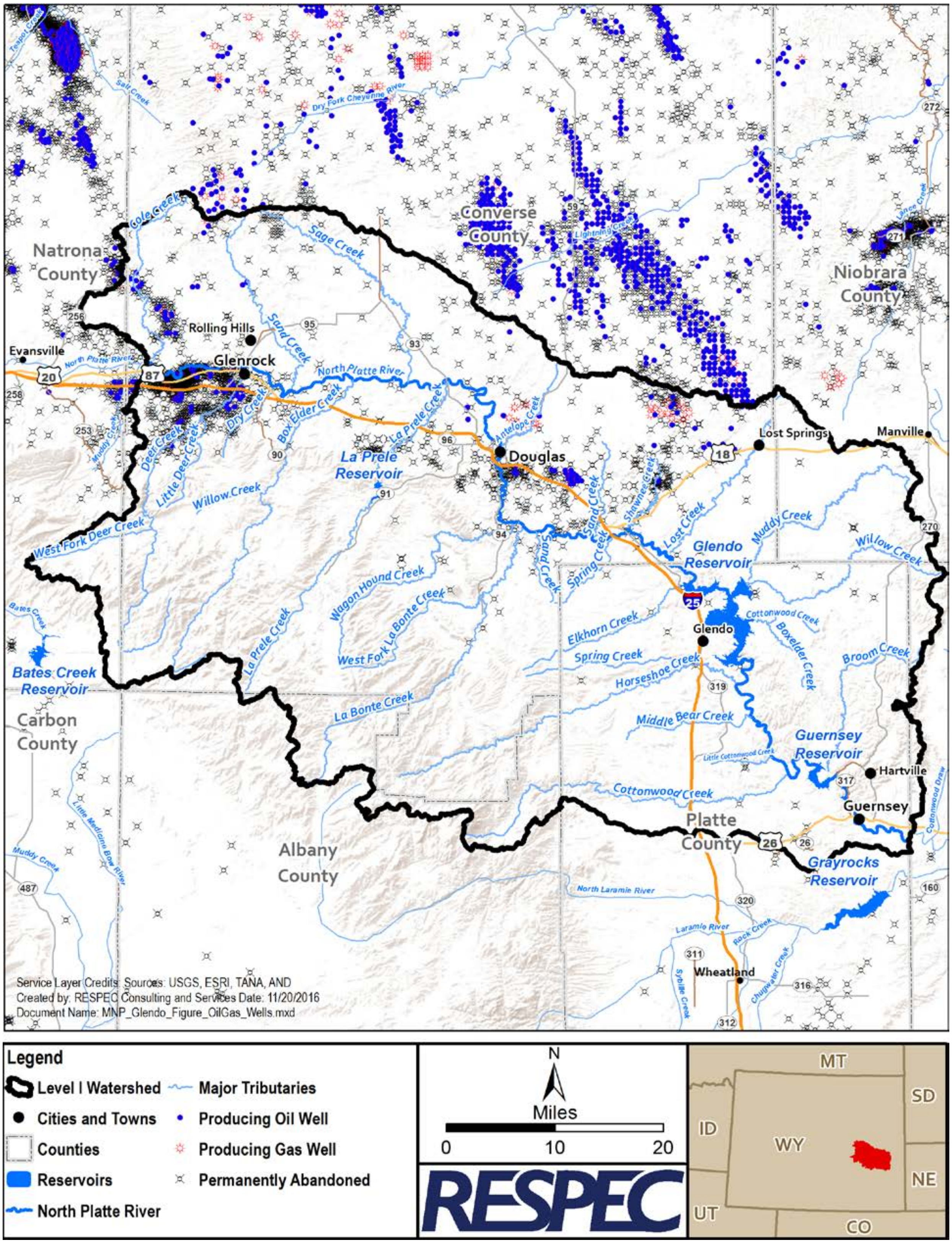


Figure 3.74. Oil-and-Gas Wells Within the Watershed.

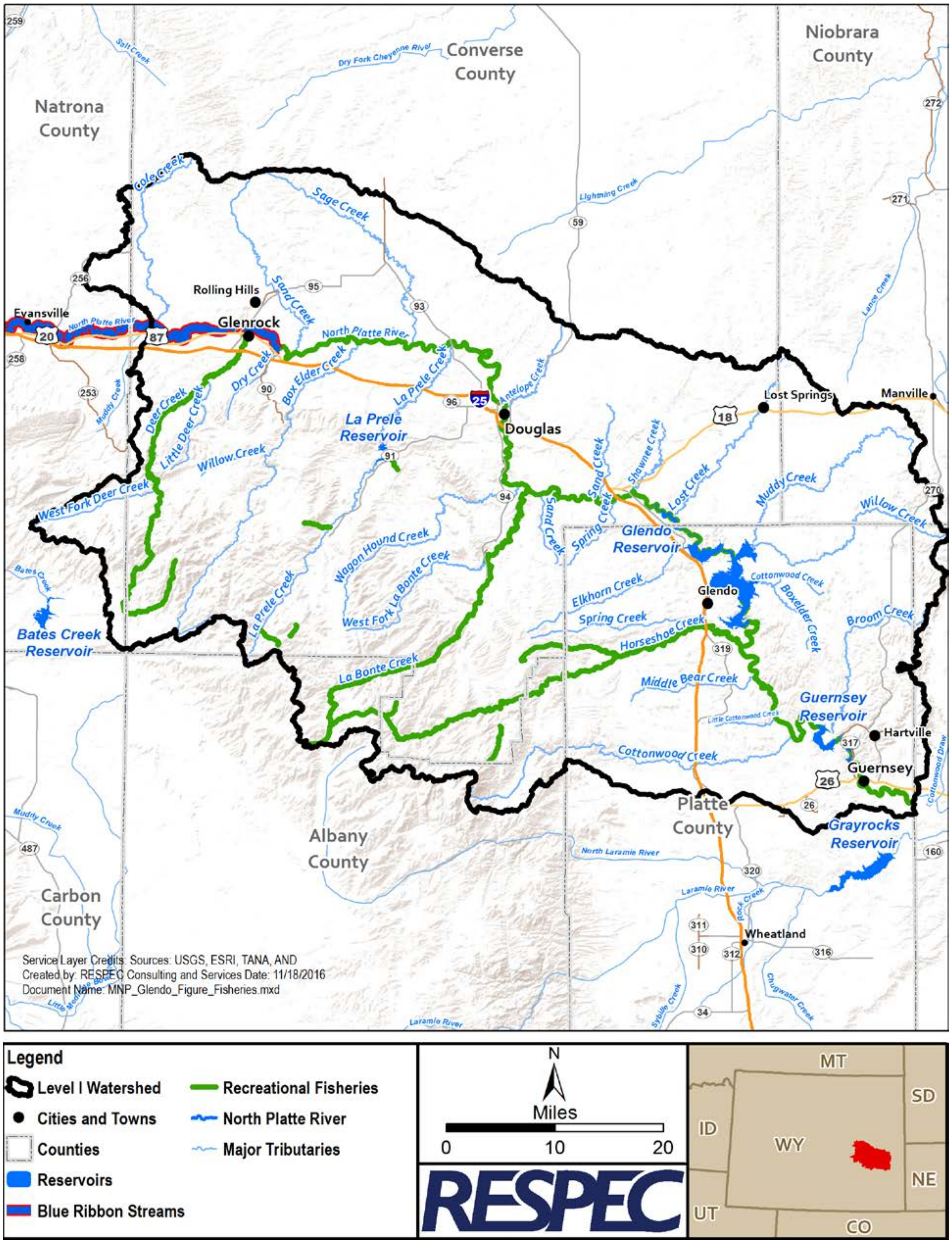


Figure 3.75. Recreational Fisheries Within the Watershed.

Several species, such as greenback cutthroat trout, sauger, shovelnose sturgeon, goldeye, plains minnow, and sturgeon chub have been extirpated from the North Platte River Basin because of fragmentation of and alterations to the North Platte River from construction of dams and large reservoirs [WGFD, 2010]. However, rainbow, brook, brown, and cutthroat trout have been widely stocked throughout the North Platte River Basin, which has provided popular and productive sport fisheries [WGFD, 2010]. Additionally, golden trout, grayling, and splake are stocked to provide popular fisheries in mountain lakes that historically supported no game fish; walleye provide poplar sport fisheries in most North Platte River reservoirs [WGFD, 2010].

3.5.1.2 *Wildlife*

Wildlife is abundant and diverse within the watershed. Approximately 57 fish species, 41 big game populations or herd units, 29 nongame mammals, as well as reptiles and amphibians, trophy game, furbearing animals, predatory animals, small game, and birds are known or expected to occur within the BLM's Casper Field Office area [BLM, 2007]. Big game species, including antelope, bighorn sheep, black bear, elk, mountain lion, mule deer, and whitetail deer, are known to occur within the study area. Raptors in the area include, but are not limited to, golden and bald eagles; ferruginous, red-tailed, and Swainson's hawks; great-horned owls; American kestrel; and prairie falcon [BLM, 2007].

Commonly observed mammals in the watershed include coyotes, jackrabbits, red fox, raccoon, skunk, cottontail, and ground squirrels [BLM, 2007]. Approximately 183 nongame bird and raptor species are found in the study area. Migratory and residential birds include waterbirds, shorebirds, marshbirds, and songbirds. Raptors and neotropical migrants that are known or suspected in the study area are protected under the Migratory Bird Treaty Act (e.g., eagles, hawks, owls, falcons, and vultures) [BLM, 2007].

Turtles, lizards, and snakes are the most common reptiles that generally occur in aquatic, outcrop, and a variety of terrestrial vegetation types. Amphibian species that potentially occur in the study area include tiger salamanders, toads, and frogs occupying aquatic habitats, such as, wetlands, riparian corridors, or open water [BLM, 2007]. The greater sage-grouse and the black-footed ferret are also known to occur within the study area and are recognized as Wyoming BLM sensitive species [BLM 2007]; these species are discussed further in Section 3.5.1.3.

The WGFD has developed geodata that shows hunt areas, herd units, seasonal range, crucial ranges, parturition areas, and migration routes and barriers for antelope, bighorn sheep, black bear, elk, mountain lion, mule deer, and whitetail deer [WGFD, 2015a]. Crucial range has been defined as the seasonal ranges that are the determining factor that affect a herd's ability to maintain populations. Parturition areas are those where lambing, fawning, or calving occur. Approximately 438,717 acres (nearly 21 percent) of the study area has been classified as crucial range for antelope, bighorn sheep, elk, mule deer, and whitetail deer. Figures 3.76 through 3.79 display the herd units, crucial range, seasonal range, and parturition areas for antelope, bighorn sheep, elk, mule deer, and whitetail deer.

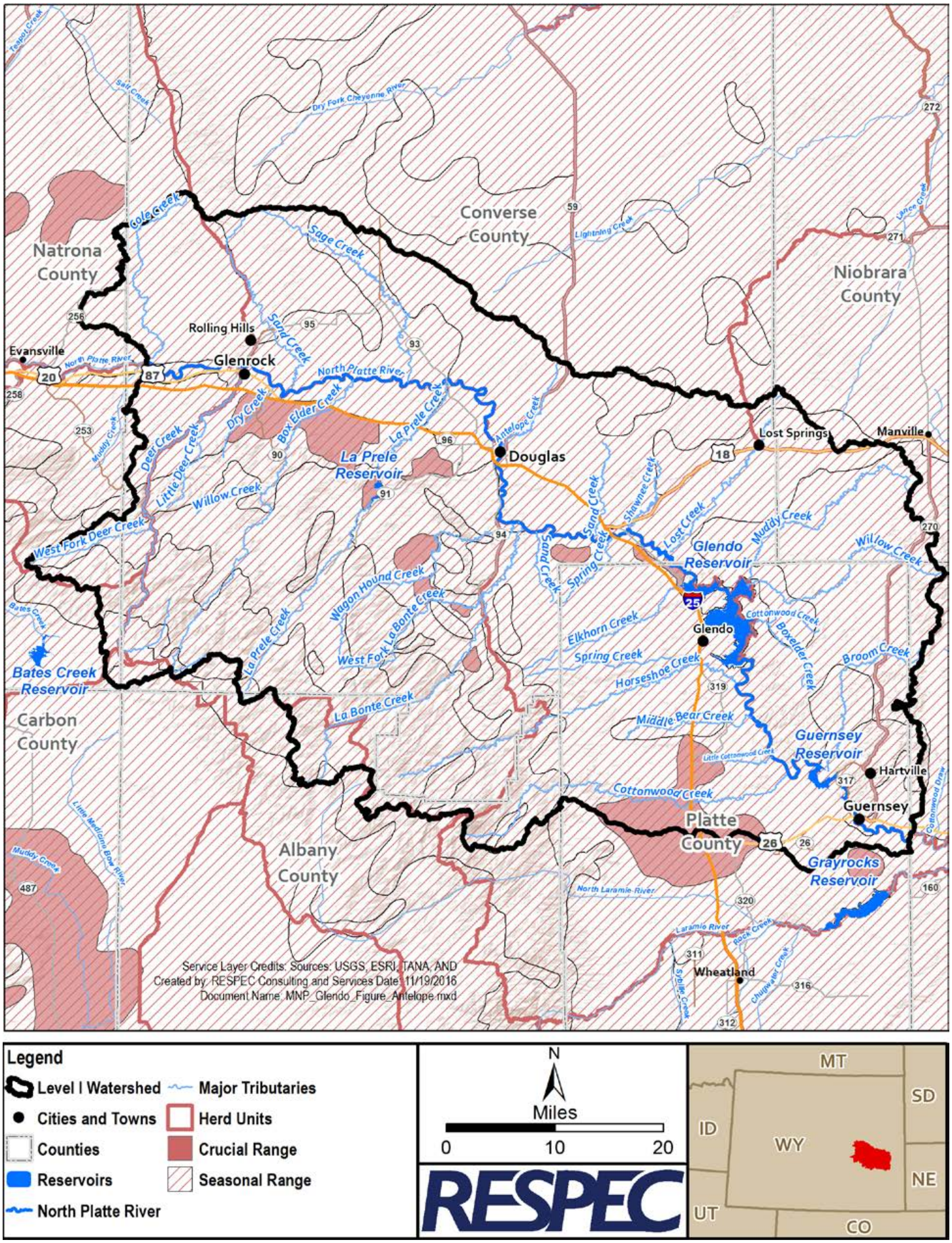


Figure 3.76. Antelope Habitat Within the Watershed.

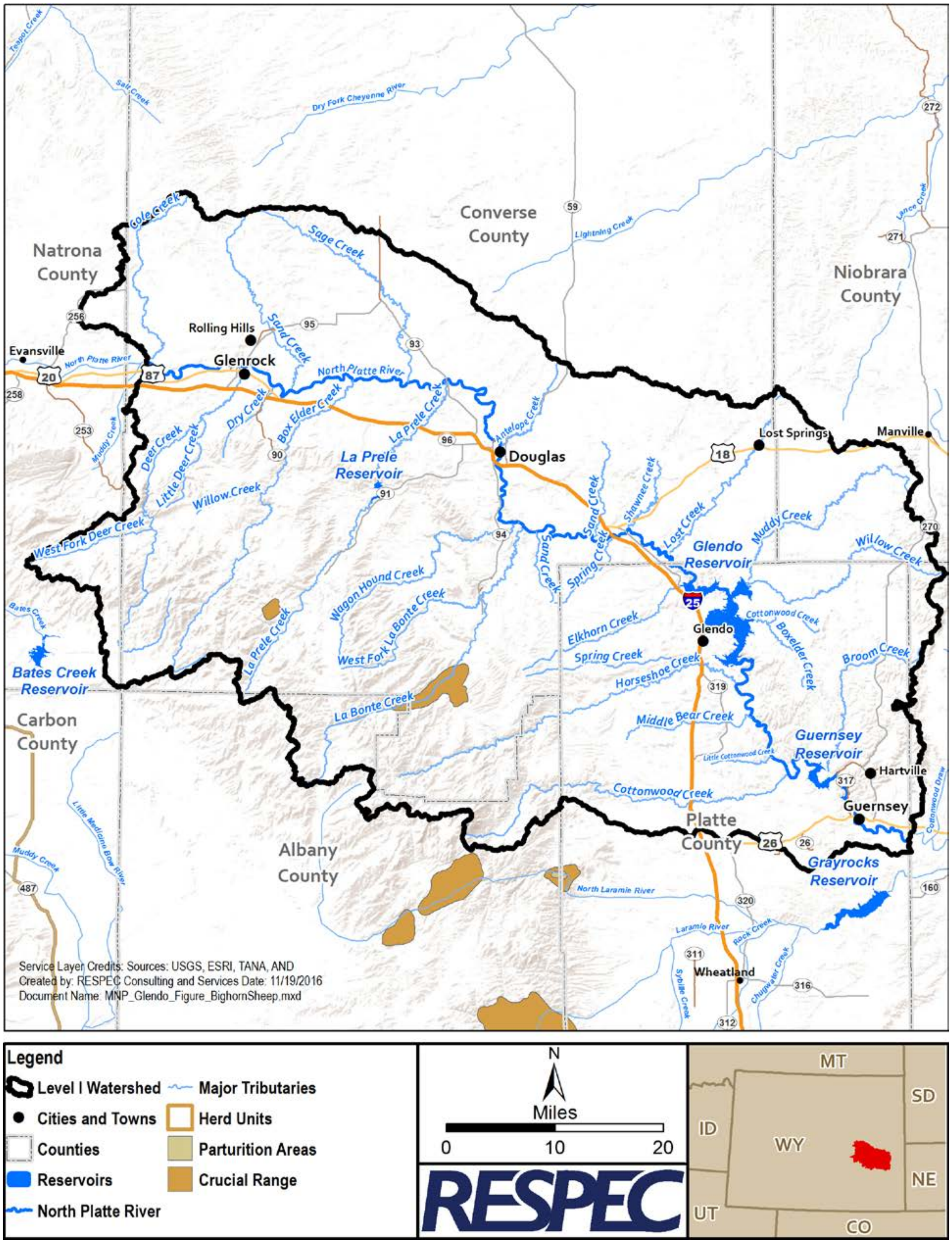


Figure 3.77. Bighorn Sheep Habitat Within the Watershed.

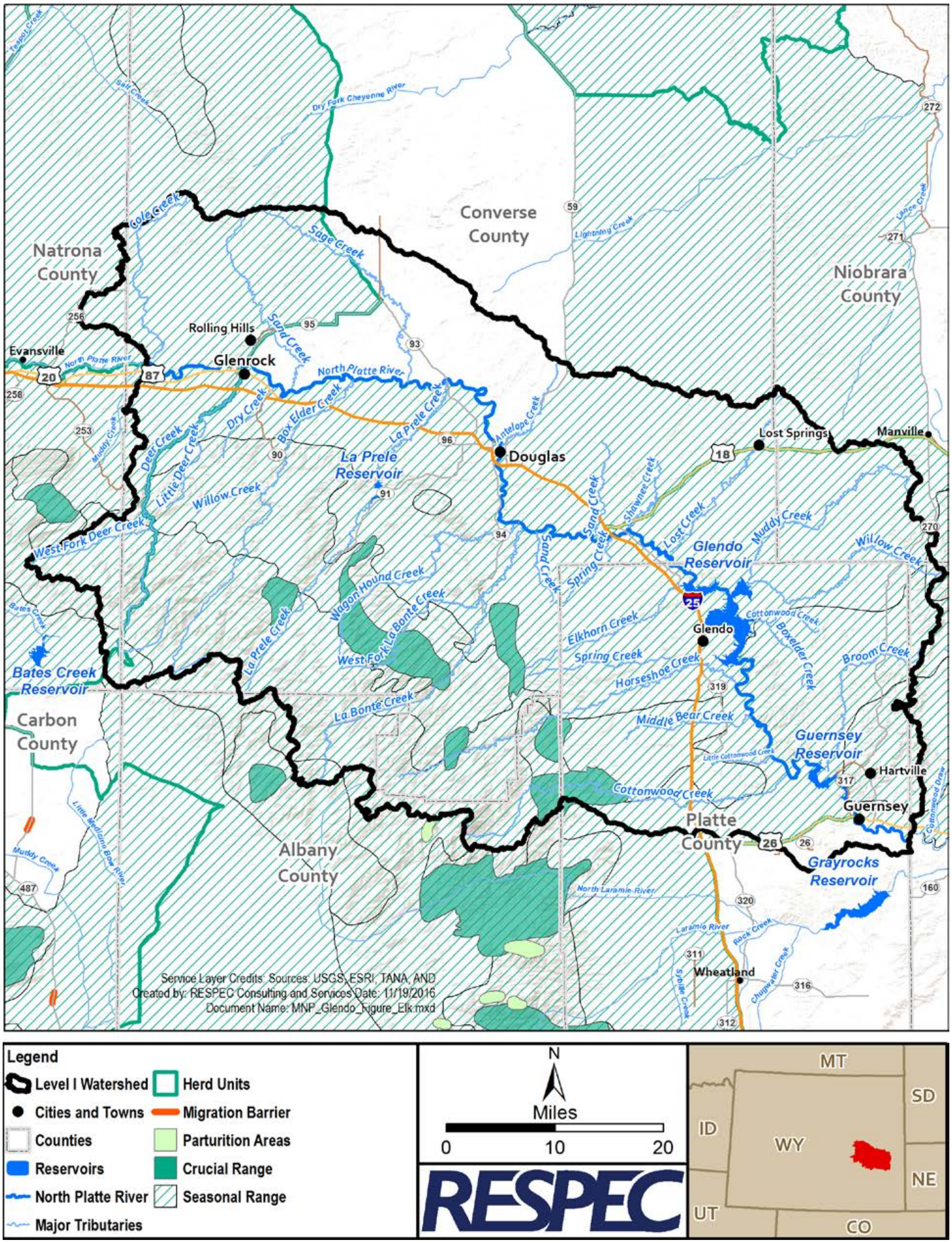


Figure 3.78. Elk Habitat Within the Watershed.

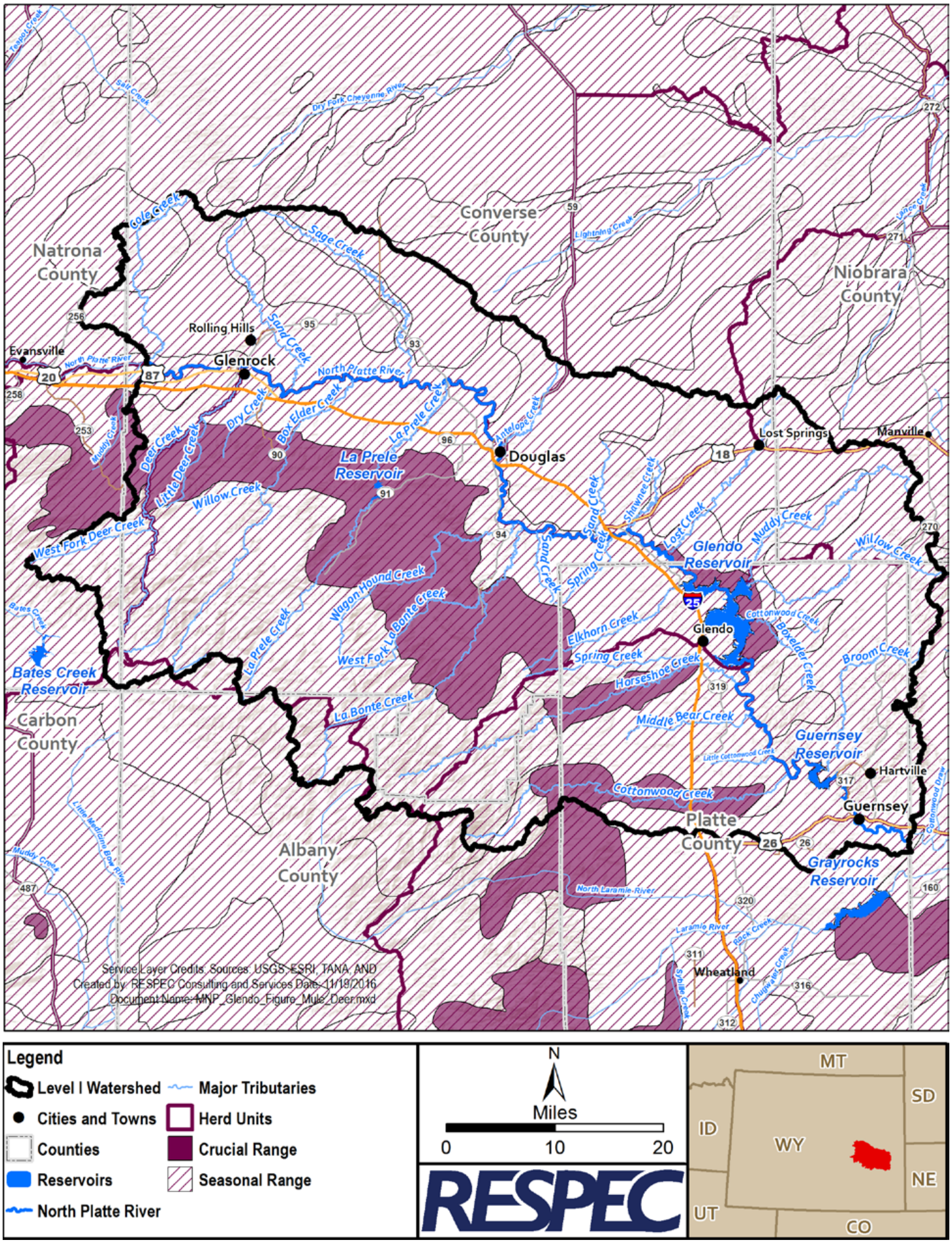


Figure 3.79. Mule Deer Habitat Within the Watershed.

3.5.1.3 *Species of Concern*

The Wyoming Natural Diversity Database (WYNDD) records and maintains a list of species in Wyoming that are thought to be rare or sensitive. The species of concern (or tracked species) are those that are vulnerable to extirpation because of rarity, inherent vulnerability, or habitat threats. The Species of Potential Concern (or watched species) are those that appear to be presently secure but have limited distribution.

Table 3.36 lists the tracked or watched species of amphibians, birds, crustaceans, fish, insects, mammals, mollusks, and reptiles found within the study area [WYNDD, 2016]. The list shows only one endangered species that is known to occur in the study area: the black-footed ferret (*Mustela nigripes*). Three threatened species occur within the study area: Canada lynx *(Lynx canadensis)*, grizzly bear (*Ursus arctos arctos*), and Preble's meadow jumping mouse (*Zapus hudsonius preblei*).

The BLM definition of a sensitive species is as follows: species that could easily become endangered or extinct in the state, including: (a) species under status review by the USFWS and National Marine and Fisheries Service; (b) species whose numbers are declining so rapidly that federal listing may become necessary; (c) species with typically small or fragmented populations; and (d) species that inhabit specialized refuge or other unique habitats.

On September 22, 2015, the US Department of the Interior determined that the greater sage-grouse does not require federal protection under the ESA and withdrew the greater sage-grouse from the USFWS's candidate species list. However, the greater sage-grouse is still recognized as a sensitive species/species of concern by the BLM and a species of concern by the WGFD. In June 2008, Executive Order 2008-2 was signed by the governor; this order stresses additional management consideration to greater sage-grouse and greater sage-grouse habitat statewide. This original executive order has been extended most recently by Executive Order 2015-4, which was signed by Governor Mead in July 2015. The order includes requirements of state agencies to encourage development outside of the core areas and to focus management to the greatest extent possible on the maintenance and enhancements of habitat within them. The core areas for greater sage-grouse cover approximately 135,680 acres (6.5 percent) of the study area and are shown in Figure 3.80.

The WGFD identifies the greater sage-grouse as a Native Species Status of 2 (NSS2 (Ba)), which suggests that the species has a vulnerable population or distribution is restricted or declining but extirpation is not imminent and the limiting factors are severe and continue to increase in severity [WGFD, 2010]. The greater sage-grouse is not listed as a threatened or endangered species and does not receive any protections from the Endangered Species Act (ESA); however, the BLM and WGFD have developed restrictions and recommendations to help protect the greater sage-grouse. Additional information about Wyoming's sage-grouse management including mitigation, *de minimus* activities, core area maps and data, and the Density Disturbance Calculation Tool (DDCT) can be found at the WGFD's website (*https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management*) and the BLM's Greater Sage-Grouse website (*https://www.blm.gov/wy/st/en/programs/Wildlife/sage-grouse.html*).

Table 3.36. Wyoming Natural Diversity Database: Species of Concern and Potential Concern Within the Study Area (Page 1 of 4)

Scientific Name	Common Name	Listing Status	Tracking Status
Amphibian			
Ambystoma mavortium	Tiger Salamander		Watched
Lithobates pipiens	Northern Leopard Frog	Not Warranted	Tracked
Rana luteiventris	Columbia Spotted Frog		Tracked
Spea bombifrons	Plains Spadefoot		Tracked
Bird			
Accipiter gentilis	Northern Goshawk	Not Warranted	Tracked
Ammodramus bairdii	Baird's Sparrow		Tracked
Ammodramus savannarum	Grasshopper Sparrow		Watched
Antigone canadensis	Sandhill Crane		Watched
Aphelocoma californica	Woodhouse's Scrub-Jay		Tracked
Aquila chrysaetos	Golden Eagle		Watched
Artemisiospiza nevadensis	Sagebrush Sparrow		Tracked
Asio flammeus	Short-eared Owl		Tracked
Athene cunicularia	Burrowing Owl		Tracked
Aythya collaris	Ring-necked Duck		Watched
Bucephala albeola	Bufflehead		Watched
Bucephala clangula	Common Goldeneye		Watched
Buteo regalis	Ferruginous Hawk		Tracked
Calcarius ornatus	Chestnut-collared Longspur		Tracked
Catherpes mexicanus	Canyon Wren		Watched
Centrocercus urophasianus	Greater Sage-Grouse	Not Warranted	Tracked
Chaetura pelagica	Chimney Swift		Watched
Charadrius montanus	Mountain Plover	Not Warranted	Tracked
Chlidonias niger	Black Tern		Tracked
Cinclus mexicanus	American Dipper		Watched
Coccyzus americanus	Yellow-billed Cuckoo		Tracked
Coccyzus erythropthalmus	Black-billed Cuckoo		Tracked
Cygnus buccinator	Trumpeter Swan	Not Warranted	Tracked
Cygnus columbianus	Tundra Swan		Watched
Empidonax hammondii	Hammond's Flycatcher		Watched
Falco columbarius	Merlin		Watched
Falco peregrinus	Peregrine Falcon	Delisted	Tracked
Gavia immer	Common Loon		Tracked
Haliaeetus leucocephalus	Bald Eagle	Delisted	Tracked

Table 3.36. Wyoming Natural Diversity Database: Species of Concern and Potential Concern Within the Study Area (Page 2 of 4)

Scientific Name	Common Name	Listing Status	Tracking Status
	Bird (continued)		
Junco hyemalis	Dark-eyed Junco		Tracked
Lanius ludovicianus	Loggerhead Shrike		Tracked
Larus argentatus	Herring Gull		Watched
Larus californicus	California Gull		Watched
Larus delawarensis	Ring-billed Gull		Watched
Megascops asio	Eastern Screech-Owl		Watched
Melanerpes lewis	Lewis's Woodpecker		Tracked
Myiarchus cinerascens	Ash-throated Flycatcher		Watched
Numenius americanus	Long-billed Curlew		Tracked
Nycticorax nycticorax	Black-crowned Night-Heron		Watched
Oreoscoptes montanus	Sage Thrasher		Watched
Oreothlypis virginiae	Virginia's Warbler		Tracked
Pandion haliaetus	Osprey		Watched
Passerina caerulea	Blue Grosbeak		Watched
Passerina cyanea	Indigo Bunting		Watched
Pelecanus erythrorhynchos	American White Pelican		Tracked
Peucaea cassinii	Cassin's Sparrow		Watched
Phalaropus lobatus	Red-necked Phalarope		Watched
Pheucticus ludovicianus	Rose-breasted Grosbeak		Watched
Picoides dorsalis	American Three-toed Woodpecker		Tracked
Plegadis chihi	White-faced Ibis		Tracked
Psiloscops flammeolus	Flammulated Owl		Watched
Recurvirostra americana	American Avocet		Watched
Regulus satrapa	Golden-crowned Kinglet		Watched
Rhynchophanes mccownii	McCown's Longspur		Tracked
Selasphorus calliope	Calliope Hummingbird		Tracked
Setophaga townsendi	Townsend's Warbler		Watched
Sialia sialis	Eastern Bluebird		Watched
Sitta pygmaea	Pygmy Nuthatch		Tracked
Sphyrapicus thyroideus	Williamson's Sapsucker		Tracked
Spizella breweri	Brewer's Sparrow		Watched
Spizella pallida	Clay-colored Sparrow		Watched
Sterna forsteri	Forster's Tern		Tracked
Sterna hirundo	Common Tern		Watched

Table 3.36. Wyoming Natural Diversity Database: Species of Concern and Potential Concern Within the Study Area (Page 3 of 4)

Scientific Name	Common Name	Listing Status	Tracking Status
Bird (continued)			
Strix nebulosi	Great Gray Owl		Tracked
Troglodytes hiemalis	Winter Wren		Watched
Tyto alba	Barn Owl		Watched
Vireo olivaceus	Red-eyed Vireo		Watched
Fish			
Fundulus sciadicus	Plains Topminnow	Not Warranted	Watched
Luxilus cornutus	Common Shiner		Watched
Nocomis biguttatus	Hornyhead Chub		Tracked
Phenacobius mirabilis	Suckermouth Minnow		Tracked
Insect			
Danaus plexippus plexippus	Monarch Butterfly	Petition Under Review	Tracked
Euphilotes rita coloradensis	A Rita Dotted-Blue subspecies		Tracked
Hesperia ottoe	Ottoe Skipper		Tracked
Speyeria idalia	Regal Fritillary	Petition Under Review	Tracked
Mammal			
Antrozous pallidus	Pallid Bat		Tracked
Bos bison bison	Plains Bison	Not Warranted	Tracked
Canis lupus	Gray Wolf	Proposed for Delisting	Tracked
Corynorhinus townsendii	Townsend's Big-eared Bat		Tracked
Cynomys leucurus	White-tailed Prairie Dog	Petition Under Review	Tracked
Cynomys ludovicianus	Black-tailed Prairie Dog	Not Warranted	Tracked
Euderma maculatum	Spotted Bat		Tracked
Ictidomys tridecemlineatus	Thirteen-lined Ground Squirrel		Tracked
Lasionycteris noctivagans	Silver-haired Bat		Watched
Lasiurus cinereus	Hoary Bat		Watched
Lynx canadensis	Canada Lynx	Threatened	Tracked
Mustela nigripes	Black-footed Ferret	Endangered	Tracked
Myotis ciliolabrum	Western Small-footed Myotis		Watched
Myotis evotis	Long-eared Myotis		Watched
Myotis lucifugus	Little Brown Myotis	Petition Under Review	Watched
Myotis thysanodes	Fringed Myotis		Tracked
Myotis volans	Long-legged Myotis		Watched
Myotis yumanensis	Yuma Myotis		Tracked
Ovis canadensis	Bighorn Sheep		Watched

Table 3.36. Wyoming Natural Diversity Database: Species of Concern and Potential Concern Within the Study Area (Page 4 of 4)

Scientific Name	Common Name	Listing Status	Tracking Status
Mammal (continued)			
Sorex haydeni	Hayden's Shrew		Tracked
Sorex nanus	Dwarf Shrew		Watched
Spilogale putorius interrupta	Plains Spotted Skunk	Petition Under Review	Watched
Sylvilagus floridanus	Eastern Cottontail		Watched
Thomomys clusius	Wyoming Pocket Gopher	Not Warranted	Tracked
Urocitellus elegans	Wyoming Ground Squirrel		Watched
Urocyon cinereoargenteus ocythous	Prairie Gray Fox	Petition Under Review	Watched
Ursus arctos arctos	Grizzly Bear	Threatened	Tracked
Vulpes velox	Swift Fox	Not Warranted	Tracked
Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	Threatened	Tracked
Mollusk			
Anodontoides ferussacianus	Cylindrical Papershell		Tracked
Ferrissia rivularis	Creeping Ancylid		Tracked
Fossaria dalli	Dusky Fossaria		Tracked
Fossaria obrussa	Golden Fossaria		Tracked
Gyraulus parvus	Ash Gyro		Tracked
Lampsilis cardium	Plain Pocketbook		Tracked
Lampsilis siliquoidea	Fatmucket		Tracked
Oreohelix subrudis	A Mountainsnail		Tracked
Physa acuta	Pewter Physa		Tracked
Physa gyrina	Tadpole Physa		Tracked
Vallonia albula	Indecisive Vallonia		Tracked
Valvata humeralis	Glossy Valvata		Tracked
Reptile			
Apalone spinifera spinifera	Eastern Spiny Softshell		Watched
Coluber constrictor flaviventris	Eastern Yellow-bellied Racer		Watched
Lampropeltis triangulum multistriata	Pale Milksnake		Watched
Opheodrys vernalis	Smooth Greensnake		Tracked
Pituophis catenifer sayi	Bullsnake		Watched
Sceloporus tristichus	Plateau Fence Lizard		Tracked
Thamnophis radix	Plains Gartersnake		Watched
Thamnophis sirtalis parietalis	Red-sided Gartersnake		Watched

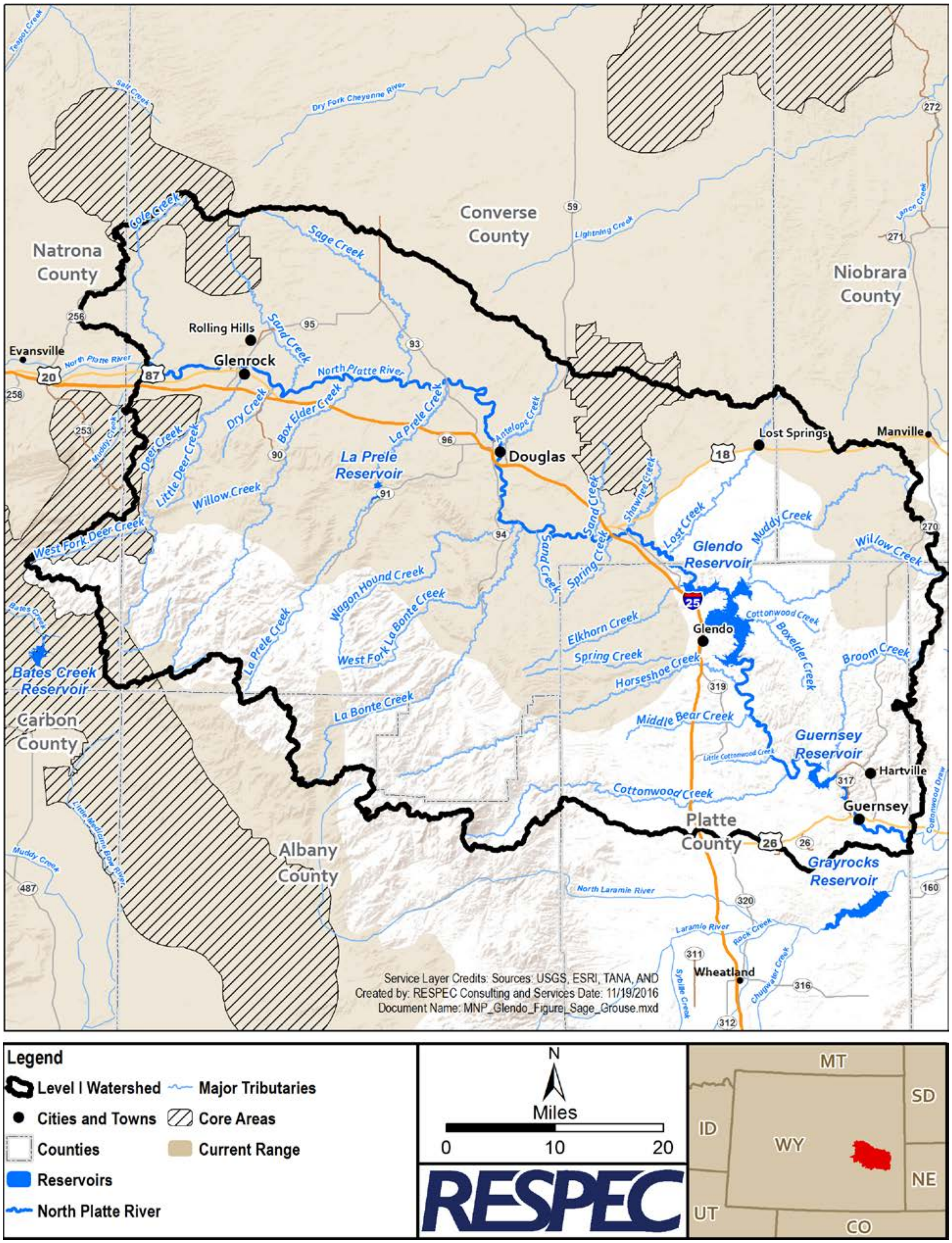


Figure 3.80. Greater Sage-Grouse Distribution and Core Areas Within the Study Area.

3.5.1.4 *Habitat Priority Areas*

As a part of the 2009 Strategic Habitat Plan, the WGFD has classified areas within the state as Crucial Habitat Priority Areas and Enhancement Habitat Priority Areas. Priority areas were further divided into aquatic, terrestrial, and combined habitats. Figure 3.81 displays the Habitat Priority Areas within the study area. Crucial, Enhancement, and Combined Habitat Priority Areas are defined by the WGFD [WGFD, 2015b]. Portions of six aquatic and five terrestrial Crucial Habitat Priority Areas are within the watershed, while portions of three aquatic, two terrestrial, and two combined Enhancement Priority Areas are within the watershed. The WGFD composed narratives that include habitat value, reason for selection, area description, affected species, and actions/solutions. In 2015, the WGFD updated the Strategic Habitat Plan and associated geodata, which was incorporated into this report and project GIS where possible. The following summaries are quotes from the WGFD for each of the areas with available summaries [WGFD, 2015c].

Eastern Tributaries (Aquatic Crucial)

Habitat Values: Native non-game fish species.

Reason Selected: Unique prairie fish assemblage for Wyoming

Solutions or Actions:

- *Improve landowner awareness and support of the "Crucial Habitat" designation and the Department's intent to focus on habitat preservation and enhancement in the area.*
- *Enroll private lands in conservation easements, CRP or other appropriate incentive programs to maintain native fish community habitat quality.*
- *Identify and acquire instream flows to maintain deep pool habitat and improve natural hydrologic function.*
- *Acquire baseline fish community and habitat (aquatic and riparian) data necessary for monitoring and identifying areas with enhancement potential.*
- *Implement best management practices where enhancement potential exists (i.e Identify, promote, and implement grazing regimes beneficial to the native fish community, which may include changes in rest-frequency, animal density, distribution, timing, etc. of livestock use; construct strategic riparian exclusions to maintain areas with overhead cover and promote woody debris recruitment to the stream; establish and maintain riparian buffers near cultivated and irrigated land to minimize nutrient and sediment inputs; evaluate barriers to fish migration, remove barriers that impede native fish migration dn secure or enhance barriers that protect native fish from downstream exotics; evaluate irrigation diversions and off-channel impoundments for potential fish loss and pursue screening to prevent entrainment; install instream structures to restore fish habitat; and conduct native fish restoration where feasible).*

Glendo Reservoir (Aquatic Crucial)

Habitat Values: Sport fishery, existing native sport firshery supported by stocking (channel catfish) and potential native sport fish habitat (sauger); 50,000 angler days

Reason Selected: The riparian habitat along the river corridor is functioning, but in need of improvement.

Additional Information:

- *The North Platte River between Orin bridge and Glendo Reservoir supports a sport fishery for native channel catfish, as well as trout and walleye angling. Sauger have been extirpated from the North Platte River. Orin Weir is a barrier to upstream* *migration fromGlendo Reservoir. Spillway structures within Glendo Wetlands are velocity barriers to fish that would try to move upstream.*

North Platte River Blue Ribbon (Aquatic Crucial)

Habitat Issues: Sediment; water temperatures; invasive riparian species, Russian olive; channel degradation; bank erosion

Reason Selected: Productive sport fishery, cottonwood gallery forest, and riparian wetlands. The Grey Reef section of the North Platte River is renowned "blue ribbon" sport fishery that annually supports over 30,000 angler days.

Additional Information:

- *The river and reservoir fisheries are directly dependent on water management decisions (flow release timing, quantity, etc.) and requirements made by the Bureau of Reclamation.*
- *Limited areas spawning habitat and fine sediment intrusion limit spawning habitat quality.*
- *River restoration efforts are needed to address invasive species, sediment transport, channel and bank stability.*
- *Water temperatures in downstream areas limit trout numbers.*

Rawhide Creek (Aquatic Crucial)

Habitat Values: Native non-game fish species.

Reason Selected: Unique prairie fish assemblage for Wyoming.

Solutions or Actions:

- *Improve landowner awareness and support of the "Crucial Habitat" designation and the Department's intent to focus on habitat preservation and enhancement in the area*
- *Enroll private lands in conservation easements, CRP or other appropriate incentive programs to maintain native fish community habitat quality*
- *Identify and acquire instream flows to maintain deep pool habitat and improve natural hydrologic function*
- *Acquire baseline fish community, native herpetofaunal, and habitat (aquatic and riparian) data necessary for monitoring and identifying areas with enhancement potential.*
- *Implement best management practices where enhancement potential exists (i.e. Identify, promote, and implement grazing regimes beneficial to the native fish community, which may include changes in rest-frequency, animal density, distribution, timing, etc. of livestock use; Construct strategic riparian exclusions to maintain areas with overhead cover and promote woody debris recruitment to the stream; Establish and maintain riparian buffers near cultivated and irrigated land to minimize nutrient and sediment inputs; Evaluate barriers to fish migration, remove barriers that impede native fish migration and secure or enhance barriers that protect native fish from downstream exotics; Evaluate irrigation diversions and off-channel impoundments for potential fish loss and pursue screening to prevent entrainment; Install instream structures to restore fish habitat; Conduct native fish restoration where feasible).*

Rawhide Watershed (Aquatic Crucial)

Habitat Values: Habitats provide breeding locations, thermoregulartory refuges. And increased prey base for native amphibians and reptiles. Support high SGCN species diversity. Native fish species and their habitat still intact.

Reason Selected: Selected due to high diversity of SGCN species. The Rawhide Watershed represents the highest amphibian and reptile diversit in the Casper region and retains a unique fish assemblage for the state:

Solutions or Actions:

- *Improve landowner awareness and support of the "Crucial Habitat" designation and the Department's intent to focus on habitat preservation and enhancement in the area*
- *Enroll private lands in conservation easements, CRP or other appropriate incentive programs to maintain native fish community habitat quality*
- *Identify and acquire instream flows to maintain deep pool habitat and improve natural hydrologic function*
- *Acquire baseline fish community, native herpetofaunal, and habitat (aquatic and riparian) data necessary for monitoring and identifying areas with enhancement potential.*
- *Implement best management practices where enhancement potential exist (i.e Identify, promote, and implement grazing regimes beneficial to native communities, which may include changes in rest-frequency, animal density, distribution, timing, etc. of livestock use; Construct strategic riparian exclusions to maintain areas with overhead cover and promote woody debris recruitment to the stream and riparian corridor; Establish and maintain riparian buffers near cultivated and irrigated land to minimize nutrient and sediment inputs; Evaluate barriers to fish migration, remove barriers that impede native fish migration and secure or enhance barriers that protect native fish from downstream exotics; Evaluate irrigation diversions and off-channel impoundments for potential fish loss and pursue screening to prevent entrainment; Install instream structures to restore fish habitat; Conduct native fish restoration where feasible; Enhance or preserve ephemeral water sources such as playas, oxbows, and wetlands).*
- *Control nonnative invasive species*

Riparian (Aquatic Crucial)

Habitat Values: Riverscapes that are interconnected and support fish migrations to complete their life histories; and riparian floodplains connected with their channels that resist flood damage, contribute woody debris, store water, resist noxious species expansion, support water quality, and provide food and cover for fish and herpetofauna.

Reason Selected: Unique prairie fish assemblage for Wyoming; 80 percent of the wildlife within Wyoming utilize these areas for a portion of their lifecycle; smallest vegetative community acreage wise, but perhaps the most important for biological diversity.

Additional Information:

- *Land uses along riparian corridors include livestock grazing, wildlife herbivory, irrigation diversions, irrigated and dry land crop production, recreation, and residential and commercial uses. Energy development and mining are variable, but* *high in portions of some watersheds. The potential for residential and ranchette-style subdivision developments is high around population centers.*

- *Some barriers associated with irrigation, travel corridors, and commercial developments fragment these aquatic communities. Irrigation withdrawals and ground water discharges have altered the naturally variable flow regimes. Restoring connectivity at barriers would allow fish to seek seasonal habitats and support their abilities to complete their annual cycles. Diversion screening would minimize fish entrainment and loss within ditches.*
- *Native riparian communities include narrowleaf and plains cottonwood, green ash, boxelder, and mixed shrub and herbaceous types. Transportation corridors, residential, commercial and agricultural type conversions, heavy ungulate herbivory, and invasive plant community type expansion have reduced native riparian communities and confined segments of the riparian corridors. Sometimes, these reductions and confinements have reduced riparian and stream functions (e.g., reduced shade, woody debris contributions, and channel meandering; steepened channel gradients increasing bed and bank erosion, loss of water tables) and food and cover available for various life stages of fish. Some potential exists for reducing confinements by reconnecting abandoned oxbows, which would help moderate steepened stream gradients, raise local water tables, increase riparian and channel habitat development, and increase food and cover for various life stages of fish.*

Lower North Platte (Aquatic Enhancement)

Habitat Issues: Inadequate winter flows; lack of minimum pool in Guernsey Reservoir; habitat fragmentation; invasive species both in-stream and riparian.

Reason Selected: Sport fishery potential; native non-game fish species habitat

Additional Information:

- *The sport fishery potential and endemic aquatic species assemblage below Glendo Dam are limited by fluctuating water flows. A low flow of 25 cfs occurs below Glendo Dam during the nonirrigation season, which provides limited instream habitat for a sport fishery and endemic aquatic species. The current operational regime at Guernsey Reservoir, which includes a mean annual reservoir drawdown of 97 percent to accommodate the silt run, precludes any fisheries development. No flows are released below Guernsey during the non-irrigation season, which results in about 21-miles of dewatered river over the winter. Fish are restricted to deeper pools where they can over-winter during the no flow period. The Laramie River provides flow to the North Platte River during the non-irrigation season from its confluence with the North Platte River to the Nebraska border*

Middle North Platte (Aquatic Enhancement)

Habitat Issues: Sport fishery; native sport fish habitat (channel catfish) and potential native sport fish habitat (sauger); native non-game fish habitat

Reason Selected: The Dave Johnston power plant dam separates the predominantly coldwater fisheries assemblage from the coolwater fisheries assemblage below. The riparian habitat along the river corridor is functioning, but in need of improvement.

Additional Information:

- *The Dave Johnston power plant dam below Glenrock is a barrier to upstream fish movement. Fauna below the barrier is more diverse than above. The barrier isolates the predominantly coolwater assemblage below from the predominantly coldwater assemblage above.*
- *The North Platte River between Dave Johnston power plant and Glendo Reservoir supports a sport fishery for channel catfish, as well as trout and walleye. Sauger have been extirpated from the North Platte River. Orin weir, and to a lesser extent Morton diversion dam, are barriers to upstream migration from Glendo Reservoir to the Dave Johnston power plant dam.*

Ormsby (Terrestrial Crucial)

Habitat Values: Pronghorn winter-yearlong ranges; big sagebrush/grassland, and riparian cottonwood communities.

Reason Selected: This area provides a unique combination of habitat values, vegetation community diversity, and wildlife species diversity. This area is not accounted for in the sage-grouse core area or big game crucial areas.

Solutions or actions:

- *Work with livestock producers and BLM personnel on modifying livestock grazing management systems that promote native perennial plant re-establishment and vigor through rest, deferment, herding, season of use, duration, and intensity (stocking rates).*
- *Chemical applications to reduce invasive non-native plant species dominance and/or IPM practices.*
- *Prescribed fire applications in some big sagebrush communities to increase plant diversity, plant nutritional quality, and return to early plant succession.*
- *Mechanical applications in grassland and big sagebrush communities to increase plant diversity, plant nutritional quality, and return to early plant succession.*
- *Seek conservation easements, and develop agreements and partnerships with federal land management agencies, State Land Board and private landowners*

Sage Grouse Core V4 (Terrestrial Crucial)

Reason Selected: Sage-grouse core areas, designated by the Governor's Office, are described as those areas capable of maintaining habitats and viable populations of sage-grouse where they are most abundant. On a statewide basis, they include habitats and existing populations for at least two-thirds of the sage-grouse in Wyoming.

Additional Information:

- *Many natural or human-caused impacts can impact or even eliminate the functionality of these habitat components. These include wildfire, livestock grazing, invasive plants, and energy development.*
- *The core areas primarily reflect breeding habitats characterized by sagebrush communities associated with high lek densities. As better mapping efforts are completed, these areas may be adjusted to reflect other important habitat components.*

Big Game Crucial Range (Terrestrial Crucial)

Reason Selected: Big game crucial ranges provide habitat components necessary for the maintenance of populations at objective levels.

Additional Information:

- *Big Game Crucial Ranges: Crucial ranges describe the component of big game habitat that has been documented as one of the limiting factors in a population's ability to maintain itself at a certain level over the long term. With the exception of moose and mountain goat, these ranges are designated as crucial winter or crucial winter-yearlong range.*
- *Migration Routes: Migration routes are definable routes followed by big game during seasonal movements year after year.*
- *Parturition Areas: Parturition areas are documented birthing areas commonly used between 5/15 and 6/30 by the female segment members of a population.*
- *Many human activities can decrease or even eliminate the functionality of these habitat components. Among these activities, rural residential development, energy development and unmanaged vehicle travel pose the largest threats to these habitat components.*

Sandhills (Terrestrial Enhancement)

Habitat Issues: Successionally advanced big sagebrush communities; domestic and wildlife over-grazing, cheatgrass, prickly-pear cactus and soil erosion. A second limiting factor is the lack of grass and forb production and availability for wildlife in big sagebrush/grassland communities. The amount, distribution and associations of grass and forbs are critical to many wildlife species survival and productivity. Increase in plains silver sagebrush density, canopy cover, and frequency following potential big sagebrush treatments.

Reason Selected: Successionally advanced or altered vegetation communities. This area provides a unique combination of habitat values and issues, vegetative community diversity, and wildlife species diversity. Crucial big game seasonal ranges, sage-grouse core area and important vegetation communities needing management and enhancement actions.

Solutions or Actions:

- *Apply vegetation treatments to revert older age class upland communities to early seral stages, regenerate fire-dependent communities, enhance water and nutrient cycling, disperse herbivores, and restore a mosaic of multi-aged communities*
- *Construct fences and water developments with landowners to facilitate improved grazing management strategies.*
- *Develop management plans and/or agreements with livestock producers and BLM to modify livestock grazing management systems that promote native perennial plant re-establishment and vigor through rest, deferment, herding, season of use, duration, and intensity (stocking rates).*
- *Chemical applications to reduce invasive non-native plant species dominance, especially cheatgrass and follow-up Integrated Pest Management practices.*

- *Prescribed fire applications in big sagebrush communities to increase plant diversity, plant nutritional quality, and return to early vegetation community succession.*
- *Mechanical applications in big sagebrush communities to increase plant diversity, plant nutritional quality, and return to early vegetation community succession.*
- *Seek conservation easements, and develop agreements and partnerships with federal land management agencies, State Land Board and private landowners.*

North Laramie (Combined Enhancement)

Habitat Issues: Successionally advanced riparian, aspen, big sagebrush, true mountain mahogany and mixed mountain shrub communities; limited streamflows, warm irrigation return flows, domestic and wildlife over-grazing, excessive sediment loads to streams, cheatgrass, soil erosion, and channel degradation. In addition, fire suppression, conifer encroachment, big sagebrush encroachment, and altered hydrologic functions have further exacerbated the recovery of aspen communities.

A second limiting factor is the degradation of wet meadow types throughout the project area. Historic livestock use and in certain areas, current livestock use continues to degrade these areas to the point of drying them out and reducing the overall size of these areas on the landscape.

A third limiting factor is the lack of grass and forb production and availability for wildlife in big sagebrush/grassland and mountain shrub communities. The amount, distribution and associations of grass and forbs are critical to many wildlife species survival and productivity.

Reason Selected: Successionally advanced or altered vegetation communities. This area provides a unique combination of habitat values and issues, vegetative community diversity, and wildlife species diversity. Crucial big game seasonal ranges, sage-grouse core area and important vegetation communities needing management and enhancement actions.

Solutions or Actions:

- *Develop management plans and/or agreements with livestock producers and public land management agencies to modify livestock grazing management systems that promote native perennial plant re-establishment and vigor through rest, deferment, herding, season of use, duration, and intensity (stocking rates). These changes will also be sought to improve cottonwood/willow regeneration along the various streams and rivers within the area as well as wet meadows and other sensitive areas.*
- *Chemical applications to reduce invasive non-native plant species dominance and/or IPM practices.*
- *Mechanical, chemical, or fire treatments, as appropriate, in mountain shrub, aspen, and big sagebrush communities to increase vegetative community diversity, nutritional quality, and provide a diversity of age classes within shrub stands.*

North Laramie Foothills (Combined Enhancement)

Habitat Issues: Successionally advanced riparian, big sagebrush, true mountain mahogany and mixed mountain shrub decadence; limited streamflows, warm irrigation return flows, domestic and wildlife over-grazing, cheatgrass, soil erosion, and channel degradation.

A second limiting factor is the degradation of wet meadow types throughout the project area. Historic livestock use and in certain areas, current livestock use continues to degrade these areas to the point of drying them out and reducing the overall size of these areas on the landscape.

A third limiting factor is the lack of grass and forb production and availability for wildlife in big sagebrush/grassland and mountain shrub communities. The amount, distribution and associations of grass and forbs are critical to many wildlife species survival and productivity.

Reason Selected: Successionally advanced or altered vegetation communities. This area provides a unique combination of habitat values and issues, vegetative community diversity, and wildlife species diversity. Crucial big game seasonal ranges, sage grouse core area and important vegetation communities needing management and enhancement actions.

Solutions or Actions:

- *Develop management plans and/or agreements with livestock producers and public land management agencies to modify livestock grazing management systems that promote native perennial plant re-establishment and vigor through rest, deferment, herding, season of use, duration, and intensity (stocking rates). These changes will also be sought to improve cottonwood/willow regeneration along the various streams and rivers within the area as well as wet meadows and other sensitive areas.*
- *Chemical applications to reduce invasive non-native plant species dominance and/or IPM practices.*
- *Mechanical, chemical, or fire treatments, as appropriate, in mountain shrub and big sagebrush communities to increase vegetative community diversity, nutritional quality, and provide a diversity of age classes within shrub stands.*
- *Seek conservation easements, and develop agreements and partnerships with federal land management agencies, State Land Board and private landowners.*

North Laramie Foothills (Combined)

Successionally advanced or altered vegetation communities. This area provides a unique combination of habitat values and issues, vegetative community diversity, and wildlife species diversity. Crucial big game seasonal ranges, sage grouse core area and important vegetation communities needing management and enhancement actions.

- *Develop management plans and/or agreements with livestock producers and public land management agencies to modify livestock grazing management systems that promote native perennial plant re-establishment and vigor through rest, deferment, herding, season of use, duration, and intensity (stocking rates). These changes will also be sought to improve cottonwood/willow regeneration along the various streams and rivers within the area as well as wet meadows and other sensitive areas.*
- *Chemical applications to reduce invasive non-native plant species dominance and/or IPM practices.*
- *Mechanical, chemical, or fire treatments, as appropriate, in mountain shrub and big sagebrush communities to increase vegetative community diversity, nutritional quality, and provide a diversity of age classes within shrub stands.*
- *Seek conservation easements, and develop agreements and partnerships with federal land management agencies, State Land Board and private landowners.*

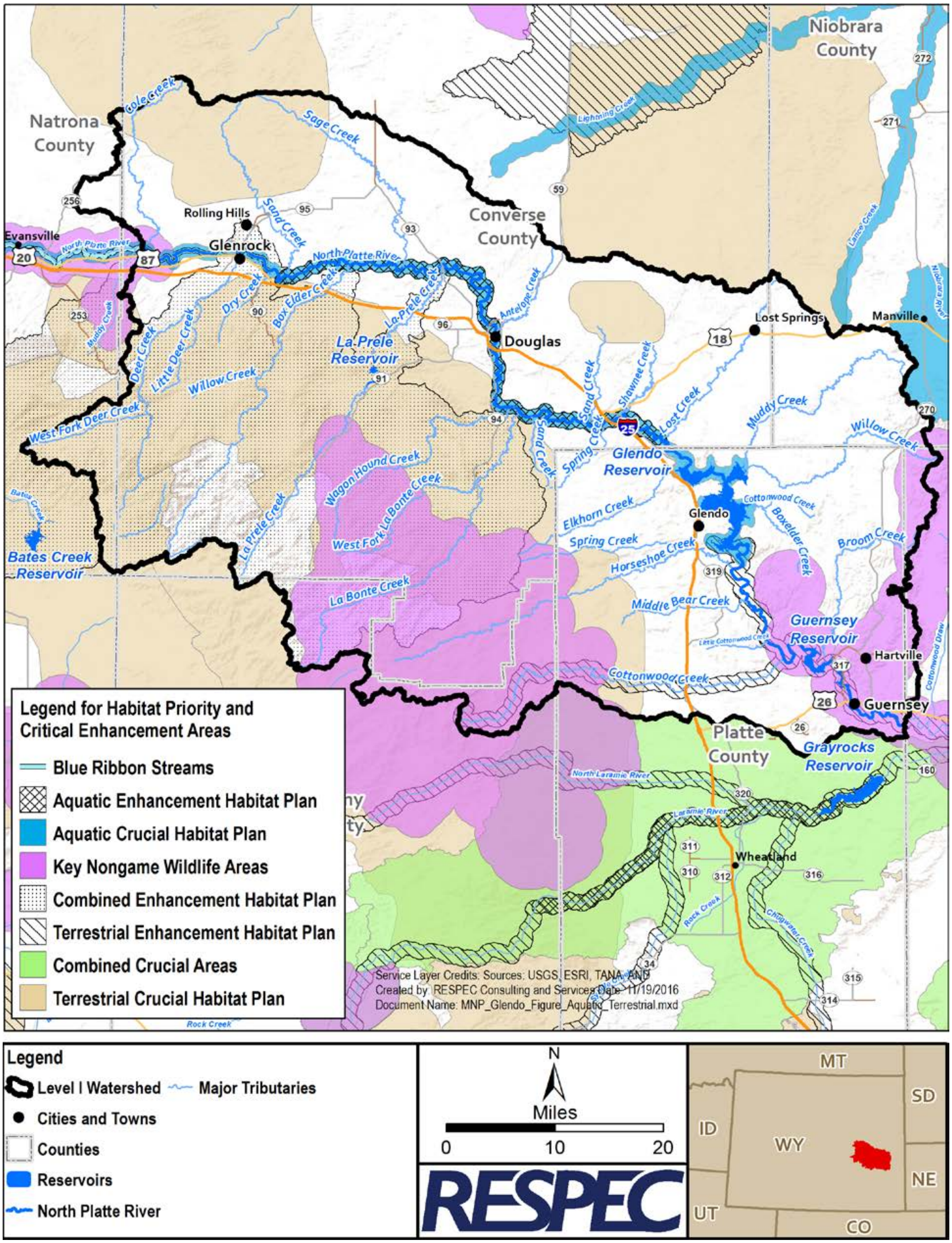


Figure 3.81. Aquatic and Terrestrial Habitat Within the Watershed.

3.6 HYDROLOGY

3.6.1 Groundwater

Groundwater in the watershed is important for livestock/wildlife water, private domestic wells, and municipal water. Groundwater availability within the watershed is variable because of the diverse aquifer characteristics and hydrogeological properties in the study area. Site-specific groundwater investigations were not conducted; hydrogeologic investigations and possibly modeling should be included in the planning for any proposed groundwater development project.

This section presents a summary of groundwater resources; although, the recently completed *Platte River Basin Water Plan Update Groundwater Study, Level I (2009–2013)* provides a more thorough treatment on the topic [Taucher et al., 2013]. Contained in Taucher et al. [2013] are maps with groundwater potentiometric surface elevations and contours for selected aquifers within the Platte River Basin. A recent, and ongoing, Weston Engineering [2015] study determined the hydrologic connectivity of a Douglas municipal well; that memo includes a summary of groundwater resources near Douglas as well as a list of additional references.

3.6.1.1 *Aquifers*

Aquifers within the watershed can be divided into three systems based on geologic age: Tertiary, Mesozoic, and Paleozoic. The primary aquifers within these systems that currently supply groundwater include the White River Formation, Cloverly Formation, Sundance, Casper, Madison Limestone, and Flathead Formation [Weston Engineering, 2015]. The most significant hydrogeological units of the area are listed in Table 3.37.

Most of the quality water at shallower depths occurs in unconsolidated Quaternary-age deposits and Tertiary-age deposits [Taucher et al., 2013]. Within the watershed, the unconfined to confined Tertiary aquifer is dominated by the White River Group. The White River Group primarily consists of shale with water confined to thin sandstone lenses and channels [Rapp, 1953]; despite small well yields, the White River is the most widely used aquifer within the watershed because of its shallow depth. Unconsolidated alluvium, especially along the North Platte River, has large permeability and large saturated thicknesses in many places [Richter, 1981]. However, as a result of the 2001 Modified Decree, many of the shallow aquifers with hydraulic connection to surface water are unavailable for development (see Section 1.3.1).

The Cretaceous-Jurassic-Age Cloverly aquifer (including the Dakota and Lakota sandstone) is most productive in the upper Lakota sandstone. The Cloverly aquifer generally has lower yields than shallower aquifers except in areas with increased fracture permeability [Taucher et al., 2013]. In the Douglas area, the wells completed in the Cloverly have had noted methane gas [Weston Engineering, 2015]. The Mesozoic Frontier, Muddy Sandstone, and Sundance Formations may be minor aquifers. Several Paleozoic formations make up aquifers within the watershed. The Casper aquifer is a major confined, artesian aquifer that can be productive in areas with large fracture permeability. The Madison Limestone is a major aquifer that is present in the subsurface in most of the watershed; the permeability of the Madison is secondary, developed along fractures, and greatest along the basin-mountain margins. Also, the Flathead Sandstone may serve as a minor aquifer near its outcrop areas.

Table 3.37. Hydrogeologic System Near Douglas, Wyoming (Modified From Centennial Engineering [1989] and Weston Engineering [2015])

System	Geologic Unit	Approximate Thickness (ft)	Hydrologic Character
Quaternary	Alluvial Deposits	0–20	Minor aquifer: restricted to perennial streams; yields significant near North Platte River
Tertiary	White River Formation	0–600	Major aquifer: most domestic and stock wells completed in White River; water commonly pumped from wells completed in channel sandstones; yields up to 60 gpm reported but are commonly less than 25 gpm; variable quality; wells in Douglas area may produce methane gas
Mesozoic	Frontier Formation	880–1,200	Local minor aquifer: upper sandstone unit may yield small quantities of water; unit is generally a regional confining unit
	Mowry Shale	100–200	Confining unit
	Muddy SS/ Thermopolis Shale	160	Local minor aquifer: Muddy Sandstone may yield small quantities of water locally; Thermopolis Shale is a confining unit
	Cloverly Formation (Dakota Sandstone)	100–300	Minor aquifer: commonly associated with oil and gas production in Douglas area; may yield water under artesian conditions; moderate potential for groundwater development
	Morrison Formation	175–200	Confining Unit
	Sundance	350	Minor Aquifer: upper and lower sandstone members comprise key units of Mesozoic aquifer system; pumped wells may yield up to 250 gpm but commonly yield less than 20 gpm
	Chugwater	570–650	Confining unit
Paleozoic	Goose Egg	300	Confining unit
	Casper (Minnelusa equivalent)	600–1,100	Major aquifer: highly prolific where saturated, yields are reported as great as 400 gpm with averages on the order of 150 gpm; sandstone units in the upper and lower portions offer the best groundwater potential; source of several springs
	Madison Limestone	200	Major aquifer: where fractures and saturated, highly variable yields (up to 1,000 gpm) are reported
	Flathead Formation (Fremont Canyon Sandstone)	100	Minor Aquifer: small yields are reported near outcrops; data are limited because of paucity of wells

3.6.1.2 *Groundwater Depth, Recharge, and Quality*

Depending on the location in the watershed, groundwater can be found at varying depths; areas near streams and along alluvial valleys have shallower groundwater with depths from 20 feet or more. Other locations in the watershed have deep aquifers with depths of more than 150 feet below the ground surface. Depth of drilling to Mesozoic and Paleozoic aquifers throughout the majority of the watershed is several hundred to over a thousand feet deep, which makes developing these aquifers expensive.

Recharge of groundwater is considered to be low because of low annual precipitation, limited area of Mesozoic and Paleozoic outcrop, and only slightly permeable White River deposits [Centennial Engineering, 1989; Rapp, 1953]. The net annual groundwater recharge rate to aquifers in the study area is approximately 10–15 percent of precipitation or approximately 1.5–2.5 inches per year [Weston Engineering, 2015]. The majority of recharge to groundwater aquifers occurs through direct precipitation; although, the upper aquifers may receive some recharge from stream-flow losses. Groundwater flow is fairly slow and directed radially away from the Laramie Range and Hartville Uplift northward toward the southern end of the Powder River Basin [Rapp, 1953].

Water-bearing properties and chemical qualities of the shallow and bedrock aquifers are highly variable across the study area [Rapp, 1953]. In general, water quality within the Mesozoic and Paleozoic Aquifer systems is better near the outcrop areas; however, "several of these aquifers also serve as petroleum reservoir rocks" with poor water quality [Centennial Engineering, 1989]. Additionally, some bedrock units have been found to contain high levels of sodium, which makes them unsuitable for irrigation use [Rapp, 1953]. Water from the White River Formation may be suitable but locally may have high levels of total dissolved solids (TDS), sulfate, hardness, and fluoride [Rapp, 1953].

In general, the potential to develop a large-scale groundwater supply within much of the study area is low because of low recharge, aquifer depth, potential interference with existing surface or groundwater rights, and locally poor-quality groundwater [Centennial Engineering, 1989].

3.6.1.3 *Wells*

Groundwater information and water well databases were obtained from the SEO. Permitted water well information, including locations, yields, and depths, was collected and compiled in the study's GIS geodatabase. As shown in Figure 3.82, approximately 5,900 SEO permitted water wells are located within the study area. Wells occur throughout the watershed, but most are located in the basin rather than within the Laramie Range.

The majority of wells are stock (1,645), domestic (1,616), or both stock and domestic (1,046). Approximately 688 wells are monitoring, a majority of which are associated with current and historic mining activities. Approximately 215 are industrial wells, 115 are irrigation wells, and 20 are municipal wells, the remaining are miscellaneous, test, and wells with various use combinations. Currently no active Underground Injection Control (UIC) permits are within the study area.

The majority of wells are completed within the Quaternary and Tertiary aquifers. Well depths range from tens of feet to 10,000 feet deep, but most wells are completed between 100 and 500 feet deep. The municipalities of Douglas, Glendo, Glenrock, Guernsey, and Hartville, along with the WWDC have groundwater wells with depths that range from 35 to 1,175 feet deep. The town of Rolling Hills has groundwater supply wells that range in depth from 1,540 to 1,850 feet deep. Well yields are typically less than 10 gpm, but some industrial (mining) wells have recorded yields in the hundreds to thousands of gallons per minute.

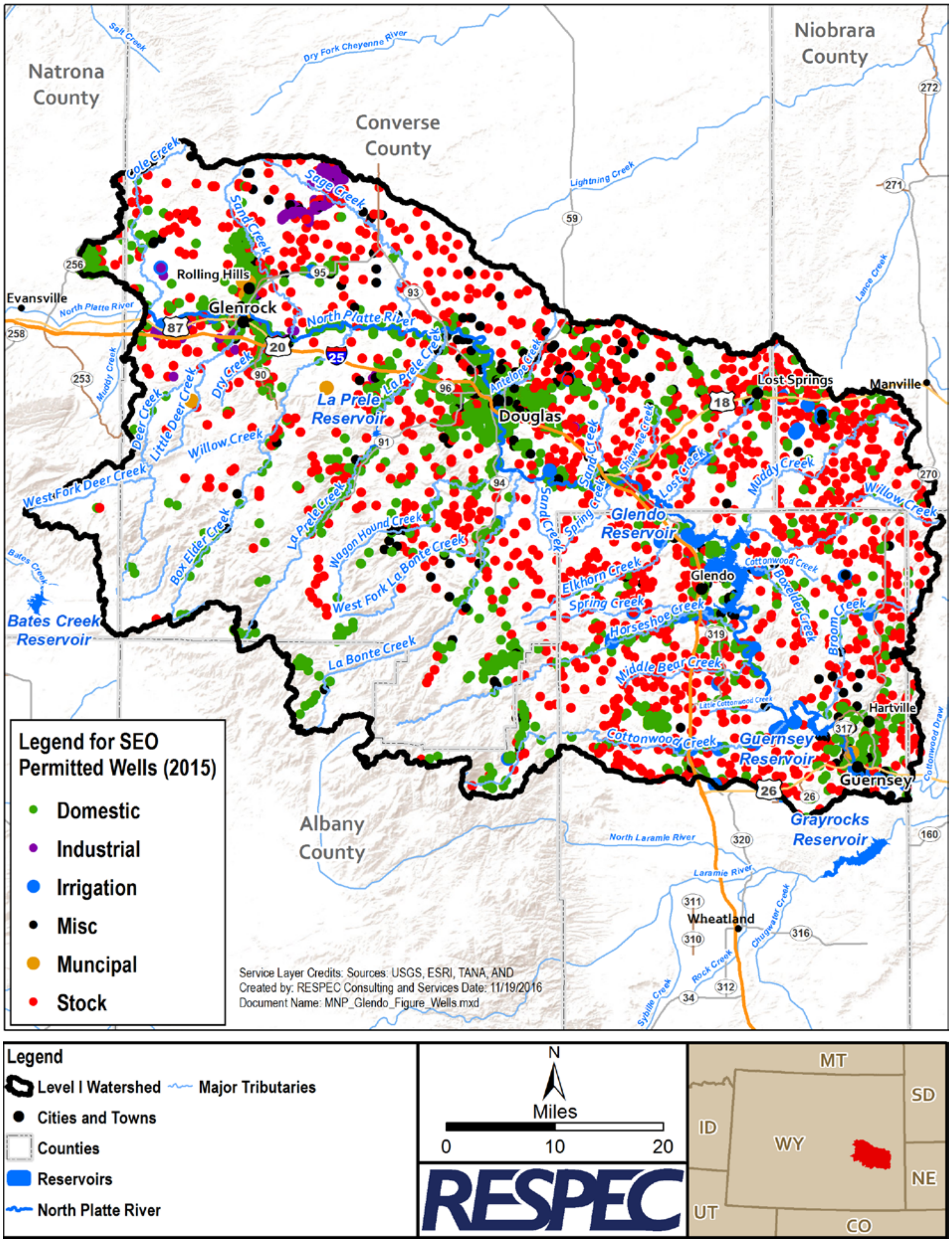


Figure 3.82. Permitted Water Wells Located Within the Study Area.

3.6.1.4 *Springs*

Nearly 300 small springs and seeps have been identified within the study area, as illustrated in Figure 3.83. The majority of springs occurs along fractures and faults within the Laramie Range and contributes to the base flow of streams within the area.

3.6.1.5 *Groundwater Usage and Impacts*

The sponsoring conservation districts have been implementing water-quantity conservation projects and water quality monitoring within the Watershed study area. In addition to the conservation districts' monitoring efforts, the USGS collected water-resource data at 112 groundwater and 2 spring sites within the watershed. The UW's Water Resources Data System (WRDS) Water Quality Database contains data from over 1,100 monitoring sites (mainly groundwater wells) within the study area. Many large groundwater supply users, including municipal and industrial users, have meters that monitor groundwater usage, which is then reported to the SEO. In general, water consumption peaks during summer months because of increased irrigation, lawn watering, and drilling.

In 2015, oil-and-gas fields within (in whole or part) the study area produced approximately 210 million gallons of water [Wyoming Oil and Gas Conservation Commission, 2016]. Production by field is summarized in Table 3.35. The largest water production occurred at Sussex and Glenrock South Fields, with combined production at approximately 160 million gallons of water in 2015 (approximately 300 gpm), or 75 percent of the oil-/gas-produced water within the study area. A group of oil-and-gas operators have proposed to drill an additional 5,000 oil-and-gas wells within Converse County in the next 5 years. Based on experience with other local wells, the amount of water needed to drill each well is expected to be 50,000 to 100,000 barrels [ICF, 2014]. The total amount of produced water would range from 55 to 91 mbls of water per year upon full field development [ICF, 2014]. Determining cumulative impacts from existing and future oil-and-gas operations is outside the scope of this study; however, the draft EIS for the Converse County Oil & Gas Project has yet to be published.

3.6.1.6 *2001 Modified North Platte River Decree and Green Areas*

As a result of water scarcity and over-appropriated surface water rights on the North Platte River, the 2001 Modified Decree emplaced stipulations regarding groundwater use in areas that are hydrologically connected to surface water (see Section 1.3.1). A hydrologically connected groundwater well is a well that is located and constructed such that if water were intentionally withdrawn by the well continuously for 40 years, the cumulative stream depletion would be greater than or equal to 28 percent of the total groundwater withdrawn by that well. "Green Area" maps have been developed and are available at the SEO's website (*http://seo.wyo.gov/documents-data/maps-and-spatial-data*). These maps depict the areas in which the groundwater at any depth is deemed nonhydrologically connected and, therefore, well construction and groundwater use are not subject to the 2001 Modified Decree.

The "Green Area" for the North Platte River–Glendo Watershed is shown in Figure 3.84. About 855,600 acres or 40 percent of the watershed is a groundwater "Green Area." Most of the area northeast of the North Platte River, at a distance of 2–3 miles or more from the river, is considered a "Green Area," and additional "Green Areas" occur to the southwest of the river, including sections along Sand Creek,

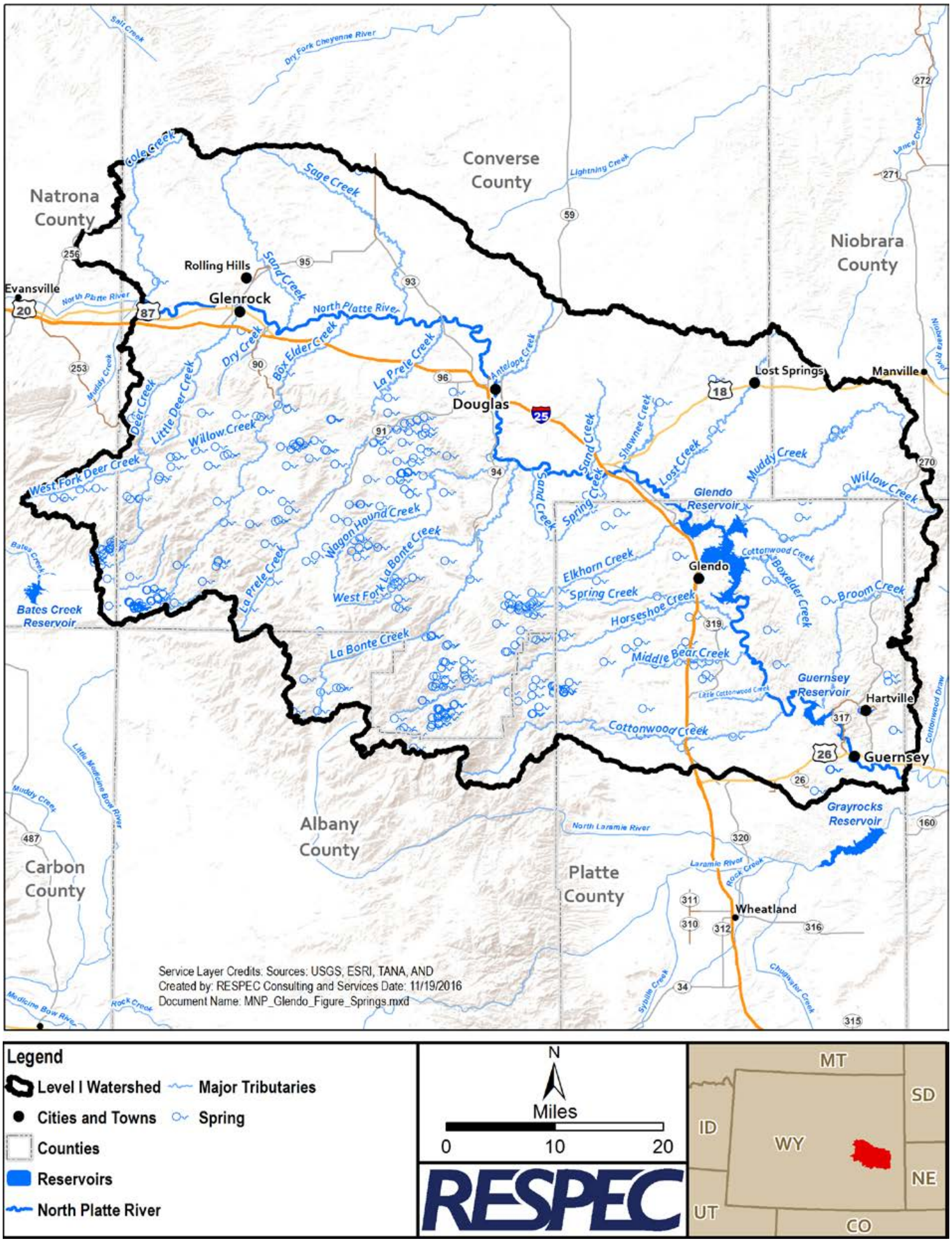


Figure 3.83. Springs Located Within the Study Area.

Spring Creek, and Middle Bear Creek. The 60 percent of the watershed outside the “Green Area” that is covered by the 2001 Modified Decree occurs within a few miles of the North Platte River and the entire southwest corner of the watershed within the Laramie Range (where groundwater contributes to surface flows via numerous springs and gaining streams). For zones outside the “Green Areas,” the SEO typically does not approve water-rights permits for new irrigated lands, and the applicant must demonstrate a lack of hydraulic connectivity.

At present, the City of Douglas Municipal Water System is in the process of trying to prove that their Sheep Mountain Well #1 (Permit No. P97415.0W), which was completed at a depth of 1,165 feet within the Casper Formation near Sheep Mountain, is not hydrologically connected to surface water [Weston Engineering, 2015]. The primary need to prove that the well is not hydrologically connected is attributed to the city exceeding their permitted water depletion rates [Weston Engineering, 2015], which could result in the city having to provide an outside source of makeup water if hydrological connection exists and surface-water flows are low. The SEO’s idealized model for creating the “Green Areas” assumed homogenous systems; as such, the existing model does not take into account the heterogeneous aquifers, complex nature of the geologic structures, and compartmentalized groundwater flows caused by large displacements along Laramide-age faults [Weston Engineering, 2015]. Ultimately, Weston Engineering [2015] has recommended using a multilayer MODFLOW model for the well.

3.6.2 Surface Water

Approximately 9,590 stream miles are located within the watershed with 1,144 miles of streams classified as perennial. The North Platte River and its tributaries (Cottonwood, Deer, Horseshoe, La Bonte, La Prele, and Wagon Hound Creeks) are important streams within the watershed along with the major waterbodies, including Glendo, Guernsey, and LaPrele Reservoirs. Other tributary streams within the watershed include: Antelope, Box Elder, Boxelder, Broom, Cole, Cottonwood, Dry, Little Cottonwood, Little Deer, Lost, Middle Bear, Muddy, Muddy Wagon Hound, North Bear, Sage, Sand, Shawnee, Spring, West Fork Deer, West Fork La Bonte, and Willow Creeks.

Using methods described by Miller [2003] in the USGS’ *Peak-Flow Characteristics of Wyoming Streams, Water-Resources Investigations Report 03-4107*, the peak flow characteristics were calculated for each of the 75 subwatersheds (HUC 12) within the study area, which is included in Appendix C [Miller, 2003]. The methodology used to compute these discharges is based on regression analyses of gaged data against basin characteristics for similar discharge values (irrigation, diversion, and reservoirs). These values are intended to be used for regional planning efforts only. Project-specific estimates would be required before designing future projects, such as water storage for rehabilitating existing or constructing new reservoirs.

The USGS has delineated watersheds through a hydrologic classification that divides and subdivides the nation into continually smaller watersheds. These organized levels of watersheds are called “hydrologic units” and assigned a HUC. The HUC identifies the level based on the size and locale of the unit. The classification currently has six levels. The first level divides the nation into

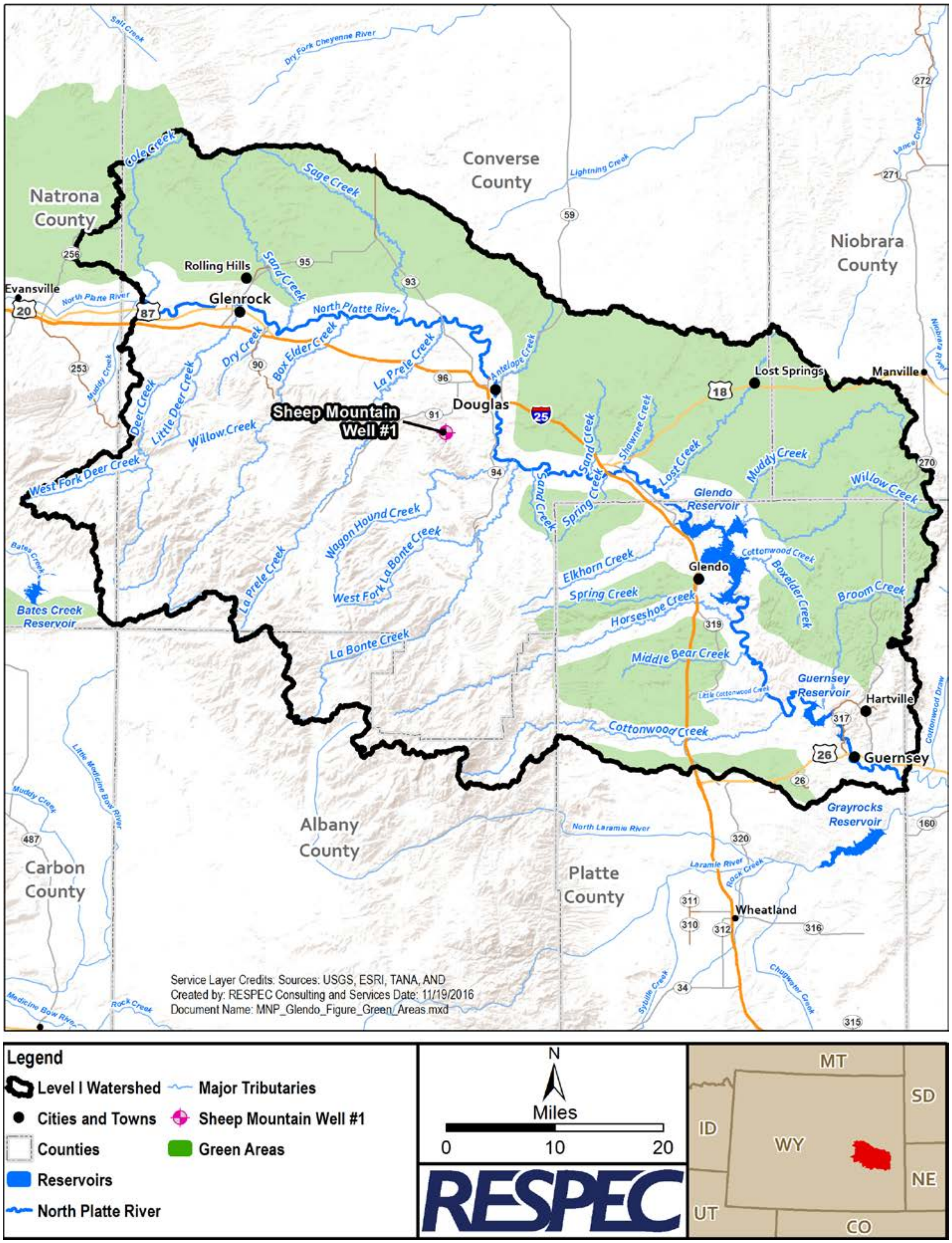


Figure 3.84. "Green Area" Map – Areas Determined Not to be in Hydrologic Connection With the North Platte River and its Tributaries Under Application of the 2001 Modified North Platte Decree.

21 regions, which is referred to as an HUC 2, because a two-digit code identifies each region. Each region is split into second, third, fourth, fifth, and sixth levels that represent HUC 4, HUC 6, HUC 8, HUC 10, and HUC 12, respectively. An HUC 12 is represented by 12 digits, which assign it to all of the above levels. The Middle North Platte–Glendo Watershed for this Level I study was defined by the eastern portion of the Middle North Platte–Casper HUC 10180007 and all of the Glendo Reservoir HUC 1080008. Figure 3.85 displays the HUC 10 watersheds within the study area. Appendix D includes a summary table of the HUC system within the study area.

3.6.2.1 *US Geological Survey Gaging Stations*

The USGS has operated multiple streamflow gaging stations within the study area. Figure 3.86 illustrates the period of record for all gages and shows that up to 17 gages were operated simultaneously. Currently, three active USGS gages are located within the watershed, as shown in Figure 3.87. A total of 40 (3 active and 37 inactive) USGS gages are located within the watershed and are listed in Table 3.38.

The North Platte River below Glendo Reservoir (06652800) has recorded the highest average monthly flows within the watershed during the summer months, followed by the station below Guernsey Reservoir (06656000). These high discharge values that were observed in July through August also reflect controlled releases from each reservoir to meet the 2001 Modified Decree, which is described in detail in Section 1.3. Additionally, the annual Guernsey silt run flushes Guernsey Reservoir, begins in July, and lasts for several days. Water from Glendo Reservoir is controlled to regulate the level of Guernsey Reservoir during this time.

Beyond peak irrigation season, the North Platte River at Orin, station 06652000, averages a higher yearly discharge than station 06652800, because of larger flow rates observed from October through the following spring season. Historical USGS discharge data and historical monthly mean discharge rates were analyzed to develop a relationship for seasonality for all of the available gaging stations within the study area. Historic monthly mean discharge rates reflect typical seasonal runoff patterns (Table 3.39); however, gages along the North Platte River also portray controlled releases to satisfy water-right demands, recreational benefits, and fulfill decree requirements downstream.

Historical monthly mean hydrographs of gaging stations on the North Platte River are plotted in Figure 3.88 and gages with longer periods of record on its major tributaries in Figure 3.89 and Figure 3.90. Gage locations on the North Platte River report their highest discharge rates in summer months (June, July, and August), with the highest flows typically seen in July, which correspond to the peak of runoff and irrigation seasons. Gage stations that are located on other streams, ditches, and tributaries within the watershed exhibit similar characteristics to the North Platte River; however, higher discharge rates shift. Larger flows generally occur in April, May, and June, with the highest flows typically in May. Several stations along Box Elder Creek indicate that it is the largest tributary to the North Platte River within the study area.

3.6.2.2 *Wyoming State Engineer's Office Gaging Stations*

The Wyoming SEO has eight gaging stations that currently collect streamflow within the study area; although three stations are operated by the USGS (06647500, 06652000, and 06652800). Three of the SEO stations are located along the North Platte River. Two of the three stations along the North Platte

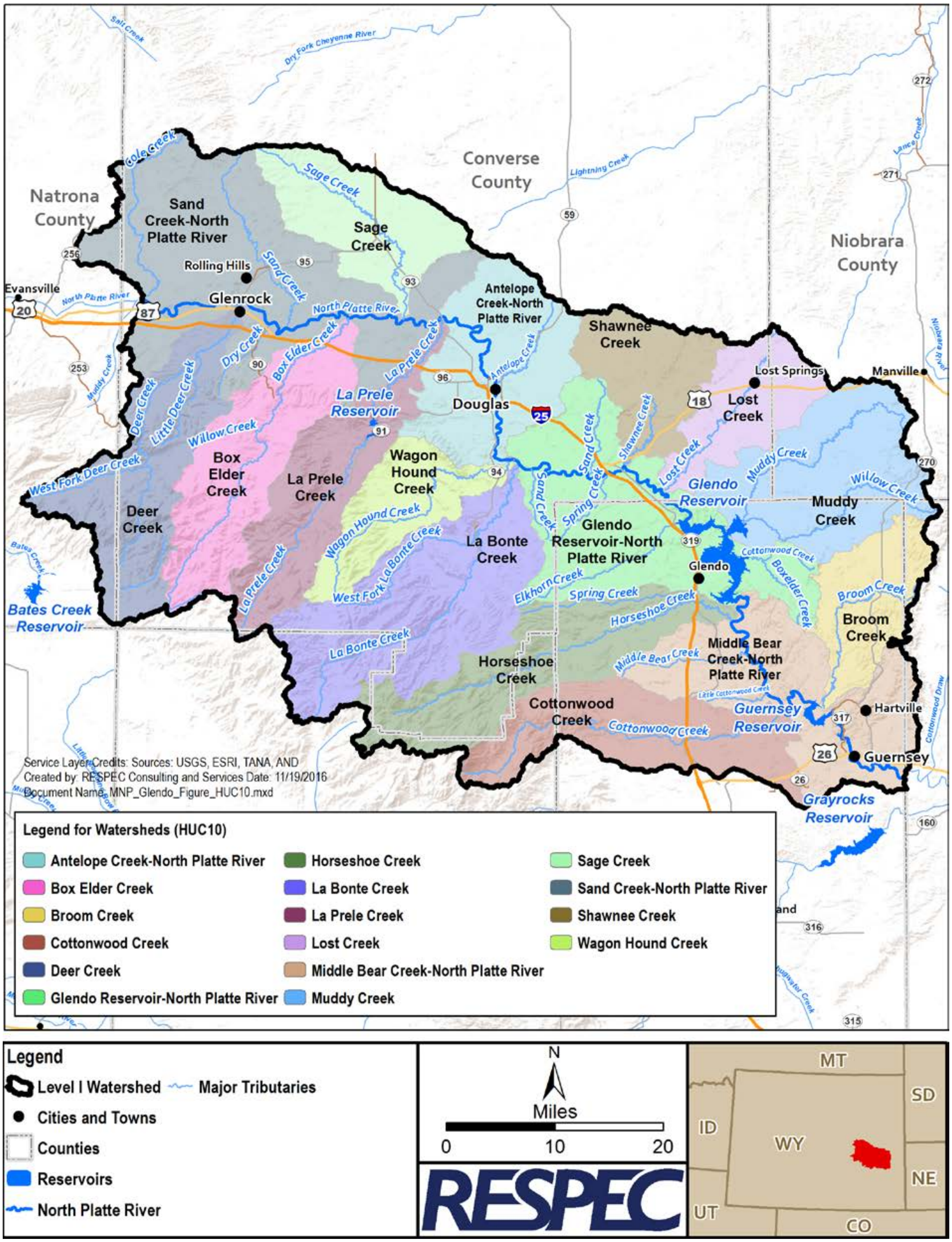


Figure 3.85. 10-Digit Hydrologic Units (HUC 10) Watersheds Within the Study Area.

River are downstream from major reservoirs; USGS stations 06652800 (below Glendo Reservoir) and 0114GOWY (below Guernsey Reservoir). The third station (USGS 06652000) is located near Orin Junction, upstream from Glendo Reservoir. Data collected along the North Platte River indicated higher monthly average streamflow from June through August. Monthly mean hydrographs of each station are shown in Figure 3.91. The remaining five stations are located on tributaries to the North Platte River and irrigation ditches above and below LaPrele Reservoir. These stations also report a shift in higher discharge, with larger flow typical in May and June (Figure 3.92). Data were obtained from the SEO's Real Time Surface Water Data website (*http://seoflow.wyo.gov/*).

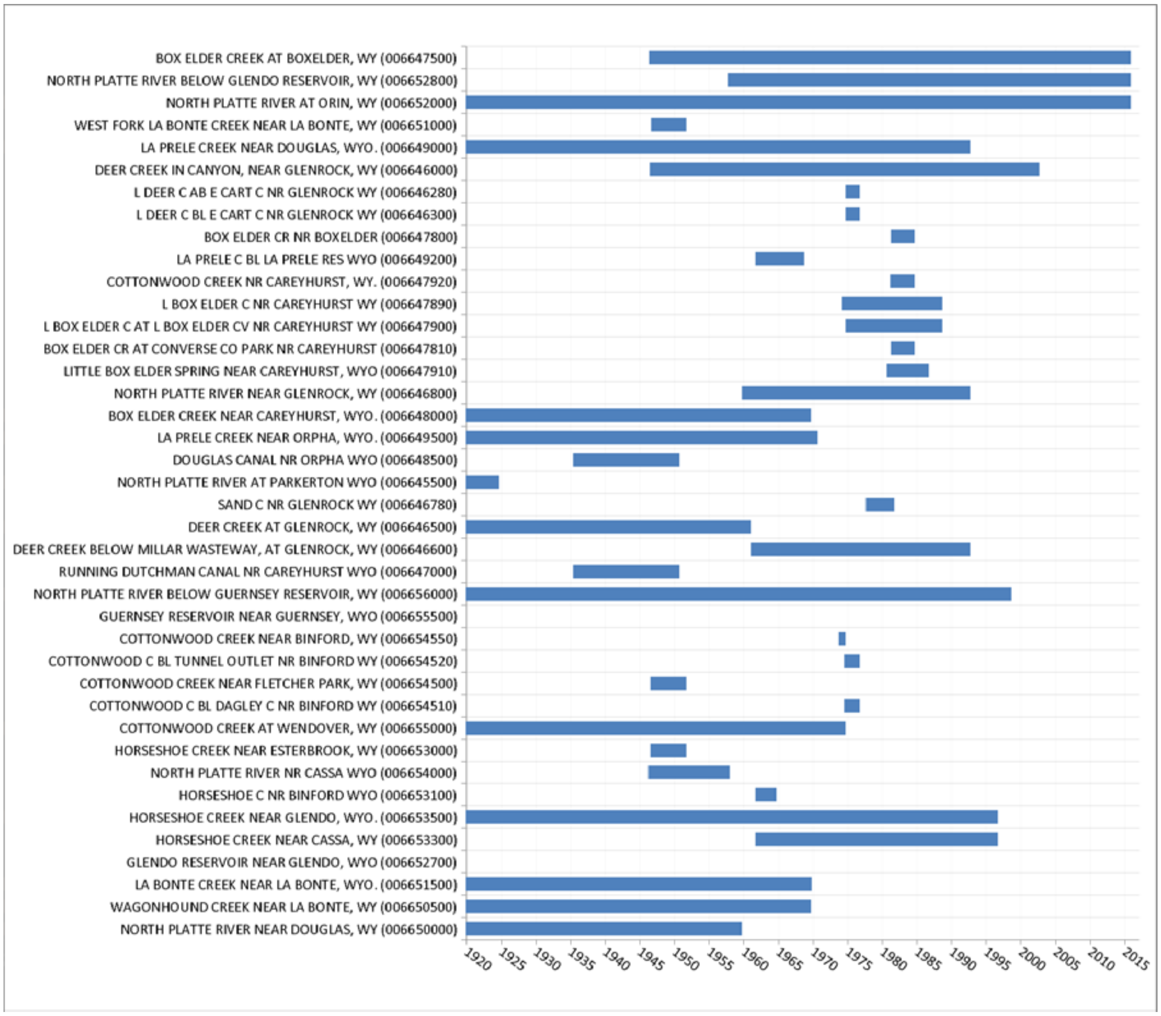


Figure 3.86. Period of Record for US Geological Survey Gages Within the Study Area.

3.6.2.3 *Bureau of Reclamation Gaging Stations*

The USBR operates and maintains multiple automated hydrologic monitoring stations, which have been deemed HYDROMET stations, within the study area. These stations remotely log field data for various hydrologic and meteorological parameters. Stream-gaging data were obtained from four HYDROMET monitoring stations and are available at the website (*http://www.usbr.gov/gp/hydromet/hydromet_arcread.html*). Table 3.40 lists and Figure 3.93 displays the four USBR HYDROMET stations and associated historical monthly mean discharge rates for each station.

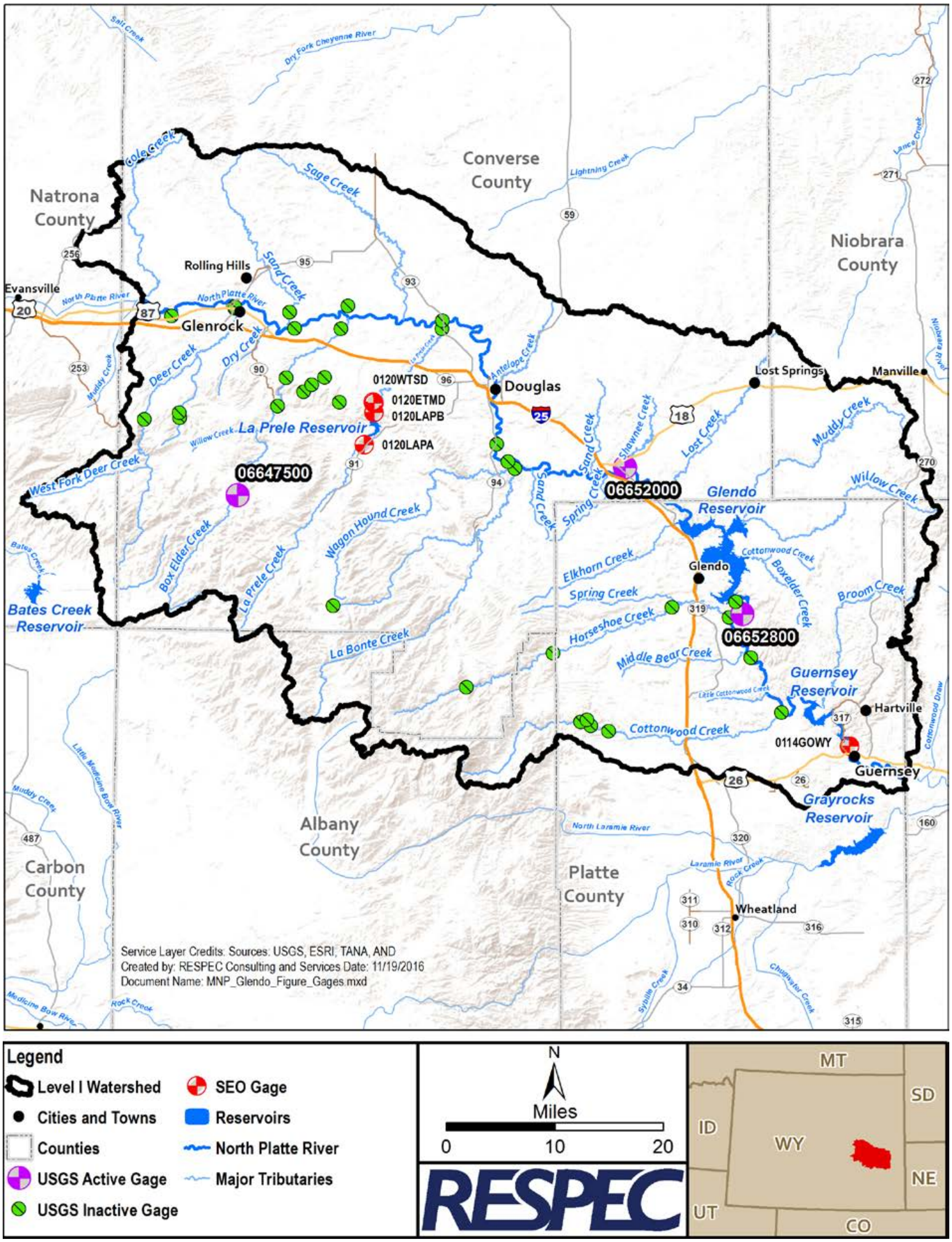


Figure 3.87. US Geological Survey and State Engineer's Office Gage Locations Within the Study Area.

Table 3.38. US Geological Survey Stations and Status Within the Study Area (Page 1 of 3)

Station Number	Station Name	Periods of Record	Drainage Area (sq. mi.)	Latitude	Longitude	Gage Elevation (ft)
6647500	Box Elder Creek at Boxelder, WY	05/01/1946–current	63	42° 36' 43.1" N	105° 51' 32.8" W	6,710
6652800	North Platte River Below Glendo Reservoir, WY	10/01/1957–current	15,548	42° 27' 25.0" N	104° 56' 50.0" W	4,489
6652000	North Platte River at Orin, WY	04/1/1895–current	15,025	42° 39' 09.1" N	105° 09' 31.0" W	4,660
6651000	West Fork La Bonte Creek near La Bonte, WY	09/01/1946–09/30/1951	21	42° 28' 00.0" N	105° 41' 00.0" W	4,742
6649000	La Prele Creek near Douglas, WY	08/01/1919–09/30/1992	135	42° 40' 52.0" N	105° 37' 48.0" W	5,600
6646000	Deer Creek in Canyon Creek in Canyon, near Glenrock, WY	06/01/1946–09/30/2002	139	42° 42' 42.0" N	106° 01' 43.0" W	5,640
6646280	Little Deer Creek above East Cart Creek near Glenrock, WY	10/01/1974–10/06/1976	4	42° 42' 54.0" N	105° 57' 51.0" W	6,250
6646300	Little Deer Creek below East Cart Creek near Glenrock, WY	10/01/1974–09/30/1976	7	42° 43' 17.0" N	105° 57' 57.0" W	6,162
6647800	Box Elder Creek near Boxelder	04/17/1981–09/30/1984	136	42° 43' 54.0" N	105° 47' 14.0" W	6,103
6649200	La Prele Creek below LaPrele Reservoir, WY	10/01/1961–09/30/1968	152	42° 43' 53.0" N	105° 36' 59.0" W	5,350
6647920	Cottonwood Creek near Careyhurst, WY	03/26/1981–09/30/1984	NDA	42° 44' 16.0" N	105° 40' 31.0" W	5,000
6647890	Little Box Elder Creek near Careyhurst, WY	03/13/1974–09/30/1988	7	42° 45' 04.0" N	105° 44' 25.0" W	5,670
6647900	Little Box Elder Creek at Little Box Elder CV near Careyhurst, WY	10/01/1974–09/30/1988	8	42° 45' 38.0" N	105° 43' 33.0" W	5,484
6647810	Box Elder Creek at Converse County Park near Careyhurst	05/01/1981–09/30/1984	138	42° 46' 11.0" N	105° 46' 21.0" W	5,248

Table 3.38. US Geological Survey Stations and Status Within the Study Area (Page 2 of 3)

Station Number	Station Name	Periods of Record	Drainage Area (sq. mi.)	Latitude	Longitude	Gage Elevation (ft)
6647910	Little Box Elder Spring near Careyhurst, WY	10/01/1980 – 09/30/1986	NDA	42° 46' 10.0" N	105° 42' 08.0" W	5,307
6646800	North Platte River near Glenrock, WY	10/01/1959 – 09/30/1992	13,538	42° 50' 10.0" N	105° 45' 30.0" W	4,920
6648000	Box Elder Creek near Careyhurst, WY	06/01/1911 – 10/07/1969	202	42° 50' 08.0" N	105° 40' 24.0" W	4,930
6649500	La Prele Creek near Orpha, WY	05/01/1916 – 09/30/1970	177	42° 50' 12.0" N	105° 29' 25.0" W	4,880
6648500	Douglas Canal near Orpha, WY	05/01/1935 – 09/30/1950	NDA	42° 50' 49.0" N	105° 29' 17.0" W	4,855
6645500	North Platte River at Parkerton, WY	05/01/1919 – 09/30/1924	17,135	42° 51' 00.0" N	105° 58' 50.0" W	5,000
6646780	Sand Creek near Glenrock, WY	09/09/1977 – 10/05/1981	NDA	42° 51' 27.0" N	105° 45' 59.0" W	4,990
6646500	Deer Creek at Glendrock, WY	04/01/1916 – 02/28/1961	212	42° 51' 42.0" N	105° 52' 02.0" W	4,980
6646600	Deer Creek below Millar Wastwat at Glenrock, WY	02/01/1961 – 09/30/1992	213	42° 51' 50.0" N	105° 51' 56.0" W	4,980
6647000	Running Dutchman Canal near Careyhurst, WY	06/01/1935 – 09/30/1950	NDA	42° 52' 00.0" N	105° 40' 00.0" W	4,958
6656000	North Platte River Below Guernsey Reservoir, WY	04/01/1901 – 09/30/1998	16,237	42° 16' 50.0" N	104° 45' 15.0" W	4,340
6655500	Guernsey Reservoir, near Guernsey, WY	NDA	16,224	42° 17' 23.0" N	104° 45' 48.0" W	4,370
6654550	Cottonwood Creek near Binford, WY	10/01/1973–09/30/1974	61	42° 18' 01.0" N	105° 11' 12.0" W	5,115
6654520	Cottonwood Creek below Tunnel Outlet near Binford, WY	08/01/1974 – 09/30/1976	57	42° 18' 27.0" N	105° 13' 08.0" W	5,246
6654500	Cottonwood Creek near Fletcher Park, WY	07/01/1946 – 09/30/1951	51	42° 18' 45.0" N	105° 14' 13.0" W	5,480
6654510	Cottonwood Creek below Dagley Creek near Binford, WY	08/01/1974 – 09/30/1976	54	42° 18' 53.0" N	105° 13' 33.0" W	5,319

Table 3.38. US Geological Survey Stations and Status Within the Study Area (Page 3 of 3)

Station Number	Station Name	Periods of Record	Drainage Area (sq. mi.)	Latitude	Longitude	Gage Elevation (ft)
6655000	Cottonwood Creek at Wendover, WY	05/01/1916 – 09/30/1974	196	42° 19' 33.0" N	104° 52' 33.0" W	4,450
6653000	Horseshoe Creek near Esterbrook, WY	07/01/1946 – 09/30/1951	46	42° 21' 30.0" N	105° 26' 35.0" W	6,350
6654000	North Platte River near Cassa, WY	04/01/1946 – 12/31/1957	19,796	42° 23' 53.0" N	104° 55' 53.0" W	4,458
6653100	Horseshoe Creek near Binford, WY	10/01/1961 – 09/30/1964	110	42° 24' 15.0" N	105° 17' 15.0" W	5,289
6653500	Horseshoe Creek near Glendo, WY	04/01/1916–09/30/1996	211	42° 27' 09.0" N	104° 58' 11.0" W	4,500
6653300	Horseshoe Creek near Cassa, WY	10/01/1961–09/30/1996	195	42° 27' 57.0" N	105° 04' 22.0" W	4,700
6652700	Glendo Reservoir near Glendo, WY	07/15/1975-08/31/1976	15,545	42° 28' 21.0" N	104° 57' 28.0" W	4,544
6651500	La Bonte Creek near La Bonte, WY	05/01/1916 – 10/24/1969	287	42° 39' 00.0" N	105° 21' 26.0" W	4,752
6650500	Wagonhound Creek near La Bonte, WY	05/01/1916 – 09/301969	112	42° 39' 35.0" N	105° 22' 10.0" W	4,741
6650000	North Platte River near Douglas, WY	04/01/1919 – 09/30/1959	18,338	42° 41' 00.0" N	105° 23' 26.0" W	4,744

Table 3.39. Monthly Mean Discharge Rates for US Geological Survey Gaging Stations Within the Study Area (Page 1 of 3)

Station Number	Site Description	Historical Monthly Mean Discharge (cfs)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6647810	Box Elder Creek at Boxelder, WY	12.7	12.3	39.4	191.9	548.8	207.4	24.0	8.0	4.5	12.4	17.4	14.1
6647800	Box Elder Creek at Converse County Park near Careyhurst	10.4	10.9	28.7	118.1	442.0	164.0	19.1	5.9	3.5	9.1	13.3	11.7
6647500	Box Elder Creek near Boxelder	2.5	2.7	9.7	82.6	231.9	73.9	8.1	1.5	0.8	2.9	3.7	2.8
6648000	Box Elder Creek near Careyhurst, WY	8.4	9.1	16.5	107.4	280.7	78.8	8.6	1.8	3.8	6.2	9.0	8.7
6654510	Cottonwood Creek at Wendover, WY	0.5	0.9	2.3	8.9	18.6	9.1	3.0	3.6	0.3	0.3	0.3	0.5
6654520	Cottonwood Creek below Dagley Creek near Binford, WY	0.0	0.0	0.3	6.5	14.3	5.0	0.5	2.0	0.0	0.0	0.0	0.0
6655000	Cottonwood Creek below Tunnel Outlet near Binford, WY	3.0	3.2	3.8	9.8	26.3	23.2	5.4	3.3	4.2	3.2	3.2	3.0
6654550	Cottonwood Creek near Binford, WY	0.8	0.7	1.6	23.1	14.3	8.3	1.3	0.0	0.0	4.1	2.8	1.3
6654500	Cottonwood Creek near Careyhurst, WY	1.1	1.4	3.5	12.6	29.9	28.6	7.4	2.0	0.6	0.7	1.1	1.3
6647920	Cottonwood Creek near Fletcher Park, WY	0.5	0.5	1.2	2.5	3.7	1.1	0.8	0.6	0.5	0.5	0.5	0.5
6646500	Deer Creek at Glendrock, WY	12.5	13.4	28.8	181.1	324.8	72.0	8.0	1.8	3.7	8.2	13.3	13.0
6646600	Deer Creek below Millar Wastwat at Glenrock, WY	19.4	20.9	35.5	149.1	357.1	101.1	8.7	2.3	5.3	14.1	19.4	19.0
6646000	Deer Creek in Canyon Creek in Canyon, near Glenrock, WY	9.4	10.2	34.2	189.9	274.0	84.8	15.0	6.0	6.0	11.4	14.4	10.5
6648500	Douglas Canal near Orpha, WY	0.0	0.0	0.0	0.8	21.2	33.4	44.4	39.3	13.9	0.0	0.0	0.0
6653100	Horseshoe Creek near Binford, WY	2.2	5.5	8.3	84.3	135.9	73.9	13.0	2.6	1.3	2.4	3.6	2.2

Table 3.39. Monthly Mean Discharge Rates for US Geological Survey Gaging Stations Within the Study Area (Page 2 of 3)

Station Number	Site Description	Historical Monthly Mean Discharge (cfs)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6653300	Horseshoe Creek near Cassa, WY	5.9	6.4	10.5	49.1	143.7	139.1	26.9	8.7	5.1	6.3	8.1	7.1
6653000	Horseshoe Creek near Esterbrook, WY	1.0	1.3	3.3	32.1	70.3	32.4	7.6	1.1	0.4	1.0	1.4	1.3
6653500	Horseshoe Creek near Glendo, WY	5.9	6.3	9.7	54.7	129.6	91.0	17.5	5.5	4.7	5.8	6.8	6.5
6651500	La Bonte Creek near La Bonte, WY	5.8	7.2	21.4	151.3	293.6	98.4	19.3	7.5	4.9	6.3	6.8	6.4
6649000	La Prele Creek near Douglas, WY	7.3	7.9	15.8	91.3	221.0	69.5	10.7	3.9	3.7	8.3	8.5	7.8
6649500	La Prele Creek near Orpha, WY	9.2	9.2	9.6	13.6	41.6	26.9	6.9	5.5	7.4	11.6	10.5	10.0
6647900	Little Box Elder Creek at Little Box Elder CV near Careyhurst, WY	0.0	0.0	0.3	2.2	3.4	0.7	0.2	0.1	0.0	0.0	0.0	0.0
6647890	Little Box Elder Creek near Careyhurst, WY	0.7	0.8	1.5	4.8	5.4	1.8	1.0	0.7	0.7	0.7	0.7	0.7
6647910	Little Box Elder Spring near Careyhurst, WY	2.3	2.3	2.5	2.7	2.9	2.9	2.7	2.6	2.5	2.5	2.4	2.4
6646280	Little Deer Creek above East Cart Creek near Glenrock, WY	0.4	0.4	0.6	1.8	3.6	1.9	0.9	0.6	0.5	0.6	0.5	0.5
6646300	Little Deer Creek below East Cart Creek near Glenrock, WY	0.2	0.3	0.4	1.7	4.3	1.9	0.7	0.3	0.2	0.3	0.3	0.2
6647000	Running Dutchman Canal near Careyhurst, WY					8.7	12.7	14.5	10.6	2.2	0.4		
6646780	Sand Creek near Glenrock, WY	0.0	1.2	0.1	0.0	2.8	0.0	2.1	1.2	0.0	0.2	0.0	0.0
6650500	Wagonhound Creek near La Bonte, WY	1.1	1.7	4.8	29.0	48.4	19.0	4.5	2.2	1.2	1.1	1.6	1.3
6651000	West Fork La Bonte Creek near La Bonte, WY	0.6	0.6	1.8	20.1	26.6	12.2	3.1	0.4	0.3	0.6	0.9	0.7

Table 3.39. Monthly Mean Discharge Rates for US Geological Survey Gaging Stations Within the Study Area (Page 3 of 3)

Station Number	Site Description	Historical Monthly Mean Discharge (cfs)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6652000	North Platte River at Orin, WY	843.5	911.8	1183.6	1909.7	3089.4	3118.1	2709.3	2266.0	1521.6	1056.3	967.1	825.8
6645500	North Platte River at Parkerton, WY				1978.6	3069.0	6607.4	5456.0	4433.6	3110.3			
6652800	North Platte River Below Glendo Reservoir, WY	17.1	85.2	431.9	1052.5	2147.5	2773.9	4959.8	4871.8	2202.9	56.8	28.7	18.4
6656000	North Platte River Below Guernsey Reservoir, WY	161.2	200.4	470.1	1172.7	2893.4	4148.3	4791.0	4248.8	2687.4	533.3	241.3	174.0
6650000	North Platte River near Cassa, WY	152.1	172.7	219.9	729.4	2178.8	3743.4	4421.9	4079.7	2187.7	424.6	214.7	166.6
6646800	North Platte River near Douglas, WY	888.9	973.2	1106.1	1523.7	2154.3	2213.0	2341.2	2216.3	1574.7	1180.0	1065.9	882.5
6654000	North Platte River near Glenrock, WY	160.9	200.0	284.0	652.5	1965.2	2548.2	4062.7	4302.2	2291.7	299.0	196.1	173.0

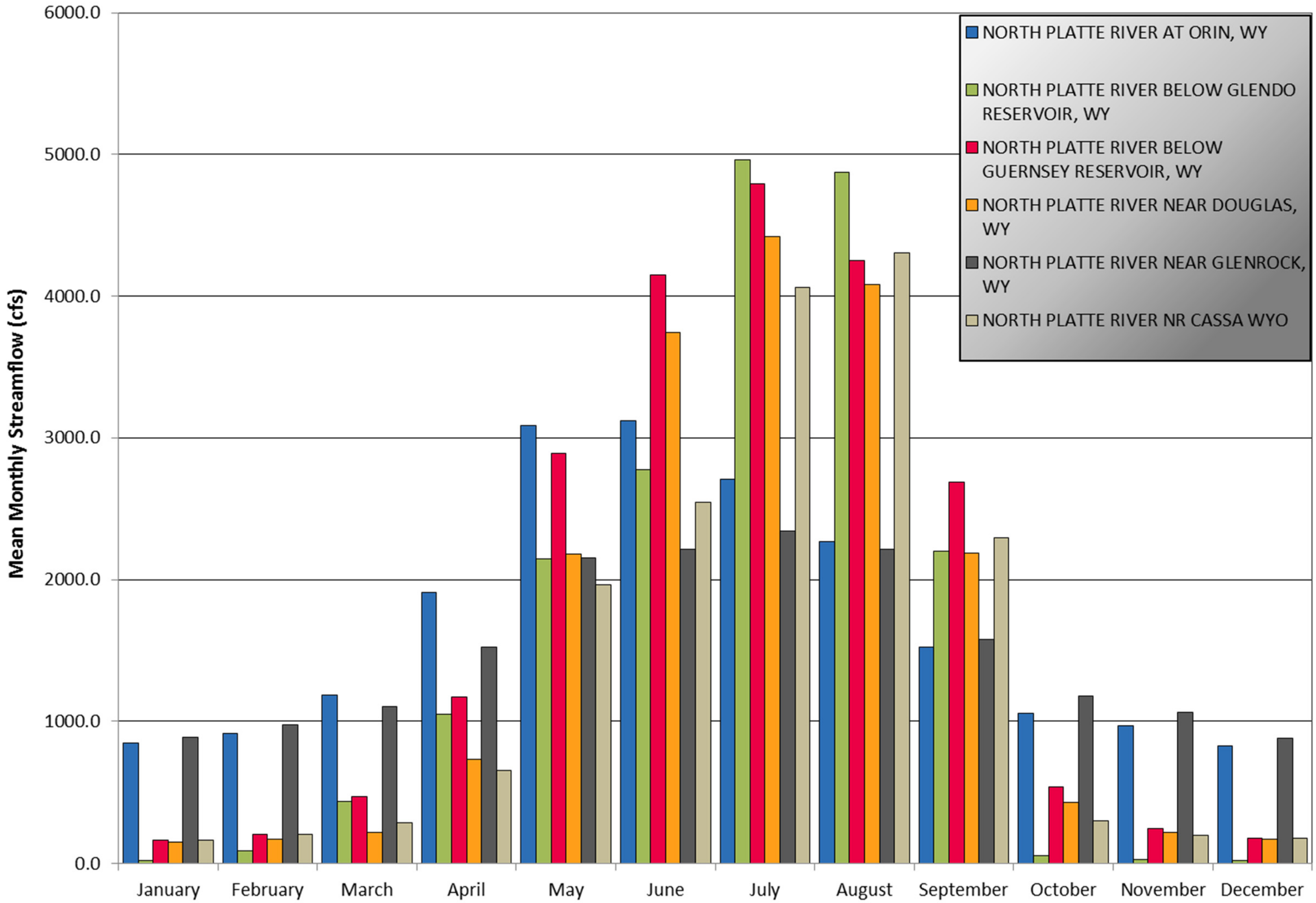


Figure 3.88. Mean Monthly Streamflow for US Geological Survey Gages on the North Platte River Within the Study Area.

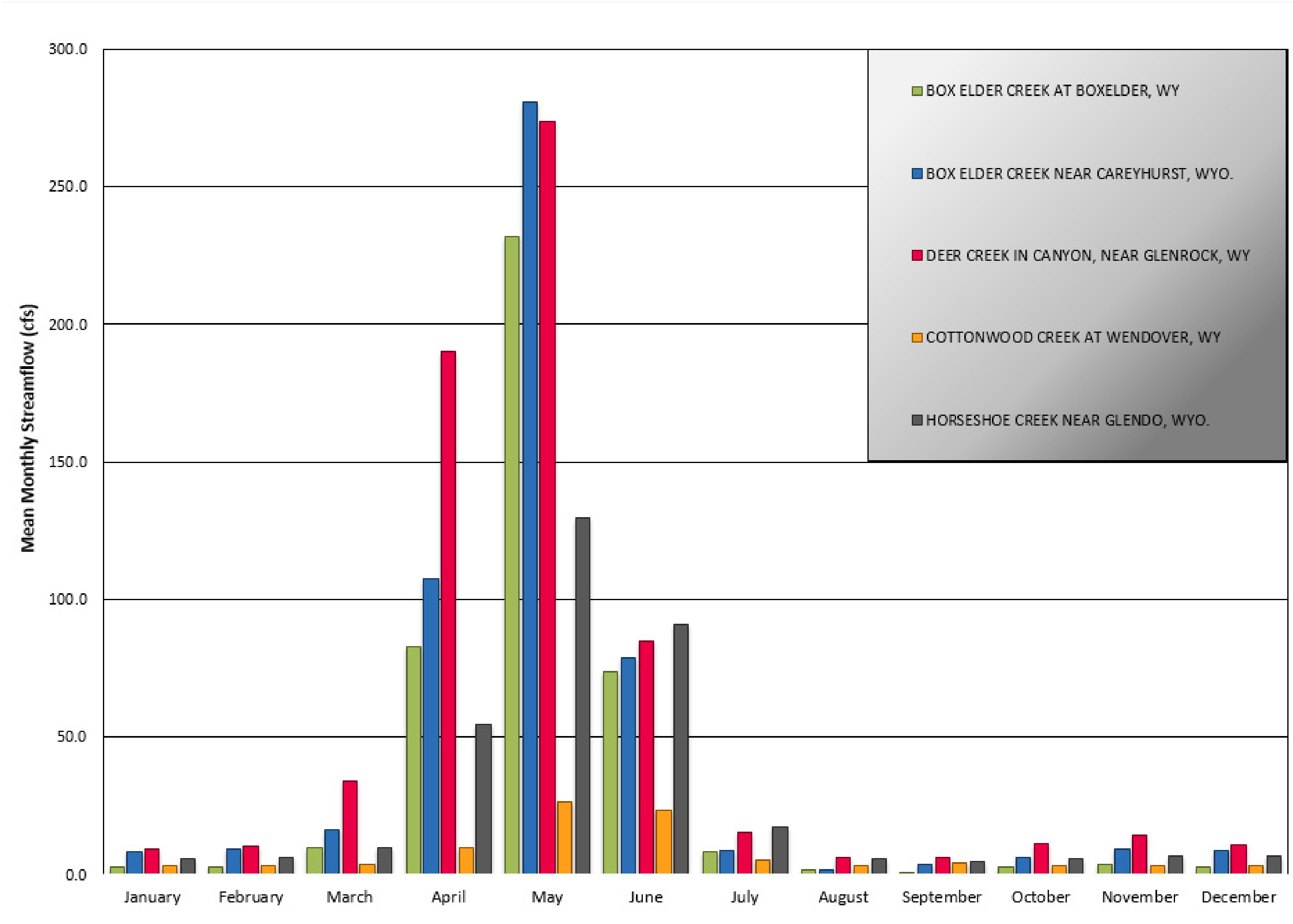


Figure 3.89. Mean Monthly Streamflow for US Geological Survey Gaging Stations on Major Tributaries to the North Platte River Within the Study Area.

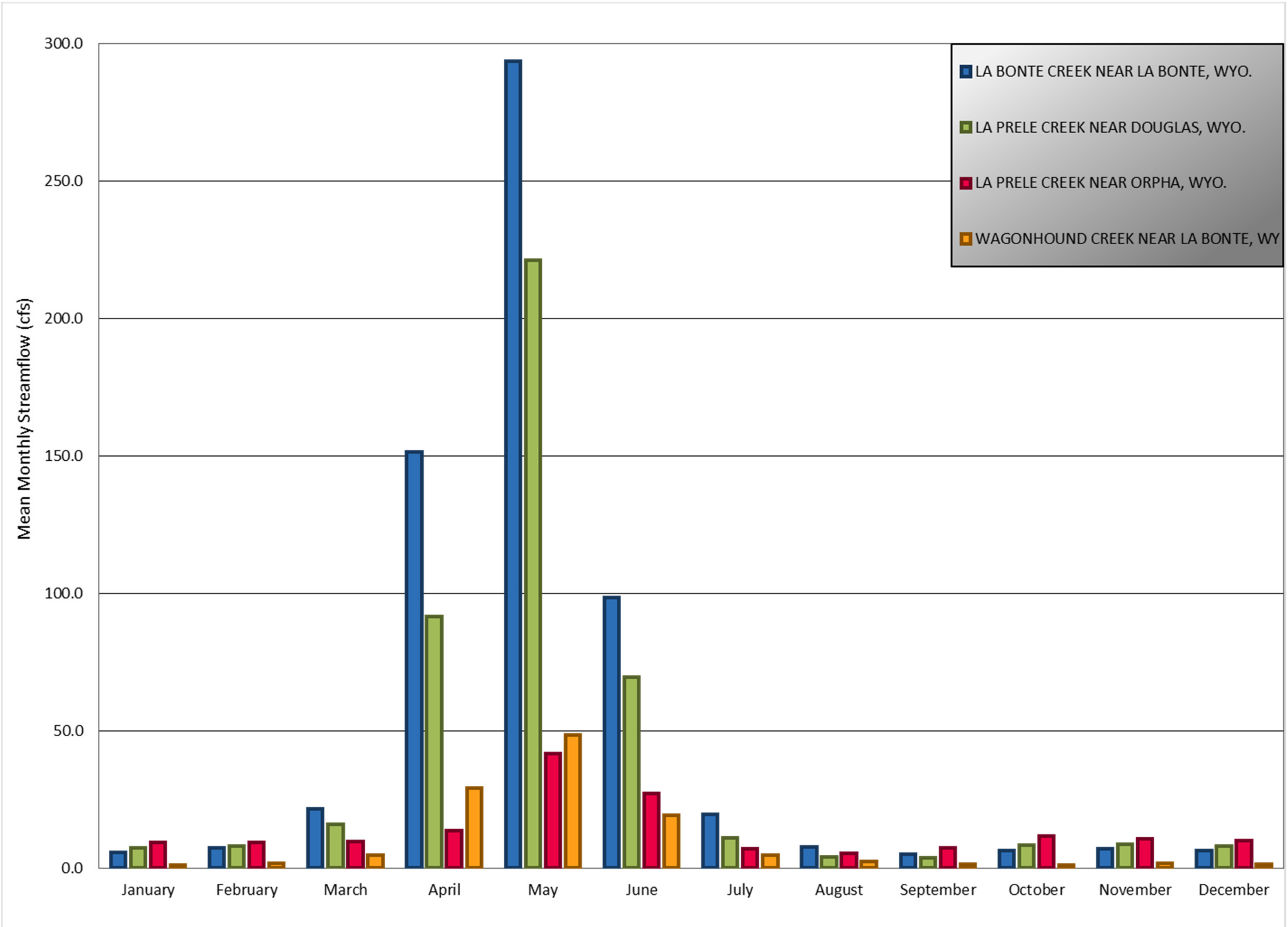


Figure 3.90. Historical Mean Monthly Streamflow for US Geological Survey Gaging Stations on Major Tributaries to the North Platte River Within the Study Area.

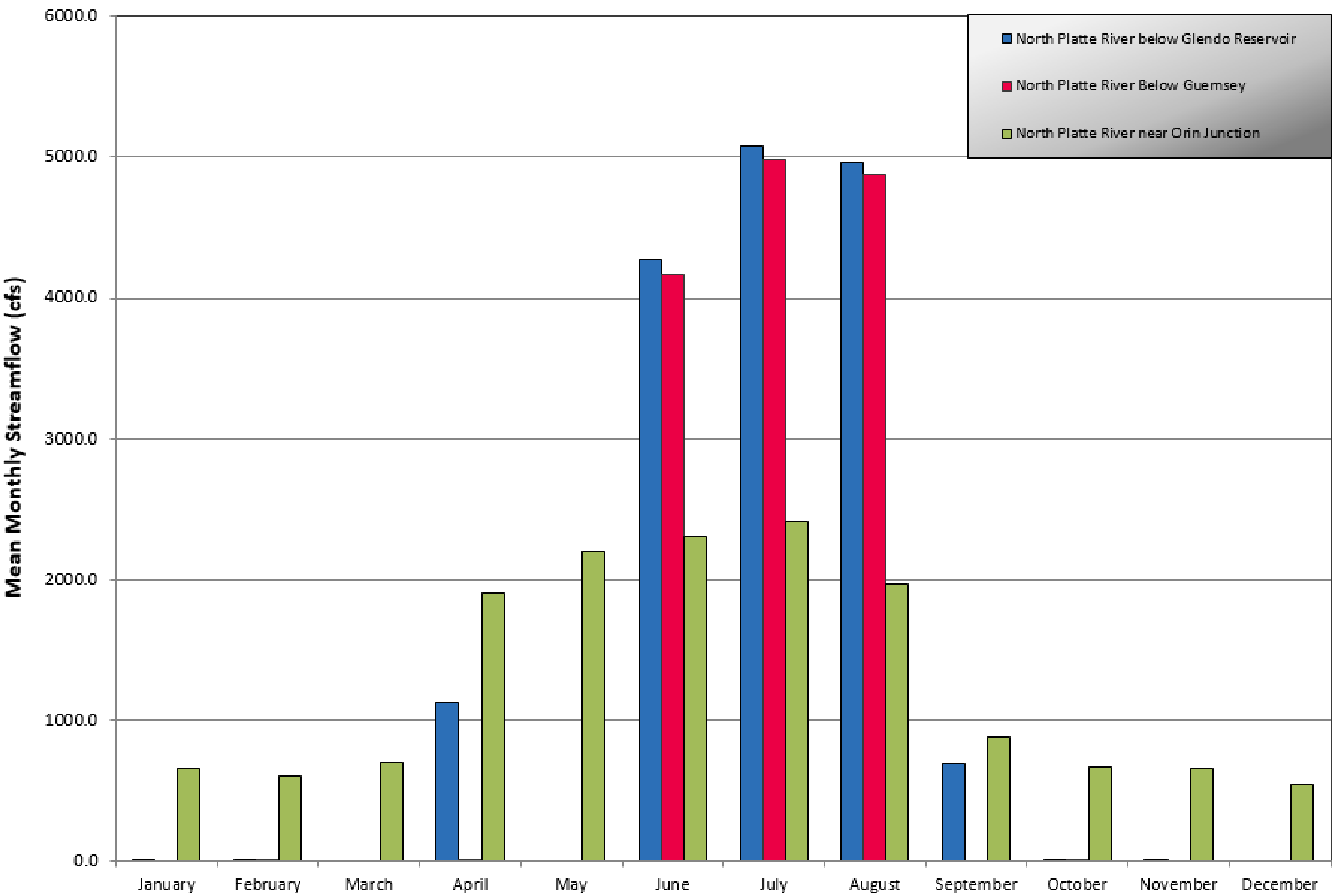


Figure 3.91. Mean Monthly Streamflow for the State Engineer's Office Gaging Stations on the North Platte River Within the Study Area.

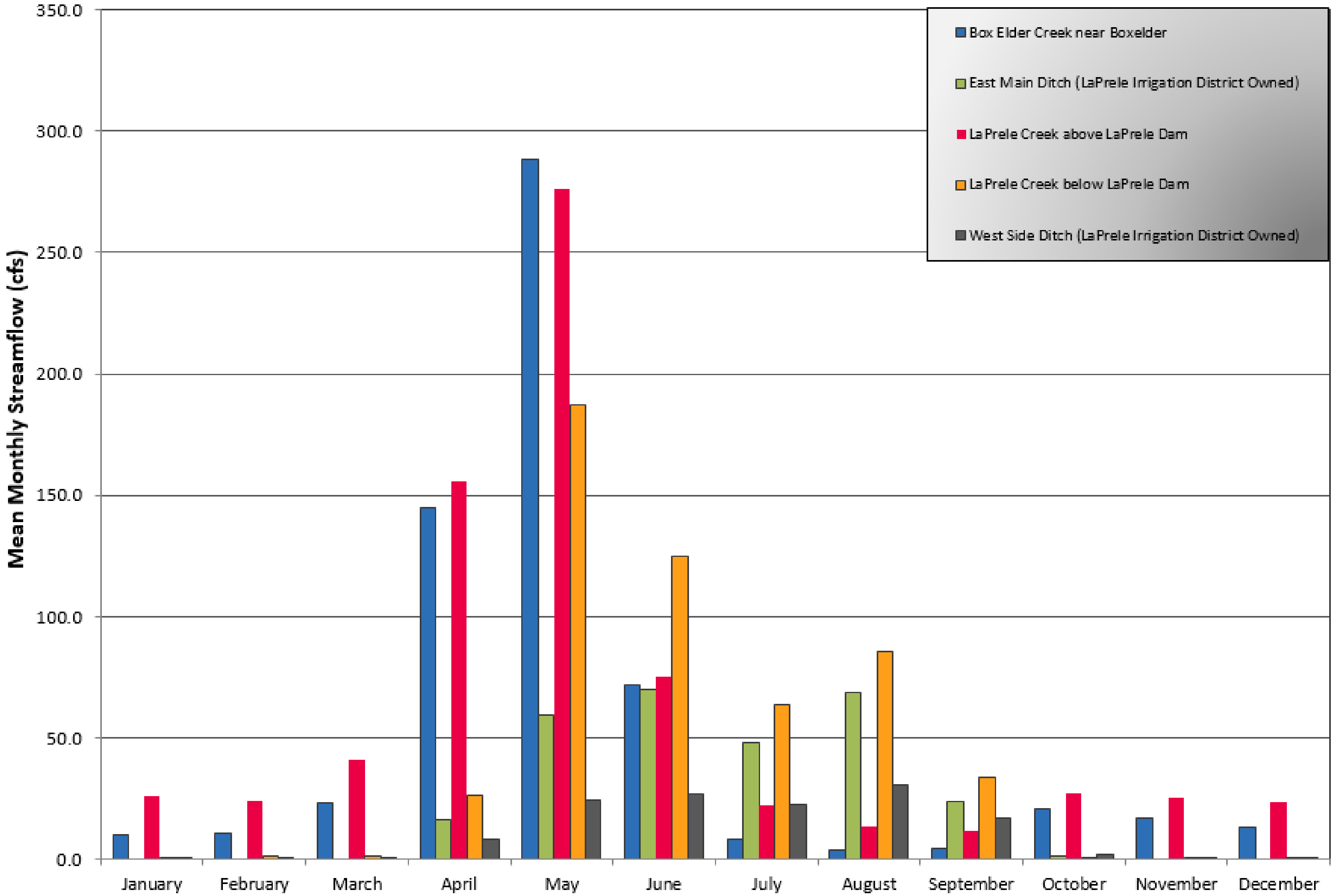


Figure 3.92. Mean Monthly Streamflow for the State Engineer's Office Gaging Stations on Tributaries to the North Platte River Within the Study Area.

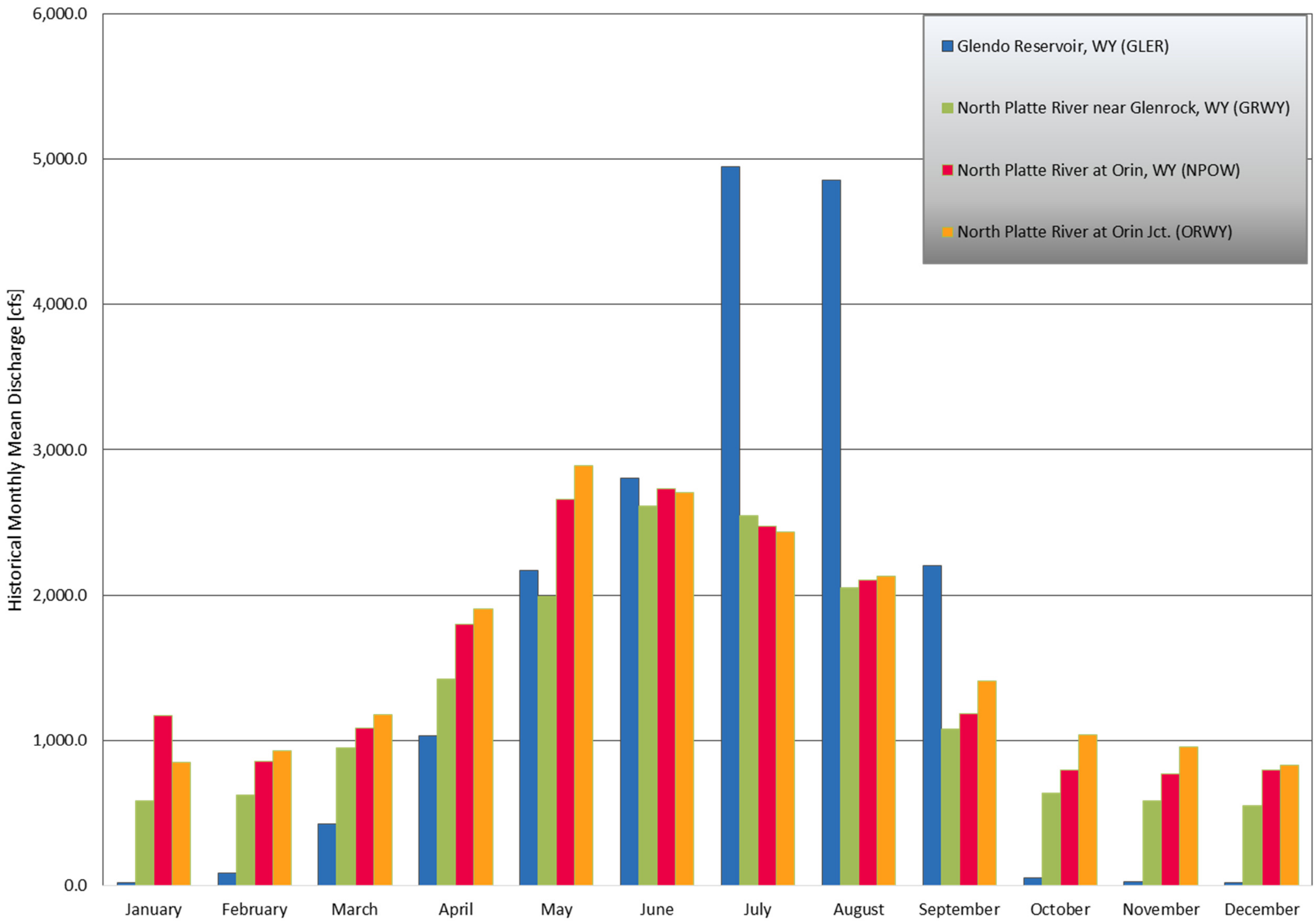


Figure 3.93. Monthly Mean Discharge for US Bureau of Reclamation HYDROMET Stations Within the Watershed.

3.6.2.4 *Wyoming Water Development Commission Temporary Gaging Stations*

No temporary gaging stations were installed within the watershed as part of this Level I study.

3.6.3 Available Flow and Hydrologic Condition

The study area is located within the Platte River Basin Plan, and an update of the basin plan is being completed by the WWDC. As part of the basin plan update, a hydrologic spreadsheet model is being developed that is comparable to other river basin plans completed for the Statewide Framework Plan. At the time of this report, model creation was ongoing and unavailable for use within this study. However, wet, normal, and dry year hydrologic conditions for the three currently operating USGS sites were computed by using each station's period of record.

The three long-term and current USGS gaging stations that were used to assess the available flow and hydrologic conditions in the study area are North Platte River at Orin (06652000); North Platte River below Glendo Reservoir (06652800); and Box Elder Creek near Boxelder (06647500). Wet, normal, and dry flow zones were determined for each of the long term flow gages in the basin based off the Northeast Basin Plan. The Platte River Basin Plan states that years with nonexceedance probabilities of 20 percent or less are selected as dry years, and years with exceedance probabilities of 20 percent or less are selected as wet years.

The 50th percentile, range, and average flow in each percent exceedance category were computed for each station's period of record, as shown in Table 3.41. Figures 3.94 through 3.96 display the flow duration curve for wet, normal, and dry conditions at the three sites. At site North Platte River at Orin (06652000) gage which, is located upstream of Glendo Reservoir, average flows ranged from 4,129 cfs in the wet zone to 602 cfs in the dry zone. Flows at site North Platte River below Glendo Reservoir (06652800), ranged from 5,262 cfs in the wet zone to 3 cfs in the dry zone. Flows at site Box Elder Creek near Boxelder (06647800) contribute to flows at the North Platte River at Orin (06652000) gage, and averaged 163 cfs in the wet flow zone and 0.4 cfs in the dry flow zone.

Table 3.40. Wet, Normal, and Dry Streamflow Statistics for Current US Geological Survey Gages Within the Watershed

USGS Gage Station	Flow Zone (cfs)		
North Platte River at Orin, WY (6652000)	**Wet**	**Normal**	**Dry**
50th Percentile (cfs)	3,520	1,220	612
Range (cfs)	2,380–20,300	739–2,370	240-736
Average (cfs)	4,129	1,341	602
North Platte River Below Glendo Reservoir (6652800)	**Wet**	**Normal**	**Dry**
50th Percentile (cfs)	4,930	39	2.0
Range (cfs)	3,790–10,300	6.5–3,770	0.69-6.4
Average (cfs)	5,262	854	2.8
Boxelder Creek at Boxelder, WY (6647500)	**Wet**	**Normal**	**Dry**
50th Percentile (cfs)	107	3.0	0.0
Range (cfs)	29–2,460	1.1-28.0	0.0-1.0
Average (cfs)	163	5	0.4

Table 3.41. Monthly Mean Discharge Rates for US Bureau of Reclamation Gaging Stations Within the Study Area

Historical Monthly Mean Discharge (cfs)												
USBR Gage Station	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Glendo Reservoir, WY (GLER)	18.6	84.2	422.1	1,030.8	2,167.0	2,806.1	4,944.9	4,858.2	2,200.8	55.1	28.9	20.1
North Platte River near Glenrock, WY (GRWY)	585.2	623.4	945.1	1,422.6	1,989.9	2,611.6	2,546.8	2,052.1	1,076.8	638.6	580.4	552.3
North Platte River at Orin, WY (NPOW)	1,171.0	852.1	1,086.6	1,800.5	2,660.2	2,734.7	2,475.7	2,100.9	1,186.8	792.1	770.0	795.7
North Platte River at Orin Junction (ORWY)	843.9	924.5	1,176.8	1,902.2	2,892.4	2,706.6	2,435.0	2,129.3	1,410.9	1,037.9	950.9	828.5

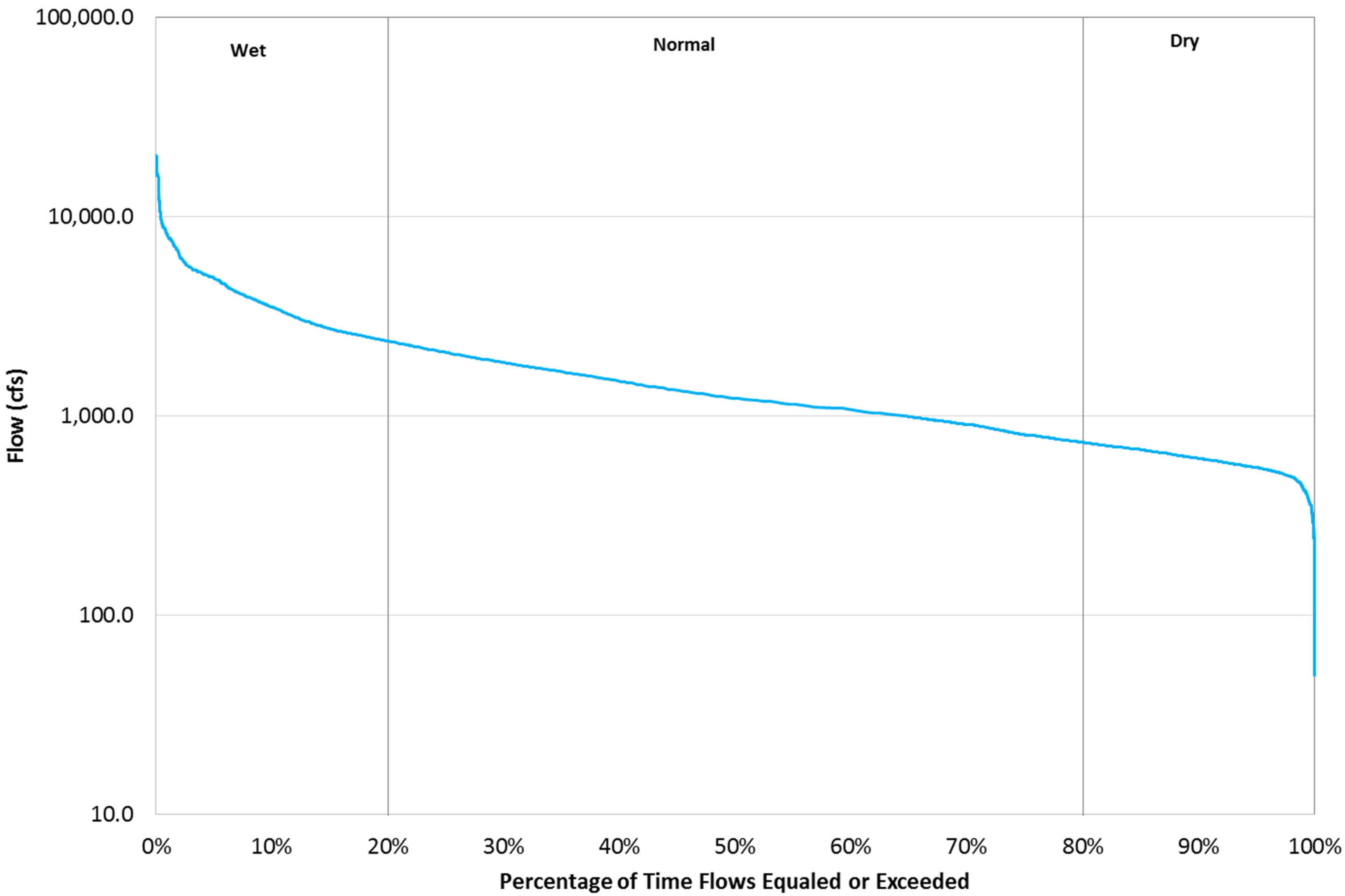


Figure 3.94. Flow Duration Curve for the North Platte River at Orin, Wyoming (USGS Gage Station 6652000).

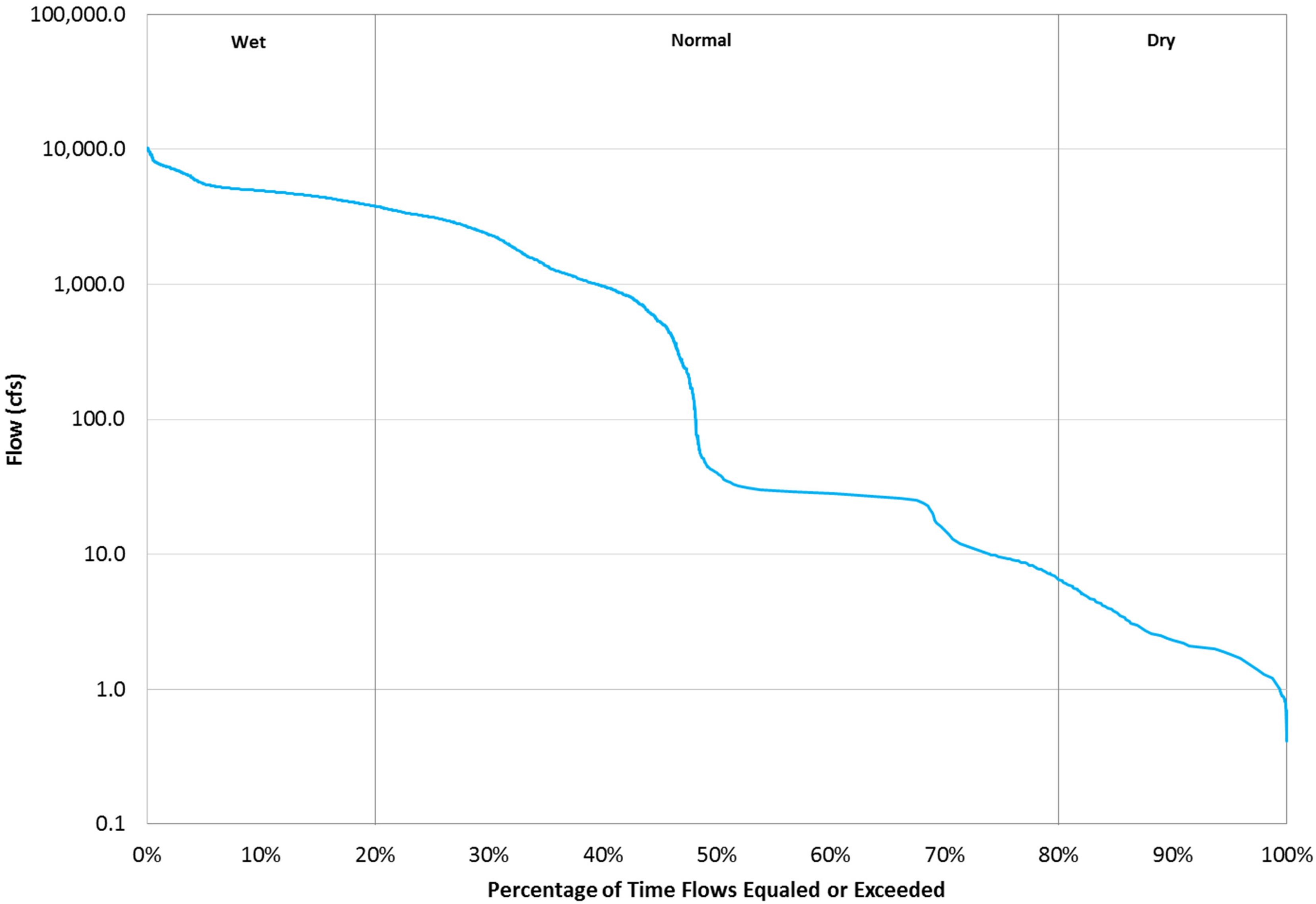


Figure 3.95. Flow Duration Curve for the North Platte River Below Glendo Reservoir (USGS Gage Station 6652800).

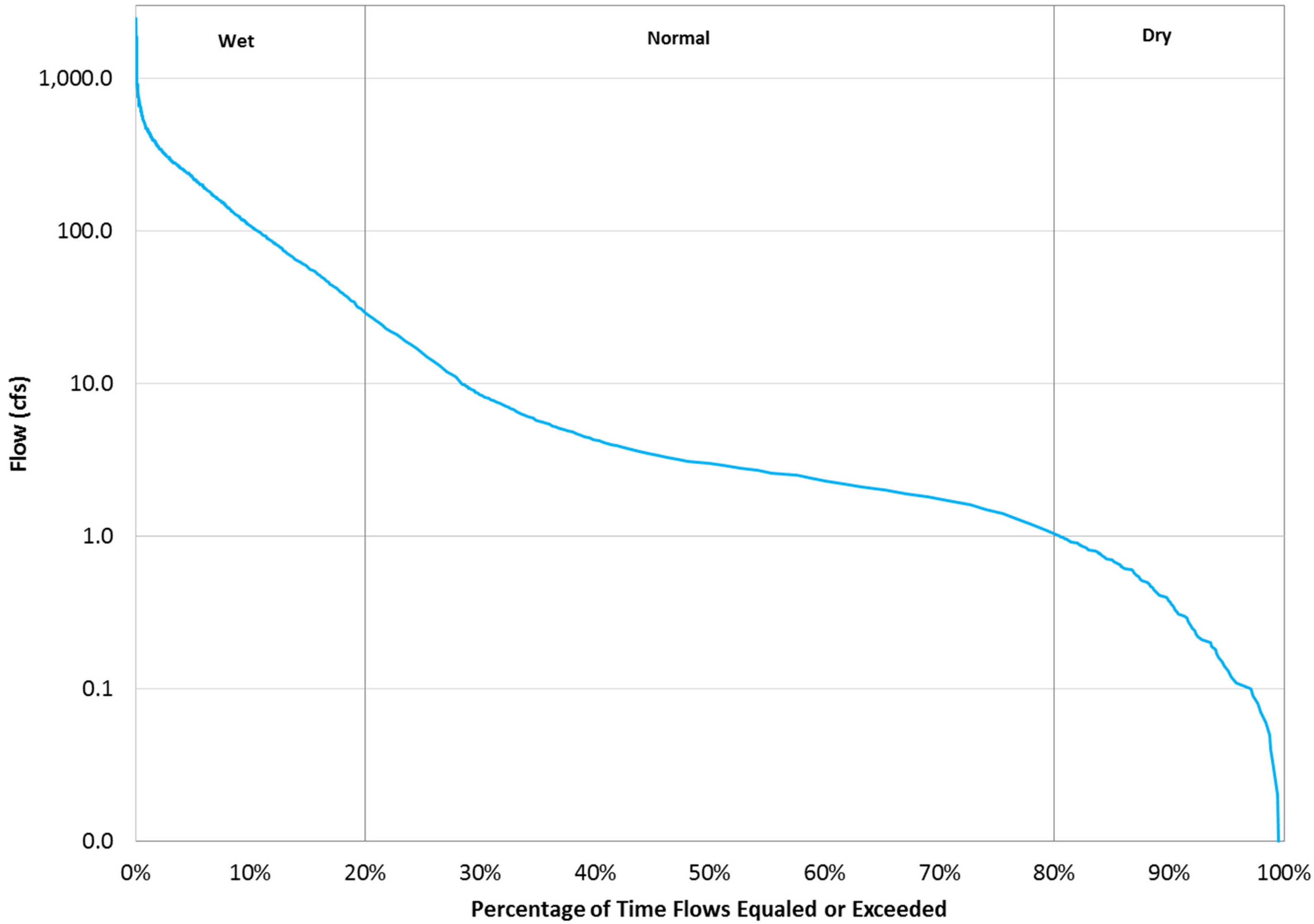


Figure 3.96. Flow Duration Curve for Boxelder Creek at Boxelder, Wyoming (USGS Gage Station 6652000).

3.7 STREAM GEOMORPHOLOGY

3.7.1 General

The field of fluvial geomorphology is the study of how land is formed under processes associated with running water. The balance between processes such as erosion, deposition, and sediment transport determines the character and condition of a stream. The objective of the geomorphic evaluation of the study area is to determine the nature of this balance.

The condition of a stream can be assessed with respect to its basic form (width, depth, and slope) as well as its state of equilibrium, or geomorphic stability [Thorne et al., 1996; Johnson et al., 1999]. Stable, or equilibrium, channels are defined as those that have achieved a balance between flow energy and sediment delivery, such that sediment is transported at the rate at which it is delivered, and the form and pattern of the channel is maintained [Thorne et al., 1996]. Dynamically stable channels are adjustable in nature and "stability" does not preclude lateral migration and associated dynamics such as bank erosion and sediment deposition.

In geomorphically stable conditions, minor changes in either sediment supply or transport energy result in gradual adjustment of channel form to accommodate those changes [Lane, 1955]. Channels destabilize when changes in those factors are extreme enough that rapid and dramatic alterations in pattern or form occur. Common indicators of channel instability include active downcutting and accelerated bank erosion, major changes in channel width/depth ratios, and increased flooding caused by sediment deposition. Geomorphic function is achieved when a channel is in equilibrium while undergoing processes such as lateral migration, sediment reworking, and occasional overbank flooding that effectively create and sustain quality habitat elements, such as bars; pool/riffles; step/pools; and healthy, regenerating riparian corridors.

A commonly used term today for this type of stability is dynamic equilibrium. A stream in dynamic equilibrium has adjusted its width, depth, and slope such that the channel is neither aggrading nor degrading. However, change may be occurring in the stream bank, erosion may result, and bank stabilization may be necessary, even on the banks of a stream in dynamic equilibrium. The equilibrium concept of streams discussed above can also be described by various qualitative relationships. One of the most widely used relationships is the one proposed by Lane [1955] which states that:

$$Q_s D_{50} \alpha Q_w S \tag{3-1}$$

where Q_w is the water discharge, S is the slope, Q_s is the bed material load, and D_{50} is the median size of the bed material. This relationship is commonly referred to as Lane's Balance and is illustrated in Figure 3.97. This graphic indicates that a change in any of the four variables will cause a change in the others such that equilibrium is restored. When a channel is in equilibrium, it will have adjusted these variables such that the sediment being transported into the reach is transported out without significant deposition of sediment in the bed (aggradation) or excessive bed scour (degradation). This definition of stability means that a channel is free to move laterally by eroding one bank and accreting the opposite bank at a similar rate.

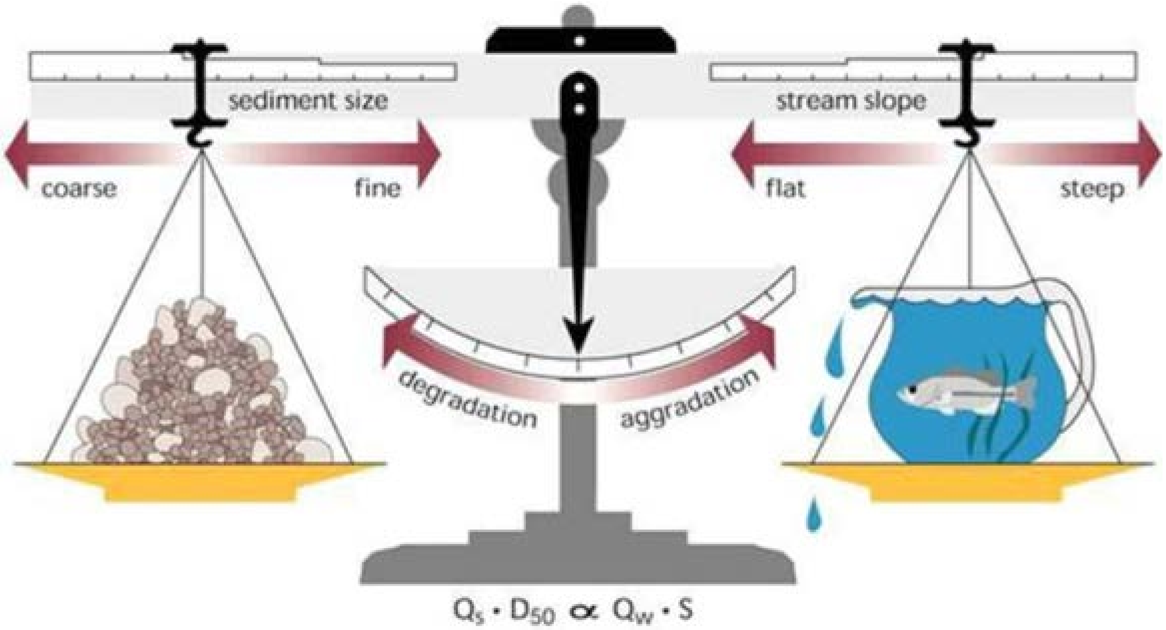


Figure 3.97. Graphical Rendition of Lane's Balance [Watson et al., 1999].

In summary, a stable river, from a geomorphic perspective, has adjusted its width, depth, and slope such that no significant aggradation or degradation of the stream bed or significant planform changes (meandering to braided) occur. By this definition, a stable river is not in a static condition but, rather, is in a state of dynamic equilibrium where it is free to adjust laterally through bank erosion and bar building [Watson et al., 1999]. Impairments to geomorphic function reflect a significant loss of the functional potential of the green channel segment. These impairments are typically described in general, qualitative terms, and any rehabilitation of impaired channel segments requires a more thorough, site-specific assessment of impacts, impairments, and feasible remedies.

3.7.2 Rosgen Classification System

The literature presents descriptions of many systems for classifying and evaluating stream systems. Of these, perhaps the most widely used today is the Rosgen Stream Classification System [Rosgen, 1996]. This system is based on the stream's existing channel morphology and was used in this study. Parameters such as the sinuosity, slope, width/depth ratio, and size of channel materials are evaluated and used to classify the stream into one of the various types included in the system.

The Rosgen System has four classification levels; each level is more detailed than the previous. Figure 3.98 illustrates the hierarchy of the levels and the general nature of effort associated with each. Much of the Level I geomorphic characterization is qualitative and uses aerial imagery and topographic maps. Streams are divided into eight broad types based on their channel and floodplain geometry.

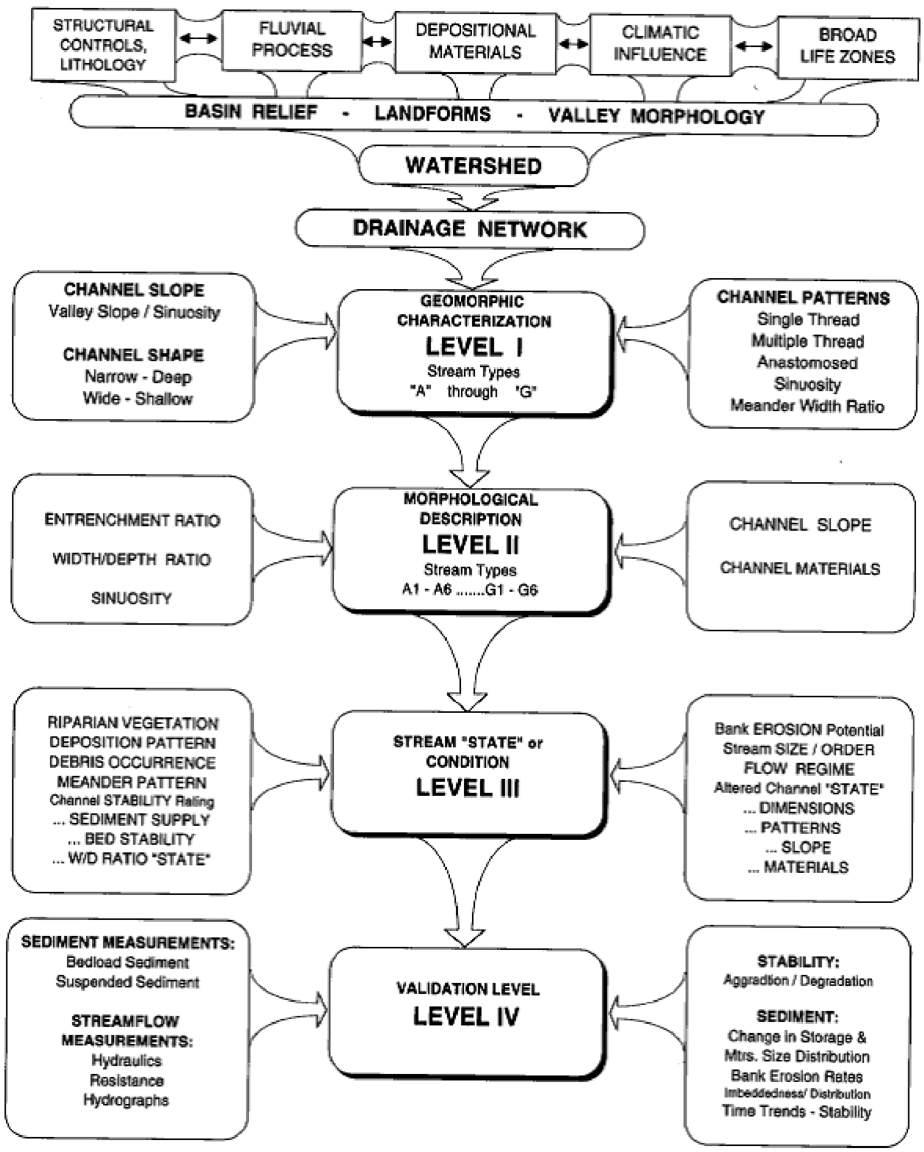


Figure 3.98. Hierarchy of the Rosgen Stream Classification System.

The purpose of the Level I geomorphic classification is to provide an inventory of the study area's overall stream morphology, character, and condition; this classification is also intended to serve as an initial assessment for use in more detailed assessments and to determine the location and approximate percentage of stream types within the study area. Rosgen Classification System stream types can be thought of in their relative location in the watershed, from their headwaters through lowlands. The major types reflect their location in the watershed. For example, "A" type streams are located in headwaters; "C" and "E" stream types are located in meandering lowlands.

The Level II characterization provides a more detailed description of the stream by using measurements at selected locations. Stream types are subdivided into 94 subtypes based on the degree of entrenchment, width-to-depth ratio, water-surface slope, channel bed materials, and sinuosity, as shown in Figure 3.99. The Level II characterization is more quantitative than the Level I effort. Levels III and IV require extensive data collection and quantification of stream features. This study included a Level I classification of the North Platte River and its major tributaries.

3.7.2.1 *Level I Methods*

The Level I geomorphic classification effort was conducted primarily by using existing information incorporated into the study's geodatabase. Several analytical tools were developed and integrated into the GIS to evaluate various geomorphic parameters (sinuosity, slope, and stream station determination). The data incorporated in the project GIS include digital aerial photography, USGS topographic maps, a digital elevation model (DEM), and digitized hydrography information. The most current data available were used in the geomorphic evaluation. Because the DEM was limited to a 10-meter grid, elevations and subsequent slope calculations are approximate. Stream alignments were digitized by using 2012 aerial photography and represent the best available estimate of current channel alignment.

The evaluated streams were divided into reaches based on the definable geographic factors (e.g., confluences with tributaries, major road crossings) or where their geomorphic character displayed changes. Each reach was evaluated in light of the characteristics required at the Level I classification. These parameters, as indicated in Figure 3.98, were channel slope, channel shape, channel patterns, and valley morphology. Note that in the Level I classification, these parameters are not typically quantified, and the relative magnitude (i.e., "moderate," "slightly") is used to classify the stream.

Based on this initial effort, potential reference reaches can be identified for further study in Level II classification efforts. The end product of the Level I classification is the determination of the major stream types (A through G). Figure 3.100 shows the major stream types within the Rosgen Classification System along with their relative locations within a typical watershed. Brief descriptions of the various stream types encountered in the watershed are presented in the following text.

A-type channels are relatively steep channels that form in headwater areas as well as within bedrock canyons. These channels are entrenched and confined by steep valley margins such that little to no floodplain area borders them. Because the boundaries of A-type channels are typically highly resistant to erosion, these stream types are generally quite resilient with respect to human impacts. The most common cause of geomorphic change within A-type channels is large-scale sediment transport events, (e.g., landslides, debris flows, and debris jam failure) that may result in blockage or deflection of channel flow. The upper reaches of La Bonte Creek and Little Deer Creek are described as A-type channels from the Level I geomorphic classification effort. Additionally, the other headwater streams can be assumed to originate in the Laramie Mountains. Streams located within canyons in the watershed could also indicate A-type channels such as Boxelder Creek as shown in Figure 3.101.

B-type channels tend to form downstream of headwater channels, in areas of moderate slope where the watershed transitions from headwater environments to valley bottoms, such as Cottonwood Creek as shown in Figure 3.102. B-type channels are characterized by moderate slopes, moderate entrenchment, and stable channels. Because of the relatively steep channel slopes and stable channel boundaries, B-type channels are moderately resistant to human impacts; although, their reduced slopes

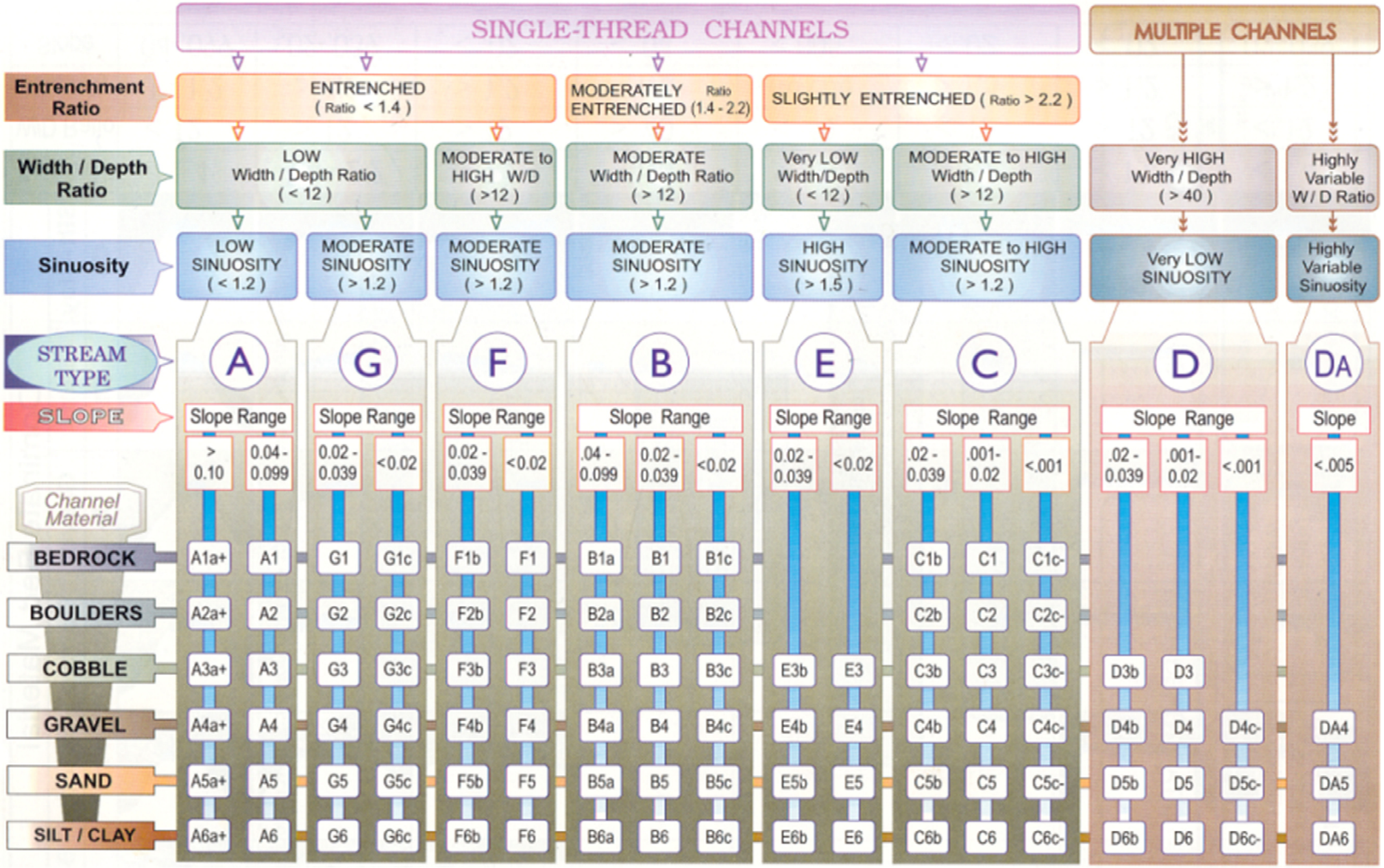


Figure 3.99. Rosgen Classification System Matrix [Rosgen, 1996].

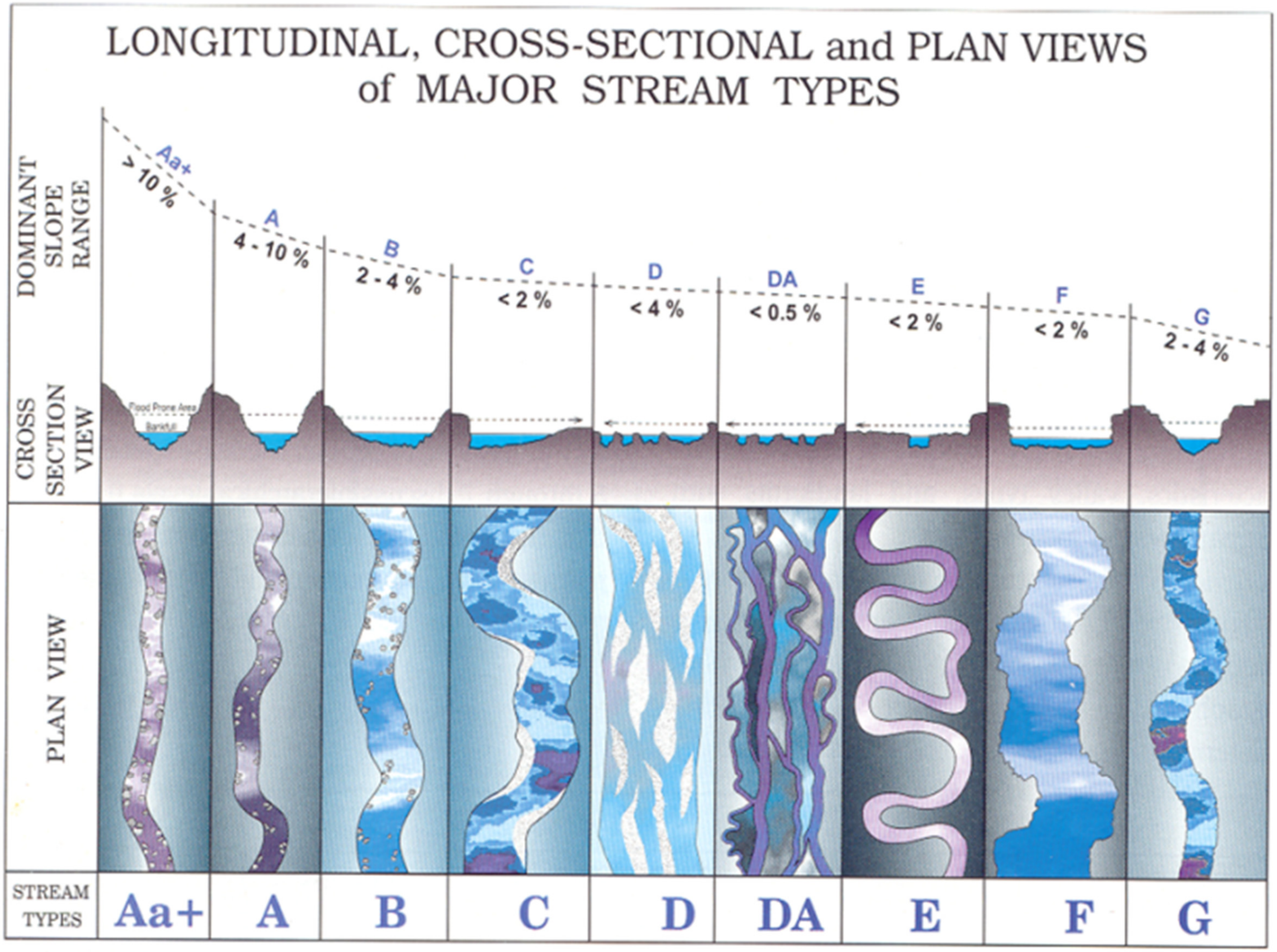


Figure 3.100. Major Stream Types Within the Rosgen Classification System.

Figure 3.101. Example of an A-Type Channel: Boxelder Creek.

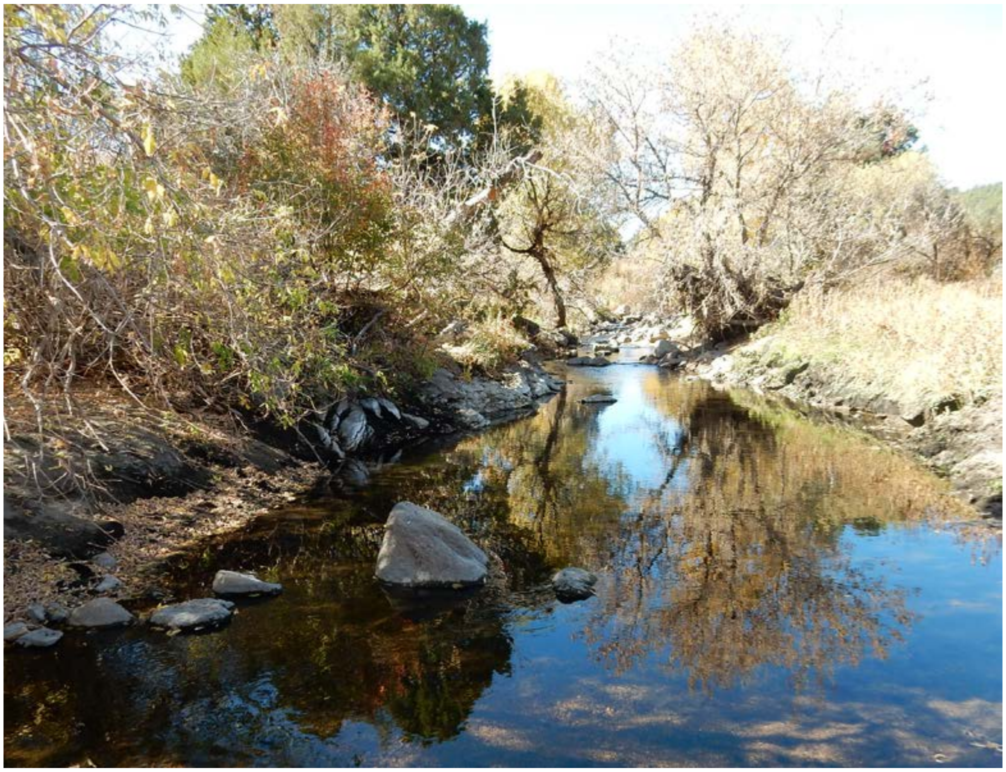


Figure 3.102. Example of a B-Type Channel: Cottonwood Creek.

relative to headwater areas can make them prone to sediment deposition and subsequent adjustment after a large sediment transport event (e.g., an upstream landslide, debris flow, or flood). Reaches of Boxelder, Cottonwood, Deer, Elkhorn, La Bonte, La Prele, and Wagon Hound Creeks are described as B-type channels from the Level I geomorphic classification within the study area.

C-type channels are typically characterized by relatively low slopes, meandering planforms (i.e., the shape that would be seen from above, as on a map or aerial photographs), and pool/riffle sequences such as Deer Creek near Glenrock as shown in Figure 3.103. The channels tend to occur in broad alluvial valleys and are typically associated with broad floodplain areas; these channels are not entrenched and still have “access” to their floodplains. C-type channels tend to be relatively sinuous and follow a meandering course within a single channel. In systems where the boundaries of C-type channels consist of alluvial sediments, channels tend to be dynamic and adjust rapidly in response to disturbance. Reaches of the North Platte River and Boxelder, Cottonwood, Deer, Elkhorn, Horseshoe, La Bonte, La Prele, Middle Bear, Muddy, Sage, Spring, Wagon Hound, and Willow Creeks are described as C-type channels from the Level I geomorphic classification within the study area.

D-Type Channels are typically characterized by multiple channels or braided streams with often high width/depth ratio and a gentle stream gradient. These channel types occur occasionally in glacial trough valleys, glacial outwash valleys, broad alluvial mountain valleys, and deltas. These streams also are not incised and can have high bank erosion rates supplying an indefinite amount of sediment resulting in bars and islands that adjust frequently within the channel. There were no channels described as D-type from the Level I geomorphic classification within the study area.

E-type channels are somewhat similar to C-type channels, because they form as single threads with defined, accessible floodplain areas such as Rocky Ford Creek as shown in Figure 3.104. However, E-type channels tend to have fine-grained channel margins, which provide cohesion and support dense bank vegetation. The fine-grained, vegetation-reinforced banks allow for steep banks; very sinuous planforms; and relatively deep, U-shaped channels to develop. E-type channels commonly form in low-gradient areas with fine-grained source areas and mountain meadows. E-type channels tend to have very stable planforms, and efficient sediment transport capacities because of low width/depth ratios. Reaches of Boxelder, Broom, Cole, La Bonte, Sage, Wagon Hound, and Willow Creeks are described as E-type channels from the Level I geomorphic classification within the study area.

F-Type Channels typically have low slopes (< 2 percent), which is similar to C- and E-type channel. The difference between C/E-type channels and F-type channels is entrenchment. F-type channels are entrenched, which means that the floodplain is narrow relative to the channel width. The entrenchment of F-type channels typically indicates a past downcutting event. F-type channels may form in resistant boundary materials (e.g., U-shaped bedrock canyons) and erodible alluvial materials (e.g., arroyos). When the boundary materials are erodible, channel widening occurs in the entrenched channels of Sand Creek, as shown in Figure 3.105. Reaches of Antelope, Broom, Cole, Dry, La Prele, Lost, Sage, Sand, and Willow Creeks are described as F-type channels from the Level I classification within the study area.

G-type channels are narrow, steep, entrenched gullies. G-type channels typically have high bank erosion rates and a high sediment supply. Channel degradation and sideslope rejuvenation processes are typical. No G-type channels were identified within the study area.

Figure 3.103. Example of a C-Type Channel: Deer Creek.

Figure 3.104. Example of an E-Type Channel: Rocky Ford Creek.

Figure 3.105. Example of an F-Type Channel: Sand Creek.

3.7.2.2 *Level I Classification Results*

The results of the Level I classification effort are presented in Table 3.42 and graphically in Figure 3.106. This figure displays a map of the study area and depicts the various stream types as well as the reach designations used in the classification effort. Many of the channels were classified as either F-type channels in at least some portions of their extent. F-type stream classifications denote channels that are entrenched and have “disconnected” from their floodplains, as shown in Figure 3.99. These channels are typically erosive, actively downcutting, or widening. Entrenchment occurs for a variety of reasons, including the presence of erosive soils coupled with land-use practices (e.g., road construction, energy development, and grazing). Observing channel conditions revealed entrenchment that ranged from slight to severe. In the case of many streams in the watershed, channels appear to have stabilized or be in the process of stabilizing after episodes of incision.

3.7.3 Current Channel Conditions

Generally, the river and creeks in the watershed appear stable and functioning. The drought in 2012 combined with increased precipitation and tributary streamflows from 2013 through 2016 likely contributed to changing conditions. Some of the streams that were visited during the inventory had nickpoints and reaches that were adjusting to disturbances from natural and/or man-made events.

Table 3.42. Summary of Rosgen Level I Classification Results (Page 1 of 3)

Stream	Station (Distance from Mouth) Start (mi)	End (mi)	Length (mi)	Sinuosity	Slope (%)	Rosgen Type
Antelope Creek	0.0	10.4	10.4	1.75	0.003	E
	10.4	17.4	7.0	1.42	0.008	F
Box Elder Creek	0.0	13.4	13.4	1.71	0.004	E
	13.4	32.9	19.5	1.30	0.015	C
	32.9	53.3	20.4	1.20	0.018	B
Boxelder Creek	0.0	5.3	5.3	1.24	0.007	C
	5.3	10.2	4.9	1.31	0.010	C
Broom Creek	0.0	13.0	13.0	1.35	0.008	F
	13.0	27.6	14.6	1.44	0.009	E
Cole Creek	0.0	9.7	9.7	1.31	0.007	F
	9.7	20.0	10.3	1.57	0.004	E
	20.0	33.4	13.4	1.60	0.006	E
Cottonwood Creek	0.0	13.3	13.3	1.33	0.005	C
	13.3	29.3	16.0	1.22	0.009	C
	29.3	48.2	18.9	1.22	0.033	B
Cottonwood Creek	0.0	11.3	11.3	1.23	0.009	C
Deer Creek	0.0	9.9	9.9	1.46	0.003	C
	9.9	20.0	10.1	1.26	0.009	C
	20.0	38.8	18.8	1.19	0.017	B
	38.8	53.2	14.4	1.20	0.015	B
Dry Creek	0.0	4.2	4.2	1.32	0.008	F
	4.2	10.5	6.3	1.15	0.038	B
Elkhorn Creek	0.0	11.4	11.4	1.19	0.009	C
	11.4	22.5	11.1	1.25	0.019	B
Horseshoe Creek	0.0	18.6	18.6	1.67	0.004	C
	18.6	33.6	15.0	1.30	0.009	C
	33.6	51.4	17.8	1.22	0.018	B
La Bonte Creek	0.0	13.7	13.7	1.66	0.003	E
	13.7	25.1	11.4	1.24	0.009	C
	25.1	35.4	10.3	1.11	0.022	B
	35.4	47.5	12.1	1.14	0.026	A
La Prele Creek	0.0	24.5	24.5	1.79	0.005	F
	24.5	45.2	20.7	1.32	0.012	C
	45.2	57.9	12.7	1.14	0.027	B
Little Cottonwood Creek	0.0	7.9	7.9	1.32	0.013	C

Table 3.42. Summary of Rosgen Level I Classification Results (Page 2 of 3)

Stream	Station (Distance from Mouth)		Length (mi)	Sinuosity	Slope (%)	Rosgen Type
	Start (mi)	End (mi)				
Little Deer Creek	0.0	6.9	6.9	1.46	0.016	E
	6.9	13.8	6.9	1.14	0.042	A
Lost Creek	0.0	10.1	10.1	1.51	0.003	F
	10.1	25.5	15.4	1.68	0.002	F
	25.5	34.1	8.6	1.44	0.009	C
Middle Bear Creek	0.0	6.8	6.8	1.09	0.011	C
	6.8	15.1	8.3	1.15	0.015	C
Muddy Creek	0.0	17.5	17.5	1.48	0.003	E
	17.5	33.4	15.9	1.45	0.004	E
	33.4	41.8	8.4	1.21	0.014	C
North Platte River	0.0	55.1	55.1	1.29	0.001	C
	55.1	103.7	48.6	1.24	0.001	C
	103.7	140.5	36.8	1.24	0.001	C
Sage Creek	0.0	12.8	12.8	1.27	0.003	F
	12.8	28.8	16.0	1.74	0.003	E
	28.8	38.6	9.8	1.23	0.012	F
Sand Creek	0.0	10.7	10.7	1.44	0.004	F
	10.7	21.2	10.5	1.63	0.004	F
	21.2	30.9	9.7	1.34	0.008	F
Sand Creek	0.0	7.4	7.4	1.29	0.005	F
	7.4	13.4	6.0	1.31	0.013	F
Sand Creek	0.0	4.4	4.4	1.40	0.009	F
	4.4	9.5	5.1	1.19	0.023	F
Shawnee Creek	0.0	7.7	7.7	1.99	0.003	E
	7.7	13.3	5.6	1.44	0.003	E
Spring Creek	0.0	4.9	4.9	1.10	0.011	C
	4.9	11.4	6.5	1.24	0.016	C
Spring Creek	0.0	7.4	7.4	1.16	0.014	C
	7.4	19.6	12.2	1.30	0.016	C
Wagon Hound Creek	0.0	14.3	14.3	1.81	0.005	E
	14.3	30.4	16.1	1.65	0.004	E
	30.4	43.7	13.3	1.17	0.029	B
West Fork Deer Creek	0.0	6.1	6.1	1.16	0.012	E
West Fork La Bonte Creek	0.0	12.4	12.4	2.14	0.004	E
	12.4	19.0	6.6	1.13	0.036	C
	19.0	26.9	7.9	1.12	0.019	B

Table 3.42. Summary of Rosgen Level I Classification Results (Page 3 of 3)

Stream	Station (Distance from Mouth)		Length (mi)	Sinuosity	Slope (%)	Rosgen Type
	Start (mi)	End (mi)				
Willow Creek	0.0	9.0	9.0	1.29	0.015	C
Willow Creek	0.0	13.0	13.0	1.37	0.006	F
	13.0	24.8	11.8	1.66	0.004	E
	24.8	33.9	9.1	1.33	0.012	F

Typically, field visits that were conducted on participating landowners' properties involved inventorying a failing irrigation diversion structure. These failing structures often had an effect downstream and/or upstream on stability that caused degradation that involved entrenchment of streambeds, loss of aquatic habitat, and vertical instability as presented in Section 3.4.7. Some channel reaches also lacked adequate vegetative cover to protect banks and resist erosion during runoff as evidenced by eroding banks and absence of riparian-wetland plants.

Stream restoration efforts are often promoted to increase channel stability and reconnect the channel to its historic floodplain, which requires raising the channel bed through grade controls, channel infilling, or reconstructing a new channel. However, these approaches can be difficult and costly. Another approach to incised channel stabilization is to armor the channel banks and install grade-control structures. This process will reduce sediment inputs but will not establish a dynamic, functional channel.

Perhaps the most geomorphically beneficial approach to incised channel restoration is to support the natural recovery process of channel widening and incised floodplain development. This support can be achieved by encouraging the development of a new floodplain surface adjacent to the channel to provide an area for flood energy dissipation and new riparian corridor establishment. Any work within incised channels requires an assessment of the status of the current channel stability so that the potential for further downcutting is known and accommodated for in the channel restoration design.

3.8 WATER QUALITY

3.8.1 Stream Classifications

The Water Quality Division of the WDEQ has classified 72 surface waterbodies in the watershed for water quality standards designation and attainment. Table 3.43 shows the use designation associated with each classification. Table 3.44 shows the waterbody count by surface-water classification within the study area as defined in the WDEQ's Water Quality Rules and Regulations, Chapter 1 [WDEQ, 2013].

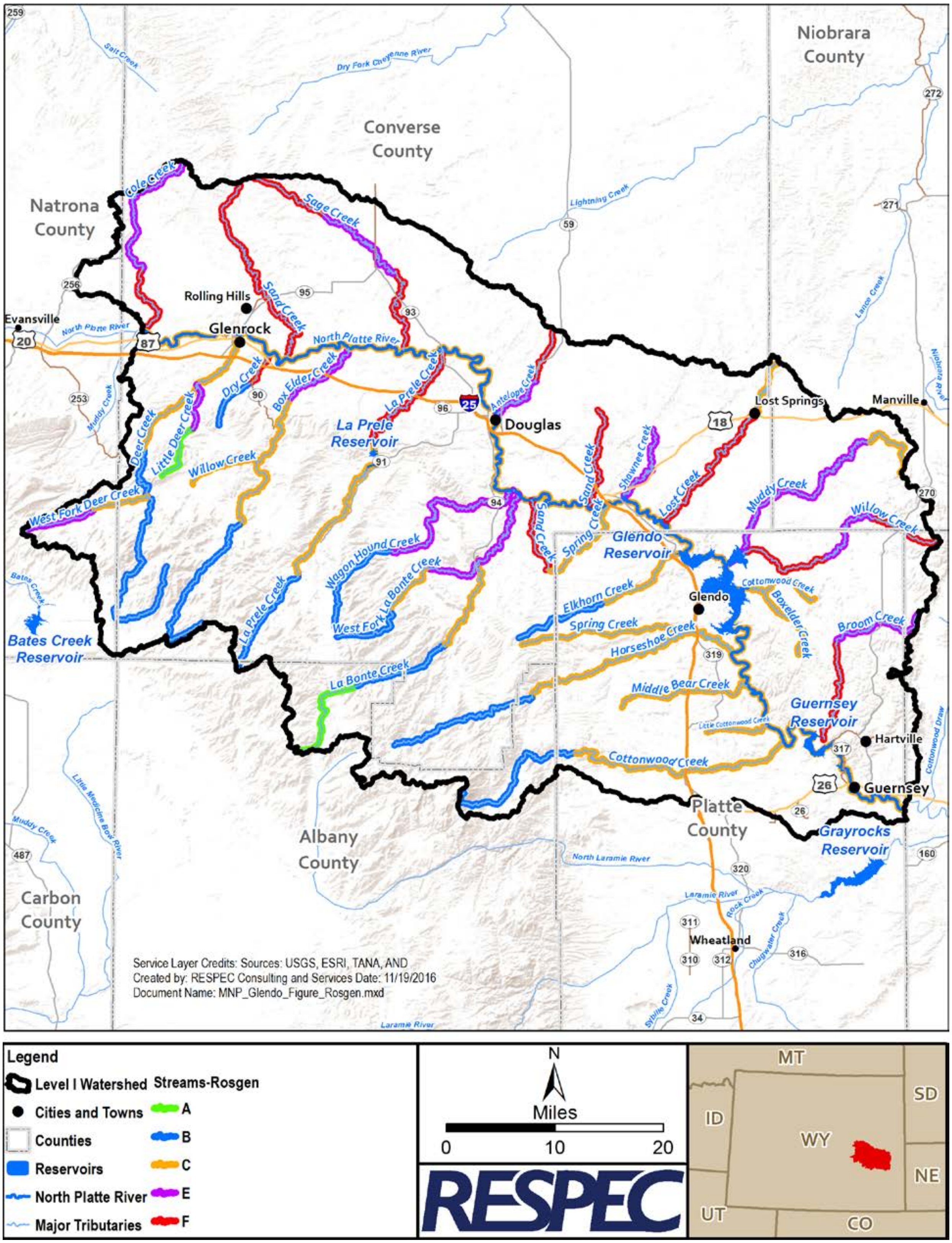


Figure 3.106. Rosgen Stream Classifications Within the Watershed.

Table 3.43. Wyoming Surface Water Classification and Use Designations

Designated Use	Surface Water Classification										
	1	2AB	2A	2B	2C	3A	3B	3C	4A	4B	4C
Drinking Water	X	X	X								
Game Fish	X	X		X							
Nongame Fish	X	X		X	X						
Fish Consumption	X	X		X	X						
Other Aquatic Life	X	X	X	X	X	X	X	X			
Recreation	X	X	X	X	X	X	X	X	X	X	X
Wildlife	X	X	X	X	X	X	X	X	X	X	X
Agriculture	X	X	X	X	X	X	X	X	X	X	X
Industry	X	X	X	X	X	X	X	X	X	X	X
Scenic Value	X	X	X	X	X	X	X	X	X	X	X

Table 3.44. Surface Water Classifications Within the Study Area

Surface-Water Classification	Waterbody Type	
	River, Stream, Creek, or Draw	Reservoir, Pond, Pit, Dam, or Lake
2AB	27	2
2C	1	0
3B	41	1
4C	0	0
Total	**69**	**3**

3.8.1.1 *Wyoming Department of Environmental Quality North Platte River Assessment*

In 2007, the WDEQ performed a water quality conditions report of the North Platte River, which gathered water quality monitoring data; identified potential causes and sources of excess sediment, and evaluated the chemical, physical, and biological condition of the river to assess the degree of designated use support [WDEQ, 2007]. The WDEQ assessment indicated that the stretch of the North Platte River, which extends through the study area, is classified as a Class 2AB water. Eight of the monitoring locations that were included in the assessment are within the study area, including three water quality stations from the WDEQ; four additional WDEQ stations that collect chemical, physical, and biological data; and one USGS station. Water quality results indicated that water temperatures on dates sampled were below the WDEQ/WQD maximum criteria of 20 degrees Celsius for a cold-water fishery and that dissolved oxygen concentrations were above the acceptable one-day minimum (8 milligrams per liter [mg/L]) [WDEQ, 2007]. Concentrations of nitrate-nitrogen and total phosphorus were below a detectable range at the WDEQ water quality station; however, single sample total phosphorus results collected from the USGS gage station upstream from Glendo Reservoir exceeded the maximum concentration.

The WDEQ used the large river qualitative habitat assessment procedure [WDEQ/WQD, 2004] to evaluate the habitat condition, streambanks, channel morphology, sediment supply, and stream stability for stations within each segment. All of the segments of the North Platte River within the study area were considered to have stable streambanks with adequate riparian vegetation and coarse material to protect the banks and minimize erosion during high flows. At station NGP193, which is located upstream from Glendo Reservoir, coarse materials were embedded by fine sediment. The WDEQ suspected that this was caused by a reduction in natural sediment transport and highly influenced by controlled releases from upstream reservoirs, irrigation diversions, and stormwater drains from the cities of Casper and Douglas. Upstream and downstream from the site, newly deposited mid-channel and point bars in addition to embedded riffles were observed, which suggested that sedimentation is occurring.

Fluctuations in reservoir releases in addition to irrigation return flows have caused changes in channel morphology, contributing to sediment deposition. Evidence of the effects of variable high flows shows an increase in near-bank stress, which result in scour, bank erosion, and ultimately deposition [WDEQ, 2007]. Consequently, controlled flows and water released from Glendo Dam facilitate sediment deposition zones just upstream from Guernsey Reservoir. Thus, the state practices the annual Guernsey silt run, which flushes Guernsey Reservoir in early July and last for several days, to remove the accumulated sediment in Guernsey Reservoir and to seal downstream irrigation canals. Further downstream from Guernsey Reservoir, excessive amounts of sedimentation are observed in the river and streambank stability declines.

3.8.1.2 *Wyoming Department of Environmental Quality Horseshoe Creek Assessment*

In 2004, the WDEQ performed a monitoring and assessment report of a 6.2-mile segment, Segment 064, along Horseshoe Creek, just upstream from the confluence with the North Platte River. This report gathered water quality monitoring data; identified potential causes and sources of excess sediment; and evaluated the chemical, physical and biological condition of the creek to assess the degree of designated-use support [WDEQ, 2004]. The WDEQ assessment determined that Segment 064 fully supports drinking water, wildlife, industrial, aesthetic value, agricultural, and fish-consumption uses; this segment also is classified as Class 2AB water.

At two monitoring points (WHP29 and WHP 31), which are located upstream from the confluence of Spring Creek, streambanks were considered stable with nonexcessive grazing and irrigation disrupting the riparian zones. Additionally, water quality parameters did not exceed existing Class 2AB water standards on the dates of sampling. Oil and grease concentrations were also tested at WHP29 and WHP31. Both tests did not indicate hydrocarbon contamination, and both were below the Wyoming surface-water standard of 10 mg/L.

Portions of Segment 064, which is 4-5 miles downstream from the confluence of Spring Creek, has the potential to become dry because of irrigation diversions and/or pumping of alluvial groundwater wells [WDEQ, 2004]. Therefore, this section is nonsupportive of cold-water fisheries, nongame fisheries, and aquatic life other than fish. Observations from the WDEQ April 2004 reconnaissance suggest that streambanks downstream from the confluence of Spring Creek to station WHP30 have a fair to moderate degree of stability. Portions of this segment experience excessive grazing and contain irrigated diversions, which tend to accelerate erosion or cause streambank failure during high flows. Sections that are susceptible to drying during the irrigation season have shown historical downcutting and widening of the reach channel bed. The WDEQ suspects that the changes in channel structure are a response to fluctuations in the natural flow regime caused by the influence of irrigation diversions.

By the final station WHP30, which is located just upstream from the confluence with the North Platte River, streambanks were considered stable and not actively eroding. Water quality parameters at station WHP30 revealed an elevated concentration of oil and grease. Although these concentrations were still below the 10 mg/L standard, the field observations from the 1999 assessment and 2004 reconnaissance did not identify any potential source for oil or grease upstream from WHP30. This section of Horseshoe Creek is located in a broad valley and was described as a sand-dominated Rosgen C5 stream type [WDEQ, 2004].

3.8.2 Wyoming Pollutant Discharge Elimination System Permitted Discharges

The watershed has 20 Wyoming Pollution Discharge Elimination System (WYPDES) point-source discharge permits with a total of 68 outfalls. A list of WYPDES permits is shown in Table 3.45. Of the WYPDES permits, four are listed as Sanitary Wastewater permits: Town of Douglas (WY0020109), Town of Glenrock (WY0020630), Town of Hartville (WY0021440), and Town of Guernsey (WY0021831). No Municipal Separate Storm Sewer Systems (MS4s) are in the watershed.

3.8.3 Waters That Require Total Maximum Daily Loads

No waterbodies are listed as impaired in the state of Wyoming's 2014 Integrated Report in the watershed, and beneficial uses for all of the streams are fully supported [WDEQ, 2014]. In 2004, Horseshoe Creek was added to Category 4C because several miles of the lower creek may dry due to irrigation withdrawals. However, aquatic life other than fish and cold-water fishery uses are fully supported on Horseshoe Creek from the confluence with the North Platte River upstream to approximately 2.3 miles and from the confluence with Spring Creek to a point approximately 12.5 miles upstream. This section of the creek does not require a TMDL.

3.9 WATER STORAGE

Water-storage development within the watershed has been impacted by institutional constraints related to the 2001 Modified Decree and/or the Platte River Recovery and Implementation Program (PRRIP), which limits the opportunity to create new reservoir projects or increase existing storage reservoirs through enlargement. Because of these constraints, the water-storage investigations focused on existing stock ponds and potential upland water-storage facilities less than 20 acre-feet. Water users identified problems with some existing reservoirs that limit the potential to store water in these facilities. Field visits and initial assessments were conducted on some of the stock ponds, stock reservoirs, and irrigation reservoirs that were identified by participants and are included in Chapter 4.0. Additionally, storage reservoirs within the watershed that have been the subject of past studies are summarized in Section 3.9.3 of this report.

Table 3.45. Wyoming Department of Environmental Quality's Wyoming Pollutant Discharge Elimination System Permitted Discharges Within the Watershed

WYPDES Permit Number	Permittee	Facility Name	Permit Type	Outfalls
WY0000710	Linc Energy Petroleum (Wyoming), Inc.	East Unit, Big Muddy Field	Oil Treaters	1
WY0000914	Linc Energy Petroleum (Wyoming), Inc.	Glenrock Block B Unit State 8	Oil Treaters	1
WY0001287	Tallgrass Midstream, LLC	Douglas Gas Plant	Industrial	1
WY0001287	Tallgrass Midstream, LLC	Douglas Gas Plant	Industrial	2
WY0001287	Tallgrass Midstream, LLC	Douglas Gas Plant	Industrial	3
WY0003115	Pacificorp	Dave Johnston Power Plant	Industrial	22
WY0003115	Pacificorp	Dave Johnston Power Plant	Industrial	7
WY0003115	Pacificorp	Dave Johnston Power Plant	Industrial	11
WY0003115	Pacificorp	Dave Johnston Power Plant	Industrial	8
WY0020109	Douglas, Town of	Douglas Wastewater Lagoon	Sanitary Wastewater	1
WY0020630	Glenrock, Town of	Glenrock Wastewater Lagoon	Sanitary Wastewater	1
WY0021440	Hartville, Town of	Hartville Wastewater Treatment	Sanitary Wastewater	1
WY0021831	Guernsey, Town of	Guernsey Wastewater Lagoon	Sanitary Wastewater	1
WY0026573	Vortex Petroleum, Inc.	SBMWCSU Tank Battery	Oil Treaters	1
WY0032492	Martin Marietta Materials, Inc.	Limestone Quarry	Industrial	1
WY0035777	Phillips 66 Company	Former Conoco Glenrock Refinery	Industrial	1
WY0050326	Wagonhound Land and Livestock Company	River Feedlot	CAFO	2
WY0050326	Wagonhound Land and Livestock Company	River Feedlot	CAFO	1
WY0050954	Wagonhound Land and Livestock Company	Morton Ranch Feedlot	CAFO	1
WY0056006	Douglas, Town of	Douglas Water Treatment Plant Upgrades	Water Treatment Plant	1

3.9.1 Major Reservoirs

The Wyoming SEO developed a list of major reservoirs within the Platte River Basin; this list requires that a reservoir have a storage capability of 1,000 acre-feet or greater and serve multiple uses. Three reservoirs in the study area are considered major: Glendo Reservoir, Guernsey Reservoir, and LaPrele Reservoir. These reservoirs are shown in Figure 3.107, and their permits, uses, and capacities are listed in Table 3.46.

3.9.1.1 *Glendo Reservoir*

Glendo Reservoir is the largest water-storage facility within the study area and is located on the North Platte River northeast of Glendo, Wyoming. The reservoir is part of the USBR's Glendo Unit and was constructed between 1954 and 1958 to work in conjunction with the North Platte and Kendrick Projects. The Glendo Unit is a multipurpose facility that provides storage for irrigation, flood control, sediment retention, recreation, power generation, fish and wildlife enhancement, and municipal and industrial water supply in the North Platte River Valley [USBR, 2007]. The Glendo Unit has six major project features including: Glendo Dam, Glendo Reservoir, Glendo Power Plant, Gray Reef Dam, Gray Reef Reservoir, and the Fremont Canyon Powerplant. Glendo Reservoir provides supplemental irrigation water to 37,251 acres in Nebraska and Wyoming as well as two powerplants with a generating capacity of 104.8 megawatts and provide power to Colorado, Nebraska, and Wyoming [USBR, 1997].

Historically, Glendo Reservoir was designed to reduce the loss of capacity in Guernsey Reservoir that was caused by silting and to increase hydroelectric power. The Glendo Dam and Reservoir design plans and investigation began in 1944; however, construction did not begin until 1954 [USBR, 2004]. Because of concerns of reduced flow downstream into Lake McConaughy in Nebraska and a request for more water from the headwaters of the North Platte River in Colorado, a conflict between the three states prolonged the construction of Glendo Reservoir and Dam. By 1954, Congress reauthorized building Glendo Reservoir after a definite plan was agreed upon by each state. Glendo Reservoir has a permitted capacity of 800,000 acre-feet divided into 100,000 acre-feet for irrigation; 115,000 acre-feet for sediment control; 275,000 acre-feet for flood control; and 310,000 acre-feet for power production. Glendo Reservoir's dam and outlet works are shown in Figure 3.108 and Figure 3.109.

Today, Glendo Reservoir has a total storage capacity of 763,039 acre-feet at a maximum water-surface elevation of 4,653 feet. This capacity includes 440,449 acre-feet allocated for active conservation, such as recreation, fish and wildlife, industrial, municipal, and irrigation; 271,017 acre-feet for flood control; and an additional 329,251 acre-feet for surcharge before reaching the dam crest at 4,675 feet. Figure 3.109 illustrates the allocations for Glendo Reservoir [USBR, 2012].

The USBR has reservoir data records for Glendo Reservoir dating back to 1958. As shown in Figure 3.109, reservoir storage varies considerably throughout a water year and by year because irrigation demands, evaporation, and wet and dry cycles significantly impact the volume of water stored in Glendo Reservoir.

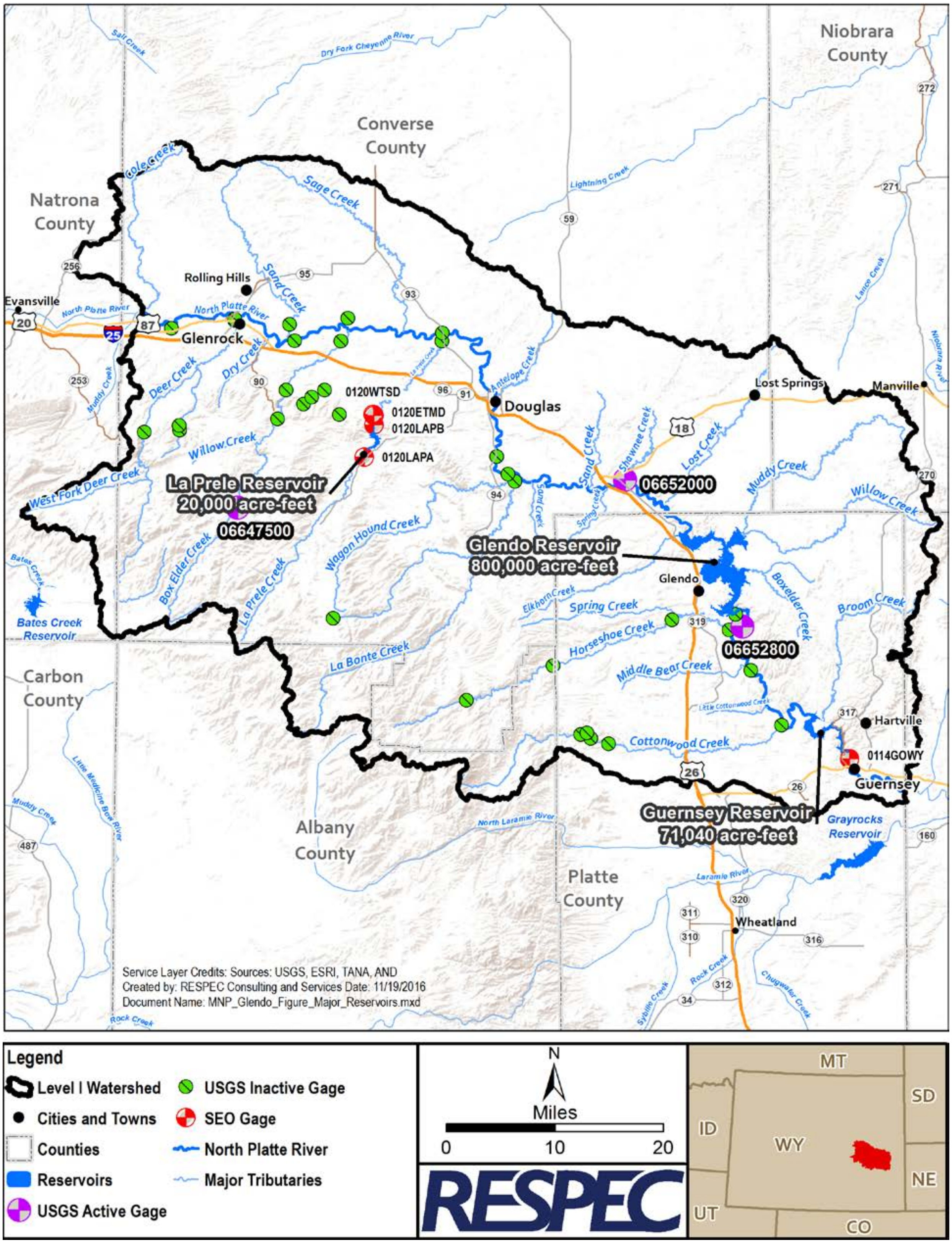


Figure 3.107. Major Reservoirs Within the Watershed.

Table 3.46. Major Reservoirs Within the Study Area

Water-Right Number	Reservoir Name	Uses	Capacity (acre-feet)	Latitude	Longitude
P5998R	Glendo Reservoir	Irrigation; powerplant	800,000	41.69061	–106.08738
P3905R	Guernsey Reservoir	Irrigation; powerplant	71,040	41.61433	–106.09431
P728R/P1581R	LaPrele Reservoir	Industrial; irrigation; domestic	20,000	41.45249	–106.2775

Figure 3.108. View of Glendo Dam and Reservoir (Looking Upstream).

Figure 3.109. Existing Outlet Works for the Glendo Reservoir.

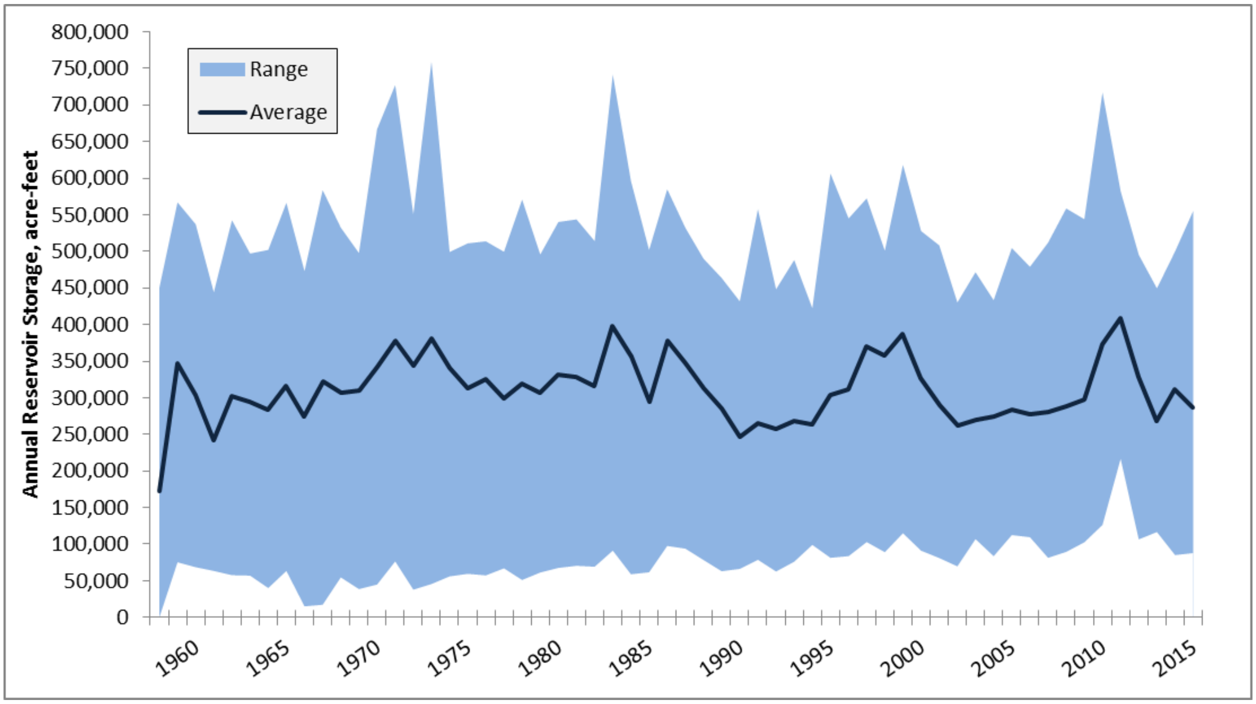


Figure 3.110. Annual Water Storage in Glendo Reservoir.

Inflows to Glendo Reservoir are extremely variable; the highest inflows occurred in water year 2011 at 2,482,256 acre-feet and the lowest inflow occurred in water year 2004 at 619,361 acre-feet. For the period of record for Glendo Reservoir (1958–2015 full water-year data), the watershed yield has averaged 1,163,810 acre-feet per water year (October 1 to September 30). Inflows are presented as computed inflow with evaporation as part of the equation to compute inflows.

During dry periods when inflows are computed for Glendo Reservoir with evaporation as part of the computation, flows may become negative; although, in the data history of Glendo Reservoir's inflow, this rarely happens. Reservoir storage fluctuates seasonally because of spring inflows, summer and fall irrigation release, and evaporation, which results in an average annual storage change of 458,111 acre-feet. Snowmelt and thunderstorms create the largest inflows during late spring into summer months. The largest outflows occur in July through September during irrigation season. Average monthly inflows and outflows to Glendo Reservoir can be found in Table 3.47. Note that inflows are calculated rather than measured.

Table 3.47. Glendo Reservoir Average Monthly Inflow and Outflow Volumes (1958–2015)

Month	Average Monthly Volumes (acre-feet)	
	Inflow	Outflow
January	51,094	1,137
February	50,942	4,781
March	70,208	26,372
April	111,019	62,071
May	175,214	131,741
June	158,036	163,887
July	152,085	303,541
August	133,606	298,632
September	87,340	130,901
October	67,316	3,353
November	57,402	1,693
December	49,548	1,208

3.9.1.2 *Guernsey Reservoir*

The Guernsey Reservoir is the farthest downstream federal reservoir on the North Platte River in Wyoming. The reservoir is located approximately 24 miles downstream from Glendo Dam and 95 miles southeast of Casper. The Guernsey Dam, Guernsey Reservoir, and a powerplant with two 3.2 megawatt generating units are part of the USBR's North Platte Project. The dam and powerplant were completed in 1928 [USBR, 1996]. Guernsey Reservoir's dam and outlet works are shown in Figure 3.111 and Figure 3.112.

The reservoir was originally equipped to hold 73,810 acre-feet of water to regulate flow released from Pathfinder Reservoir. However, this amount was greatly reduced because of sediment deposition; by the 1970s, this volume was reduced to 45,612 acre-feet. In response to the high sediment load carried into the reservoir, the USBR began practicing the Guernsey "silt run" in 1936, which lowers the water storage of Guernsey Reservoir to flush deposited sediments downstream over a 7-day period. In addition, the sediment release is also diverted into downstream irrigation canals to reduce canal seepage loss and increase the canal bank stability.

The USBR has reservoir data records for Guernsey from 1946 to present. Similar to Glendo Reservoir, storage in Guernsey Reservoir fluctuates significantly throughout the year, as shown in Figure 3.113. Data records include multiple minimum storage levels recorded at or near zero acre-feet with an annual average storage range of 37,650 acre-feet. Spring inflow, controlled releases for summer and fall irrigation, evaporation, and the Guernsey "silt run" heavily influence levels stored within the reservoir.

In addition, data records show a decrease in average storage during the beginning of the period of record because of sediment deposition that reduces the maximum capacity of the reservoir.

Figure 3.111. Downstream View of Guernsey Reservoir Dam and Existing Outlet Works.

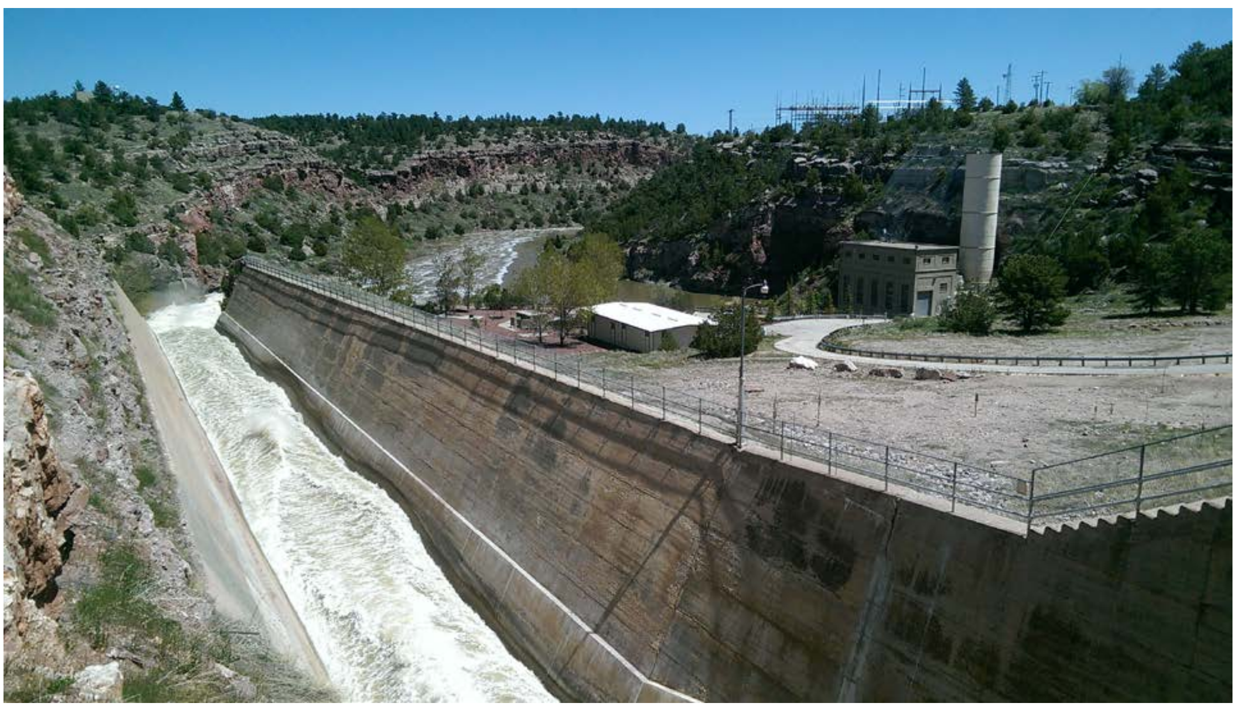


Figure 3.112. Downstream View of Existing Outlet Works From Guernsey Reservoir Dam.

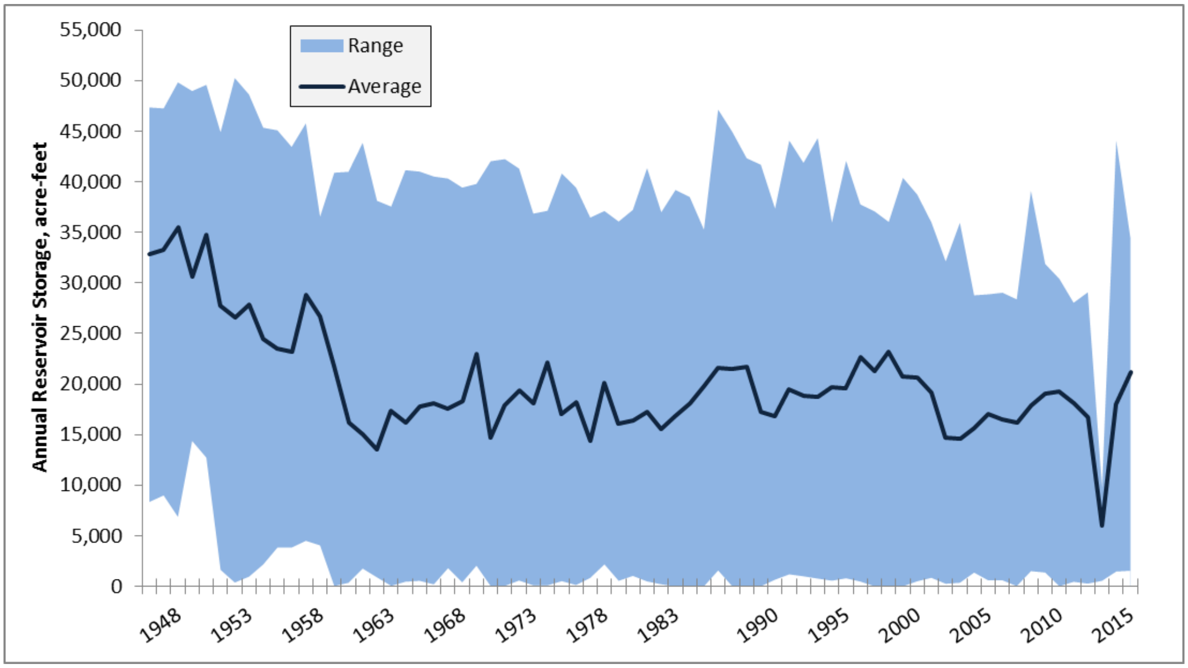


Figure 3.113. Annual Water Storage in Guernsey Reservoir.

For the period of record for Guernsey Reservoir (1946–2015 full water-year data), the watershed yield averaged 1,146,384 acre-feet. Inflows to Guernsey Reservoir are also extremely variable with the highest inflow in water year 2011 (2,506,407 acre-feet) and lowest inflow during water year 2004 (633,739 acre-feet). Influences from snowmelt and runoff during the peak storm season result in the largest inflows to Guernsey Reservoir during spring and summer months and peaking in July. Largest outflows occur during the irrigation season, with greatest flow from July to September. The average monthly inflows and outflows to Guernsey Reservoir are shown in Table 3.48.

Table 3.48. Guernsey Reservoir Average Monthly Inflow and Outflow Volumes (1946–2015)

Month	Average Monthly Volumes (acre-feet)	
	Inflow	Outflow
January	3,869	1,716
February	6,807	3,186
March	25,820	20,695
April	61,113	54,115
May	139,563	134,769
June	167,463	167,619
July	295,741	306,412
August	292,703	287,221
September	135,399	151,432
October	8,568	9,552
November	5,146	2,410
December	4,194	2,156

3.9.1.3 *LaPrele Reservoir*

The LaPrele Reservoir is located in Section 21 of Township 32 North, Range 73 West in Converse County and is owned and operated by the LID. The reservoir and dam lie across La Prele Creek, 11 miles southwest of Douglas, and provide an adjudicated 20,000 acre-feet storage capacity to over 11,400 irrigated acres downstream within the LID. Table 3.49 summarizes the reservoir's permitted facilities. LaPrele Reservoir's dam and outlet works are shown in Figures 3.114 through 3.115. Detailed information about the LID and its facilities was discussed in Section 3.4.4.

A flood on La Prele Creek in 1970 nearly overtopped the dam, which caused the Wyoming State Engineer to restrict the reservoir's storage capacity. In 1975, the LID and the Panhandle Eastern Pipeline Company entered into an agreement to repair the dam and reservoir, and restrictions were lifted in 1983 [SCS, 1990]. In 2014, the dam and reservoir facilities were inspected by the SEO, which used a remote-operated vehicle to aid the inspection. However, issues still exist with the operation of the reservoir's outlet facilities along with site access, sedimentation, and shoreline erosion.

The data from the SEO gage stations above the reservoir (Station 0120LAPA) and below LaPrele Reservoir (Station 0120LAPB) from 2009 to present were obtained and are presented in Figure 3.118 and summarized in Table 3.50. Influences from snowmelt, runoff, and early spring storms result in the largest inflows to LaPrele Reservoir during the spring and peaking in May. The largest average outflows from LaPrele Reservoir are also in May, but an elevated flow continues throughout the irrigation season.

Table 3.49. Summary of LaPrele Reservoir's Permitted Facilities

Reservoir Name	LaPrele Reservoir	LaPrele Reservoir, Enlargement
Applicant Name	LaPrele Irrigation District	LaPrele Irrigation District
Permit	P728R	P1581R
Enlargement capacity (acre-feet)		4,894.0
Total capacity (acre-feet)	15,106.00	20,000.0
Priority Date	9/21/1905	July 7, 1909
Source	La Prele Creek	La Prele Creek
Use	Irrigation, domestic, industrial	Irrigation, domestic, industrial
Outlet Works Description	The outlet consists of three 3-foot pipes. The outlet material is sandstone and limestone.	The outlet consists of four steel gates that are 5 feet in diameter. The outlet material is solid granite.
Spillway Description	The spillway is 100 feet long by 3 feet deep through solid rock.	The spillway is composed of five sections, each 4 feet high by 17 feet wide. The total width of the spillway is 85 feet.

Figure 3.114. Existing Outlet Pipe for the LaPrele Reservoir.

Figure 3.115. View of LaPrele Reservoir From the Dam.

Figure 3.116. View From Inside the Hollow Reinforced Concrete Dam of LaPrele Reservoir.

Figure 3.117. Downstream View of the Upper End of LaPrele Reservoir.

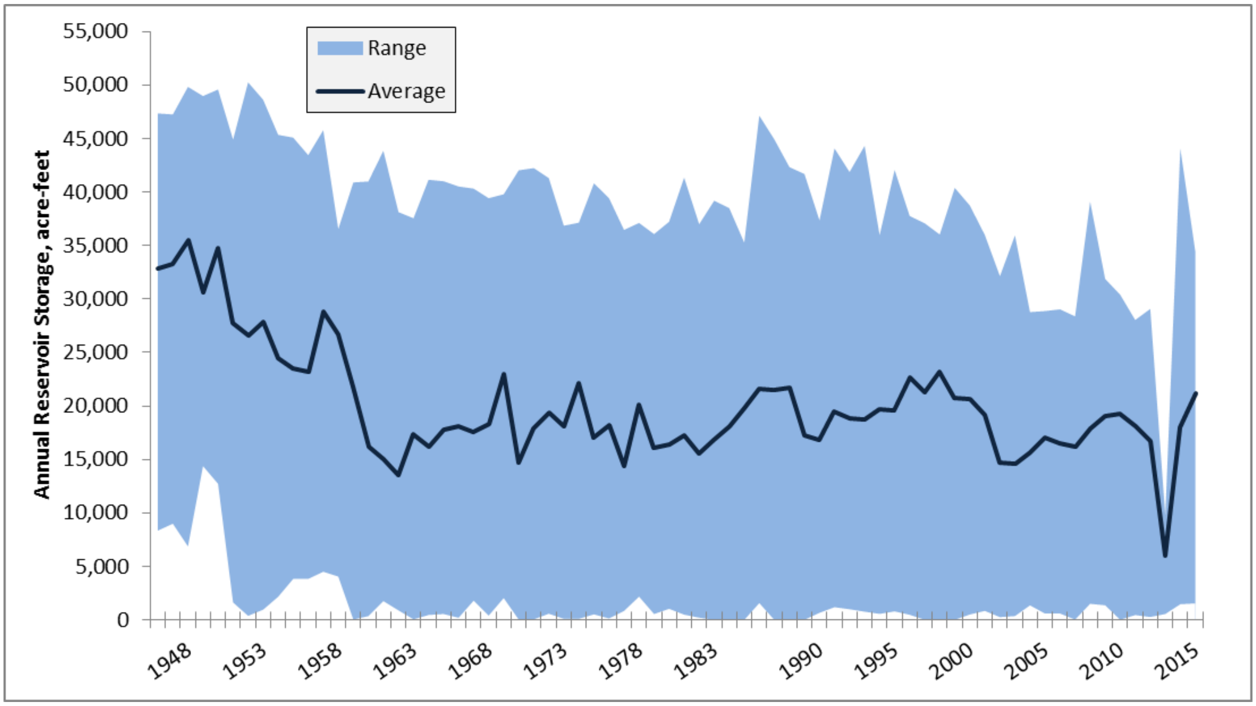


Figure 3.118. Annual Water Storage in LaPrele Reservoir.

Table 3.50. LaPrele Reservoir Average Monthly Inflow and Outflow Volumes (2009–2016)

Month	Average Monthly Volumes (acre-feet)	
	Inflow	Outflow
January	1,405	52
February	1,349	70
March	2,521	95
April	9,257	1,549
May	16,474	10,942
June	4,449	7,412
July	1,290	3,720
August	828	5,105
September	634	1,869
October	1,659	40
November	1,494	38
December	1,442	47

3.9.2 Minor Reservoirs and Stock Ponds

Approximately 758 ponds and reservoirs are permitted by the SEO, as shown in Figure 3.119, within the study area. Of these facilities, approximately 396 have a storage capacity from 1 to 19 acre-feet, while another 125 reservoirs range in capacity from 20 acre-feet–650 acre-feet. Another 237 ponds and reservoirs have a capacity of less than 1 acre-foot. These ponds and reservoirs were evaluated during field inventories, discussed with participating landowners, and examined by using high-resolution aerial imagery to determine their viability as water sources within the watershed. Also, the mapping indicated that 116 (15.3 percent) of the permitted facilities were dry and held no water, while 3 of the facilities had breached dams or spillways.

Approximately 433 of the 758 permitted ponds and reservoirs within the watershed were approved solely as stock reservoirs. Of the 396 facilities with a capacity from 1–19 acre-feet, approximately 280 were permitted exclusively as stock reservoirs. Also, 14 of the 125 facilities with a capacity of 20--650 acre-feet were permitted as stock reservoirs. Additionally, approximately 139 of the 237 facilities with a capacity of less than 1 acre-foot were permitted by the SEO as stock reservoirs. The permitted minor reservoirs within the study area have a combined potential storage of 11,427 acre-feet. Priority dates for the permitted pond and reservoir facilities range from 1896 to 2016.

3.9.2.1 *Westfork No. 1 Reservoir (Blue Downey Park Reservoir)*

Blue Downey Park Reservoir is a small fishing, livestock, and wildlife reservoir in Downey Park of the Laramie Range. The reservoir was originally permitted as Westfork No. 1 Reservoir by the Downey Park Sportsmen's Club for 22.4 acre-feet of storage. The reservoir and dam are located on an unnamed tributary to Rock Ford Creek with a drainage area of about 1,810 acres (2.8 square miles) in the NW ¼ of Section 35 of Township 29 North, Range 74 West in Converse County. Blue Downey Park Reservoir is shown in Figure 3.120.

Constructed in the 1950s with only an earthen spillway for bypassing stream flows, the reservoir is showing signs that it has met or exceeded its life expectancy. The available storage capacity of the reservoir has been significantly reduced by sedimentation (50 percent–66 percent), which leaves the fishery prone to winter kill. More significantly, a headcut is advancing up the earthen spillway from downstream, cutting off fish passage, and threatening to breach the dam [WGFD, 2014]. The headcut is shown in Figure 3.121.

In recent years, different studies have been conducted and projects have been proposed for rehabilitating the existing spillway and reservoir. In their 2013 Strategic Habitat Report, the WGFD described a proposed project to construct a rock chute on the existing spillway to stabilize the headcut [WGFD, 2013]. By 2014, the WGFD began to consider constructing a new dam downstream from the existing reservoir as a more cost-effective alternative [WGFD, 2014]. An engineering consultant was hired to prepare plans for a new dam and released a preliminary plan set in December of 2015, but funding for project construction has not yet been acquired [WGFD, 2015c].

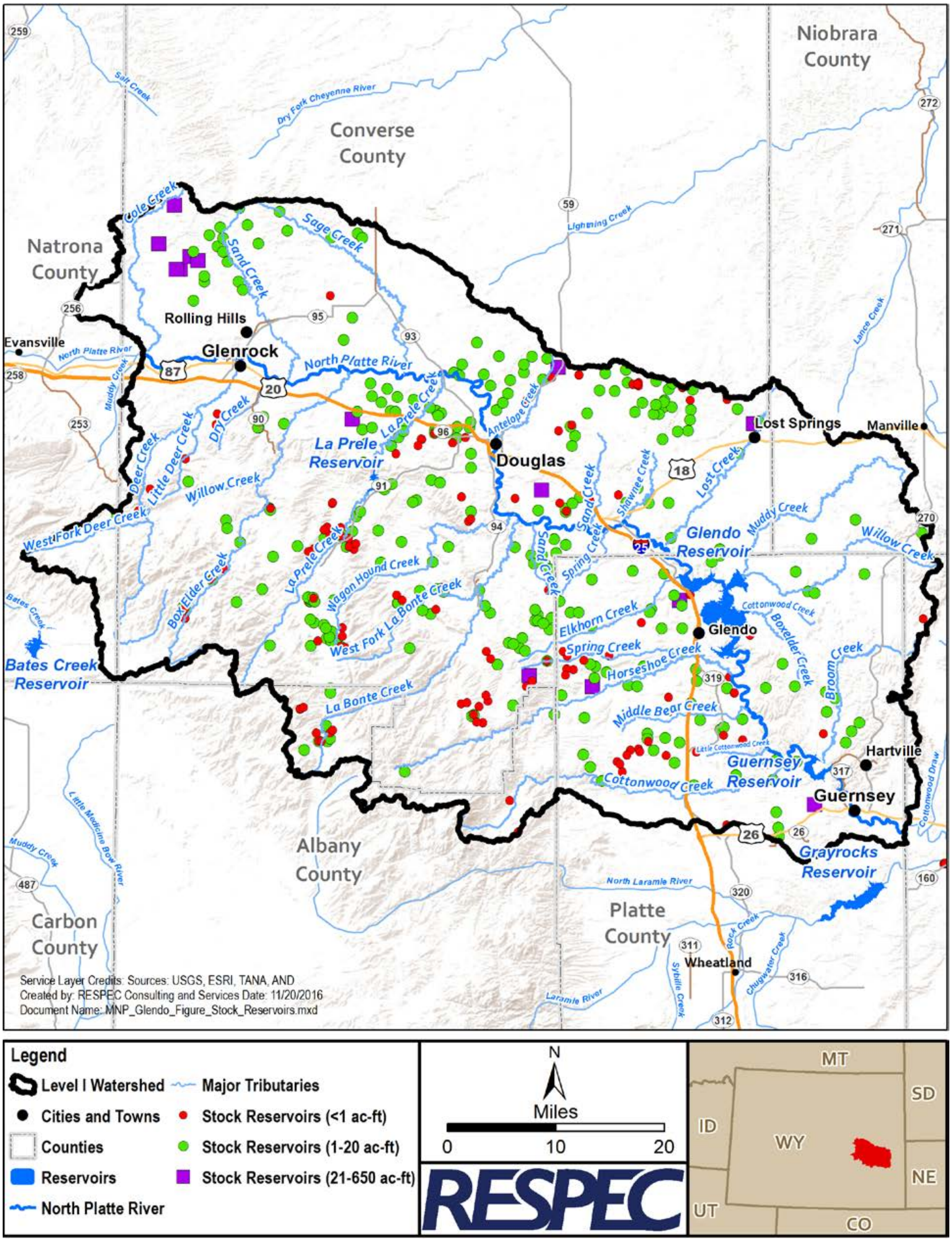


Figure 3.119. State Engineer's Office Permitted Stock Reservoirs Within the Watershed.

Figure 3.120. Westfork No. 1 Reservoir (Blue Downey Park Reservoir).

Figure 3.121. Headcut on the Earthen Spillway of Westfork No. 1 Reservoir (Blue Downey).

3.9.2.2 *Larime No. 1 Reservoir*

The Larime No. 1 Reservoir is a stock dam and reservoir supplying livestock/wildlife water located on Fivemile Creek, which is a tributary to the North Platte River. The reservoir is located in NW¼ of SW¼ of Section 3 of Township 72 North, Range 32 West in Converse County. The reservoir was permitted in 1993 (Permit No. P11848.0S) with a capacity of 3.0 acre-feet. The Larime No. 1 Reservoir is shown in Figure 3.122. Figure 3.123 shows the reservoir's issues with embankment erosion and sedimentation.

Figure 3.122. Downstream View of the Larime No. 1 Reservoir.

Figure 3.123. View of the Embankment Erosion on the Larime No. 1 Reservoir.

3.9.3 Previously Proposed Water Storage Development

Several previous studies on potential reservoir development have been completed throughout the years; the WWDC has compiled a list of proposed reservoirs from these studies. Table 3.51 lists the reservoir and dam projects proposed in different studies for the watershed. Using information found for the general location of the sites (township, range, and section), proposed locations were mapped and can be seen in Figure 3.124.

Table 3.51. Previously Proposed Reservoirs Within the Watershed (Page 1 of 2)

Project Name/ Water Source	Approximate Location	Estimated Storage (ac-ft)	Water Use	Estimated Cost ($)
Study of the Water Resources of the Missouri River Basin in Wyoming: North Platte, Laramie, South Platte, Level 1 Reconnaissance **[Person., 1936], located at the Wyoming Water Development Office and State Library**				
Foxton Reservoir/ Horseshoe Creek	Sec 25, T28N, R72W, Converse	3,200	A	100,000
Horseshoe	Sec 25, T28N, R72W, Converse	2,262	A	120,000
LaPrele #2	Sec 17, T30N, R74W, Converse	2,476	A	80,000
Pine Glen Reservoir/ South Elkhorn Creek	Sec 36,T30N, 69W, Platte	837	A	16,000
Schneider Reservoir/ Virden Creek	Sec 22, T31N, R76W, Converse	538	A	3,000
Tully Bucklin Reservoir/ Muddy Creek	Sec 19, T27N, R68W, Platte	660	A	1,500
Wagon Hound	Sec 25, T30N, R72W, Converse	2,090	A	75,000
Report on the North Platte River Basin, Level 1 Reconnaissance **[USBR, 1957], located at the Wyoming Water Development Office and the State Library**				
Duck Creek Reservoir/ Deer Creek	Below mount Duck Creek, Converse	10,600	M	
Box Elder Reservoir	Sec 23, T32N, R75W, Converse	9,300	A	
LaPrele Reservoir	Sec 17, T30N, R74W, Converse	20,000	A	
Wagon Hound Reservoir	12 miles southwest of Douglas, Converse	4,500	A	
La Bonte Reservoir	20 miles south of Douglas, Converse	14,200	A	
Working Paper Platte River Basin Cooperative Study Wyoming, Level 1 Reconnaissance **[USDA, 1980], located at the WWDO and the State Library**				
Deer Creek Reservoir	Sec 11, T31N, R77W, Converse	25,700	A, R, F	20,200,000
Boxelder Creek Reservoir	Sec 23, T32N, R75W, Converse	10,600	A, F	4,700,000
La Bonte Creek Reservoir	Sec 36, T30N, R72W, Converse	7,300	A	3,900,000
Horseshoe Creek Reservoir	Sec 31, T29N, R69W, Platte	6,000	A, R, F	2,400,000

Table 3.51. Previously Proposed Reservoirs Within the Watershed (Page 2 of 2)

Project Name/ Water Source	Approximate Location	Estimated Storage (ac-ft)	Water Use	Estimated Cost ($)
Deer Creek Project, Interim Report, Level 2 Concept Designs, **[Beck, 1982], located at the Wyoming Water Development Office**				
D1/Deer Creek	Sec 35, T32N, R77W, Converse	16,100/12,000	M, F	43,300,000
Deer Creek Project, Interim Report, Level 2 Concept Designs, **[Beck, 1982] located at the WWDO**				
D2/Deer Creek	Sec 11, T31N, R77W, Converse	62,000/17,700	M, F	30,000,000
D3/Deer Creek	Sec 13, T31N, R77W, Converse	105,000/20,500	M, F	76,800,000
OS1/Little Deer Creek	Sec 10, T32N, R77W, Converse	9,700/1,600	M, F	27,900,000
OS2/Banner Draw and Deer Creek	Sec 13, T32N, R77W, Converse	13,500/6,500	M, F	39,900,000 with Canal
Deer Creek Reservoir, Level 2 Concept Designs **[Andrews, 1984] located at the Wyoming Water Development Office and State Library**				
Deer Creek Reservoir	Sec 11, T31N, R77W, Converse	61,000	A, F, R	41,000,000

(a) Water-Use Codes: A = Agriculture, M = Municipal, R = Recreation, F = Flood Protection.

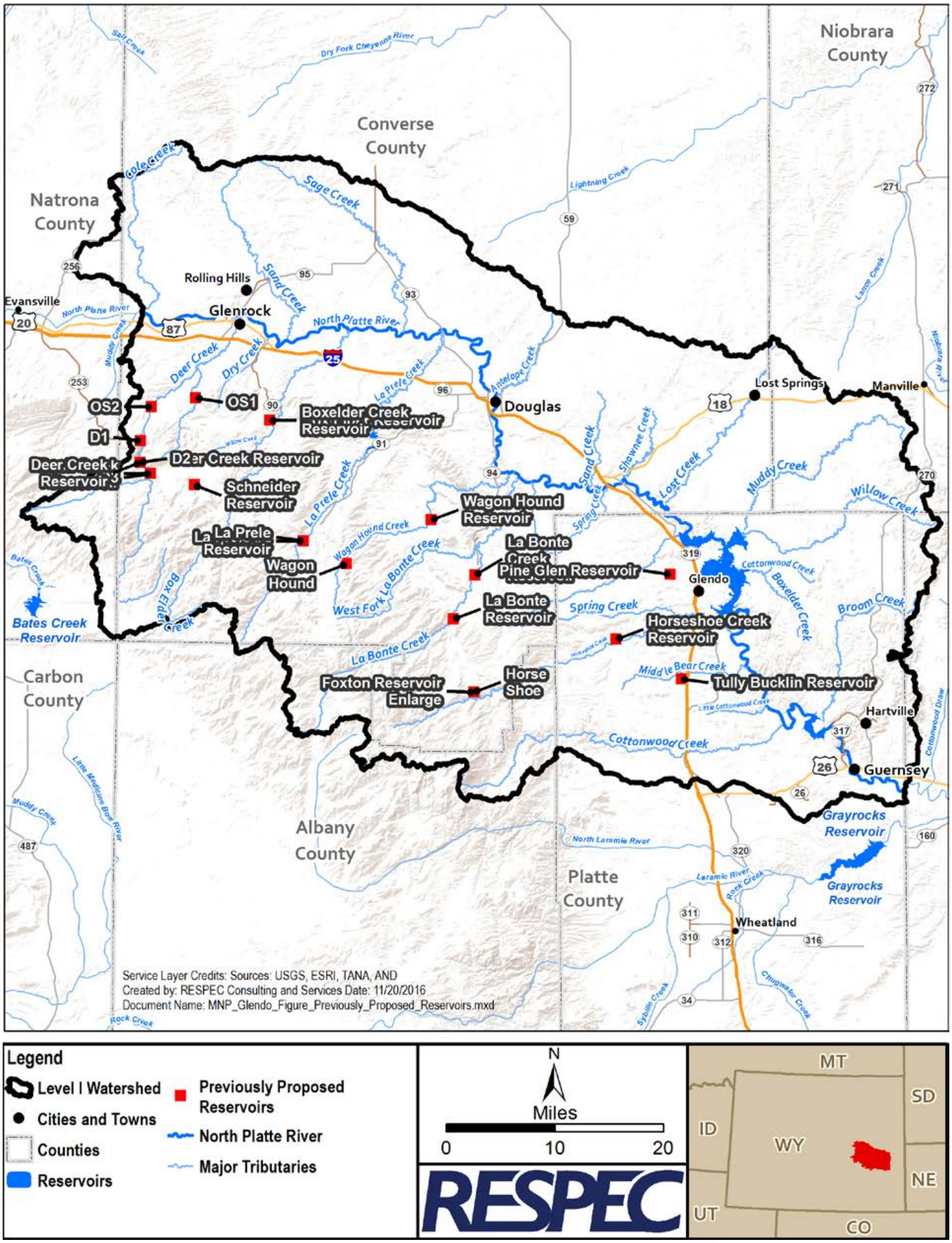


Figure 3.124. Previously Proposed Reservoir and Dam Project Locations Within the Watershed.

4.0 MIDDLE NORTH PLATTE–GLENDO WATERSHED MANAGEMENT AND REHABILITATION PLAN

4.1 OVERVIEW

The objective of this Level I watershed study is to generate a Watershed Management and Rehabilitation Plan that is technically sound, practical in nature, and economically feasible. In conjunction with developing the study's Geographic Information System (GIS), the inventory focused on assessing the watershed and identifying and evaluating improvements to address those issues described in Chapter 3.0. Opportunities for potential improvements were categorized into the following:

- **Irrigation System Conservation and Rehabilitation.** The inventory and evaluation of the existing infrastructure was completed and improvements were identified for rehabilitating existing structures and potentially conserving existing irrigation diversions.
- **Livestock/Wildlife Watering.** Based on an evaluation of existing water sources and the condition of upland grazing resources, potential upland water-source development projects were identified.
- **Grazing Management Opportunities.** Based on a review of the pertinent ecological site description (ESD) and the ambient vegetation and soil conditions, grazing management strategies are presented.
- **Surface-Water Storage Opportunities.** The results of previous investigations pertaining to developing **water**-storage opportunities within the watershed were incorporated.
- **Channel Stability Opportunities.** Stream channels within the watershed were characterized with respect to their condition and stability. Impaired channels were identified for further evaluation and alternative improvements developed.
- **Wetlands Enhancement Opportunities.** Opportunities to establish new wetlands or enhance existing wetlands within the watershed were defined.
- **Other Watershed Management Opportunities.** For each of the categories described above, a series of recommended projects were prescribed in the following portions of this chapter. These plans have been prepared to provide an overview of potential improvements that can partially or fully address the key issues identified within the watershed.

In this chapter, the conceptual plans developed within each watershed component are described with respect to improving the existing water supply through conservation. To track individual components of the Watershed Management Plan, a unique project or "improvement" number was designated for each component. The following prefixes were used for each improvement to describe the category of the Watershed Management Plan that it falls under:

- Project Components "I": irrigation system rehabilitation components (Section 4.3)
- Project Components "LW": livestock/wildlife upland watering opportunities (Section 4.4)
- Project Components "G": grazing management opportunities (Section 4.5)
- Project Components "S": surface-water storage opportunities (Section 4.6)

- Project Components "C": Stream-channel stability components (Section 4.7)
- Project Components "W": Wetlands enhancement opportunities (Section 4.8)
- Project Components "O": Other watershed management opportunities (Section 4.9).

4.2 POTENTIAL EFFECTS AND BENEFITS OF PLAN COMPONENTS

The Wyoming Water Development Commission (WWDC) Level I watershed study is a fundamental landscape analysis that is confined to a hydrologically connected drainage area or watershed and is focused on two primary components. The first component is identifying the physical attributes of that study area, which is accomplished by conducting a comprehensive inventory of the natural resources and subsequently use that inventory to describe the current resource conditions. The second component is a long-range plan that outlines management and/or rehabilitation opportunities and activities that address ecological enhancement and watershed function.

Such activities in the conservation community are commonly referred to as best management practices (BMPs) or conservation practices. These BMPs and conservation practices are eligible for grant funding assistance through the WWDC's Small Water Project Program (SWPP). The WWDC's SWPP funds are mainly used for installing BMPs and conservation practices such as stock ponds, water wells, buried water delivery pipelines, stock tanks, spring developments, solar platforms and pumps, environmental and wetland restoration, windmills, and irrigation diversion and conveyance improvements.

One or more benefits can result from implementing BMPs and conservation practices. Such benefits can be quantitative, qualitative, or both. Benefits can be local or global and specific or surrogate, depending on multiple factors that are unique and specific to the BMP or conservation practice, ecological site, watershed, or major land-resource area. BMPs and conservation practices also provide opportunities to relieve grazing pressure on riparian areas and create the potential to induce improvements to soil health, plant community diversity, and improved forage production. These practices allow for grazing deferment in the event that rest is required because of invasive species control efforts, which can also stimulate water release.

Benefits to ecosystem functionality and landscape health can be and is a response to soil health, water infiltration/percolation, and a functioning water cycle. Expected project benefits can be related to watershed function (e.g., collecting and storing water), ecological enhancements (e.g., plant and animal habitat and stream corridor or riverine stability), and societal values (e.g., economic stability and open space maintenance). Multiple benefits can result from improvement opportunities for water resources, which are critical to meet the daily water demands of the resident population of humans and animals; develop, increase, or extend irrigation water availability; and improve fishery habitat and potential recreational benefits.

4.2.1 Natural Resources Conservation Service Conservation Effects Assessment

In 2003, in the interest of government accountability, Congress and the Office of Management and Budget requested information from the US Department of Agriculture (USDA) about the effectiveness of its conservation programs. In response, the Conservation Effects Assessment Project (CEAP) was initiated by the Natural Resources Conservation Service (NRCS) to provide quantitative information about the environmental impacts of its conservation practices on agricultural lands within the contiguous 48 states. The CEAP is a joint effort of the NRCS, Agricultural Research Service (ARS), National Institute for Food and Agriculture, other federal agencies, and university scientists to quantify the environmental effects of NRCS conservation practices and programs and to develop the science base for managing the agricultural landscape for environmental quality. Initially focused on croplands, the CEAP effort has been expanded to include wildlife, wetlands, pastures, and rangelands.

The CEAP findings have been used to guide USDA conservation policy and program development that will assist conservationists, farmers, and ranchers with informed conservation decisions [Spaeth et al., 2013]. The end product of the CEAP is a literature review and a concise collection of information from hundreds of published scientific papers, journals, and additional references. Consequently, the CEAP documents provide a valuable source of information that pertains to the various BMPs incorporated in this plan and are referenced throughout the remainder of this section.

4.2.2 Watershed Function

Identifying improvement opportunities for hydrologic and watershed function—including water quantity, yield, and use—are an essential element of the Level I watershed study. Hydrologically, a watershed has three fundamental functions [Black, 1997]:

1. Collecting water from rainfall, snowmelt, and storage that becomes runoff
2. Storing various amounts and durations
3. Discharging water as runoff.

Watershed characteristics, such as geologic structure, soils, landform, topography, vegetation, and climate, influence the capture or collection of precipitation, infiltration and storage of surface water and groundwater, and runoff or discharge of water.

Implementing BMPs and conservation practices can affect water-resource quantity through improved plant communities, vegetative diversity, and ecological site health achieved from water development. Creating reliable water sources in areas devoid of such allows grazing systems to establish and changes in grazing distribution. Hydrological responses to grazing are strongly contingent on the vegetative community composition, with communities that provide greater cover and obstruction to overland flow, such as midgrass-dominated communities that have greater hydrological function (including infiltration rate) than shortgrass-dominated communities [Wood and Blackburn, 1981; Thurow, 1991; NRCS, 2011].

Poor water distribution has been the primary cause of poor livestock distribution [Holechek, 1997]. Livestock distribution and grazing behavior can be modified by adjusting the location of supplemental feed and water, implementing patch burns, and herding in addition to the traditional practice of fencing [Williams, 1954; Ganskopp, 2001; Fuhlendorf and Engle, 2004; Bailey, 2005]. The NRCS [2011] reviewed many studies and found that water distribution, steep slopes, and high elevations clearly influenced livestock distribution. Sufficient evidence also existed to recommend that the NRCS increase the role of herding and supplement placement along with water development and fences for managing livestock distribution [NRCS, 2011].

Soil vegetative cover is widely recognized as a critical factor in maintaining soil-surface hydrologic condition and reducing soil erosion [Gifford, 1985; NRCS, 2011]. Regardless of grazing system, stocking rates reduce soil-surface vegetative cover below a site-specific threshold, increase detachment and mobilization of soil particles because of raindrop impact, decrease soil organic matter and soil aggregate stability, and increase soil-surface crusting, which reduces soil-surface porosity; thus, infiltration decreases and soil erosion and sediment-transport increase [Blackburn, 1984].

Sufficient vegetative cover, critical soil cover, or residual biomass must remain during and after grazing to protect soil-surface condition (e.g., porosity, aggregate stability, and organic matter) and hydrologic properties (e.g., infiltration); however, these site-specific vegetation cover requirements vary depending on cover type (e.g., vegetation, litter, or rock), soil type, rainfall intensities, and water quality goals [Gifford, 1985]. The erosive energy of water and the long-term reduction of organic matter additions to soil detrimentally affect many soil properties through the increase of bulk density, disruption of biotic crusts, reduced aggregate stability, and organic matter content, which collectively reduce the infiltration rate and increase sediment yield and runoff [NRCS, 2011]. These efforts can increase water infiltration or percolation, stimulate spring flows, and increase flow volume and duration.

An example of restoring watershed function and water quantity was in a 74,000-acre watershed in west Texas near San Angelo where West Rocky Creek (a dry, intermittent stream for decades) started flowing again [Moseley, 1983; Wiedenfeld, 1986]. In the early part of the twentieth century, West Rocky Creek was a year-long, flowing stream until the late-1910s, when it became an intermittent, stream. By 1935, the springs that fed the creek had been dried up by mesquite and other invading woody plants [Moseley, 1983; Wiedenfeld, 1986].

During the 1950s and 1960s, ranchers and landowners on five ranches that covered approximately one-half of the watershed began conservation work, including root-plowing, reseeding, tree-dozing, aerial spraying, and chaining mainly mesquite and juniper brush. These practices limited water availability for native grasses such as sideoats grama, buffalograss, curly mesquite, and tobosa [Moseley, 1983]. Approximately 30,000 acres (70 percent) of the mesquite was removed from the watershed, and the original prairie was restored [Moseley, 1983; Wiedenfeld, 1986]. In the mid- to late-1960s, one of the five ranchers noticed that a spring that had been dry since 1935 had started flowing again; by replacing the water-hungry brush with a good grass cover, more rainfall soaked into the aquifer and recharged the dormant springs. Flow began on all five ranches by 1970 [Moseley, 1983]. Ongoing grazing management on each ranch enhanced the cover of grasses in the watershed with soils that produced an estimated 2,000 to 2,500 pounds of forage per acre, which helps retard brush succession. The ranchers periodically must maintain and control brush to keep the preferred vegetation balance [Moseley, 1983].

In southeast Arizona, long-term data on soils, vegetation, hydrology, and climate have been collected for over five decades on the Walnut Gulch Experimental Watershed, which is operated by the USDA's ARS. The Walnut Gulch Experimental Watershed is one of the most intensively instrumented, semiarid, experimental watersheds in the world, with a 10- to 100-year record of abiotic and biotic measurements and photographs [Moran et al., 2008]. Researchers studied the interaction between rainfall intensity and soils and vegetation by comparing the frequency of runoff-producing summer events between a shrub-dominated watershed and a grass-dominated watershed and found that higher rainfall intensities are needed to produce runoff on the grassed watershed [USDA, 2013]. The results also indicate that the grassland plant community is producing more plant material than the shrubland, with close to the same amount of precipitation input, which makes the grasslands more water-use efficient [USDA, 2013]. Researchers found that runoff quantities at the watershed scale are controlled by infiltration of water into alluvial channels and distribution of thunderstorm rainfall [USDA, 2013].

4.2.3 Ecological Enhancement

An ecological enhancement is any activity that improves an ecosystem, such as stabilizing erosive soils; increasing soil quality; planting or maintaining native grasses, shrubs, or trees; removing and controlling invasive species; and improving or maintaining riparian/wetland areas. Ecological sites are complex and varied within the study area as described in Section 3.4.8.6 and Figure 3.67. The potential benefits achieved from project activities and implementations that influence the condition of those ecological sites and characteristics are also just as complex and varied.

Conjunctive to soil function is plant community diversity, health and productivity, subsequent forage diversity, production, and wildlife habitat. Benefits that are accrued to water quality are significant because improvements to the chemical, physical, and biological constituents of a waterbody produce both local site enhancements and those transferred downstream. Wetland restoration provides benefits to ecological enhancement and contributions to water quality and quantity. Watersheds function by providing diverse sites and pathways along which vital chemical reactions occur as well as by furnishing habitat for the flora and fauna that constitute the biological elements of ecosystems [Black, 1997].

4.2.3.1 *Plant and Animal Habitat*

Locations of conservation practices and rangeland infrastructure can have a large, indirect impact on overall vegetation change with the spatial design of infrastructure, including fence locations, watering points, and feeders that are used to modify patterns of animal movement and forage utilization; livestock behavior and the template of topography and plant communities to which livestock respond are also taken into account [Laca, 2009; NRCS, 2011]. Using rangelands for sustainable livestock production has the potential to ensure that the wildlife habitat will continue into the future [NRCS, 2011]. Wildlife responses to conservation practices are usually species- and even species-habitat specific, which means not only that each species may respond differently to any specific practice, but also that a single species may respond differently to the same practice in different vegetation associations or conditions [NRCS, 2011].

Free-stranding water has been considered to be a resource that limits distribution and abundance of many species of wildlife in arid regions of the United States, and water developments have been used since the 1940s to improve wildlife habitat [Simpson et al., 2011]. Simpson et al. [2011] compiled and evaluated available literature for evidence of the effects of water sources on wildlife populations. Positive effects of water developments on wildlife have been documented, and species that were previously thought not to use free-standing water developments do so when it is available [Simpson et al., 2011]. Additionally, researchers studied the effects of wildlife water developments in southwestern

Arizona and found that water developments were used by a diverse array of wildlife, including mule deer, game birds, and several nongame species [Rosenstock et al., 2004].

4.2.3.2 *Stream Corridors and Riparian/Wetland Areas*

Reducing the impact to riparian plant communities by developing upland water resources can result in instream corridor benefits. Riparian plant community diversity and regeneration of preferred important woody species can help restore local water tables, trap sediments, increase wildlife habitat and migration corridors, and stabilize streambanks. Additionally, aquatic population benefits can accrue, and recreation potential can be realized.

Livestock distribution practices, such as water developments, supplement placement, and herding, are effective means of managing the intensity and season of livestock grazing in riparian areas [NRCS, 2011]. The grazing season also determines livestock-grazing effects on riparian-vegetation communities, particularly woody plants, and can be managed to conserve riparian habitats and their associated services [NRCS, 2011]. Sufficient evidence exists in peer-reviewed studies to suggest that NRCS riparian-grazing management would maintain or enhance key riparian-vegetation attributes (i.e., species composition, root mass and root density, cover, and biomass). Stream-channel and riparian soil stability would also be enhanced and, in turn, support ecosystem services such as flood and pollutant attenuation and high-quality riparian habitat [NRCS, 2011]. Peer-reviewed literature generally supports the effectiveness of water developments, supplement placement, and herding for reducing riparian vegetation use, or time spent in riparian areas [NRCS, 2011].

4.2.4 Societal Value

Natural resource stewardship not only has economic value in terms of forage, livestock, and wildlife production relationships but also can have noneconomic value placed on those conservation practices by society. Those values can even influence the perception of those who implement conservation practices and can be as much of an influence in the decision process to implement conservation as economic value. Additionally, a BMP or conservation practice can possibly provide an ecological service to accrue more value to society in general than to a local landowner. Ecosystem services are defined as those things or experiences that are produced by natural systems on which humans place value [NRCS, 2011]. Ecosystem services benefit society in diverse ways; each of the conservation practices can potentially produce different kinds, qualities, and amounts of these goods and services, depending on location, natural potentials, current states, and other factors.

Noneconomic values can and should be considered in determining watershed-enhancement programs, particularly when considering public investment in conservation. NRCS [2011] found little to no research exists that shows the direct noneconomic effects of BMPs and conservation practices on individuals, households, or social systems but acknowledged that producers likely realize psychological benefits from conservation because stewardship typically ranks high among the management goals of livestock producers [Huntsinger and Fortmann, 1990; Sayre, 2004]. Moreover, producers who believe strongly in a responsibility to society are more likely to engage in environmentally sound management practices, such as invasive weed control and riparian protection [Kreuter et al., 2005].

In 2012, in cooperation with the Wyoming Stock Growers Association (WSGA), University of Wyoming, and University of California-Davis, researchers with the USDA's ARS Rangeland Resources Research Unit in Cheyenne, who were investigating the effects of rangeland management decision making, asked WSGA producer members about their goals, ranching operations, and management practices via a mail survey. A total of 307 ranchers responded to the survey [Kachergis et al., 2013; Mealor, 2013]. Livestock and forage production were the top management goals; ecosystem characteristics that support these goals (e.g., soil health and water quality) were secondary [Kachergis et al., 2013; Mealor, 2013].

In addition to other social values and ecological enhancements, open spaces have long been held in high value in Wyoming and other western region states. From the perspectives of ranching industry, tourism interest, outdoor recreationist activity, or real-estate value, open space is significant. Preserving the custom and culture in Wyoming has been and continues to be a focal point of consideration. Open spaces are critical for upland/riparian conductivity, wildlife migrations and habitat, and recreational opportunity. Open space is valued for preserving cultural resources and for reducing or preventing land conversion to a condition that can be stewarded to an improved ecological condition.

4.3 IRRIGATION SYSTEM PROPOSED PROJECTS

This plan and its alternatives provide the irrigators and landowners with an assessment of conditions associated with the irrigation delivery infrastructure and associated hydraulic structures. The landowner or manager could use the conceptual plans as a starting point from which they could select projects for further design and for funding assistance from the WWDC's SWPP, the NRCS Environmental Quality Incentives Program (EQIP), or other participating conservation or watershed programs.

As included in Section 3.4.7, the irrigation system inventory efforts associated with this project consisted of evaluating structures, ditch conditions, and water-storage structures at the request of interested landowners and stakeholders. At the request of those individuals who asked to participate in the study, irrigation system components were inventoried. Based on the results of the field inventory, conceptual project plans for rehabilitation and/or replacement were developed. The conceptual proposed projects and components were developed with the assumption that future installation might occur within the next 10 years unless otherwise noted that the structure has failed and is nonfunctional, which warrants installing components within the next 1-to-3-year time frame.

Conceptual irrigation rehabilitation components were planned for study participants. The typical component was assumed to be replacement of a medium-sized diversion and headgate structure, and installation of a 12-inch buried plastic irrigation pipeline (PIP). Note that the actual alignment, volumes, dimensions, and lengths need to be determined for these conceptual projects and components included within this report. Additional work such as design, permits, clearances, constructions specifications, financing, and bid solicitations may be required before commencing any installation.

In Sections 4.3.1 through 4.3.15, the individual structures that were inventoried and planned are discussed. The structures that were inventoried and their respective component identifiers in the Watershed Management Plan are summarized in Table 4.1. This information has been incorporated to the study's GIS. Figure 4.1 displays the location of the proposed irrigation projects within the study area.

Table 4.1. Summary of Recommended Irrigation System Improvements

Plan Item	Project Name	Component
I-01.1	LaPrele Main Canal Diversion	Rehabilitate weir structure and stabilize banks
I-01.2	LaPrele Main Canal Diversion	Rehabilitate main headgate structure
I-01.3	LaPrele Main Canal Diversion	Rehabilitate bypass headgate structure
I-02.1	LaPrele Westside Canal Diversion	Rehabilitate diversion weir and stabilize banks
I-02.2	LaPrele Westside Canal Diversion	Rehabilitate headgate structure
I-03.1	LaPrele Lateral No. 1	Rehabilitate headgate structure
I-03.2	LaPrele Lateral No. 1	Install 5,300 feet of 18-inch PIP pipeline
I-03.3	LaPrele Lateral No. 1	Rehabilitate headgate structure
I-03.4	LaPrele Lateral No. 1	Install 5,200 feet of 15-inch PIP pipeline
I-04.1	LaPrele Lateral No. 9A Sublaterals	Rehabilitate the headgate structure
I-04.2	LaPrele Lateral No. 9A Sublaterals	Install 2,700 feet of 12-inch PIP pipeline
I-04.3	LaPrele Lateral No. 9A Sublaterals	Install 2,800 feet of 12-inch PIP pipeline
I-05.1	LaPrele Lateral No. 4 Sublateral	Rehabilitate the headgate structure
I-05.2	LaPrele Lateral No. 4 Sublateral	Install 1,000 feet of 12-inch PIP pipeline
I-06.1	LaPrele Lateral No. 2A Sublateral	Rehabilitate the headgate structure
I-06.2	LaPrele Lateral No. 2A Sublateral	Install 600 feet of 12-inch PIP pipeline
I-07.1	East Side No. 3 Reservoir	Rehabilitate dam and reservoir
I-08.1	J A Moran Ditch Regulating Reservoir	Construct irrigation-regulating reservoir
I-09.1	Walker No. 3 Ditch	Rehabilitate headgate structure
I-09.2	Walker No. 3 Ditch	Install 3,500 feet of 24-inch PIP pipeline
I-09.3	Walker No. 3 Ditch	Install 5,300 feet of 18-inch PIP pipeline
I-10.1	Hoffman Ditch and Diversion	Rehabilitate diversion and headgate
I-10.2	Hoffman Ditch and Diversion	Install 3,500 feet of 12-inch PIP pipeline
I-10.3	Hoffman Ditch and Diversion	Install 725 feet of streambank stabilization
I-11.1	Johnson Pump Lift (Cassa Ditch)	Rehabilitate inlet and screen structure
I-11.2	Johnson Pump Lift (Cassa Ditch)	Rehabilitate inlet and screen structure
I-11.3	Johnson Pump Lift (Cassa Ditch)	Install 1,200 feet of 18-inch PIP pipeline
I-11.4	Johnson Pump Lift (Cassa Ditch)	Install 2,200 feet of 15-inch PIP pipeline
I-12.1	Wright No. 2 Ditch	Rehabilitate diversion and headgate
I-12.2	Wright No. 2 Ditch	Install 3,500 feet of 12-inch PIP pipeline
I-13.1	Wright No. 2 Ditch (Enlg.)	Rehabilitate diversion structure
I-13.2	Wright No. 2 Ditch (Enlg.)	Install 2,800 feet of 12-inch PIP pipeline
I-14.1	Seepage Saddle Ditch and Diversion	Rehabilitate diversion and stabilize banks
I-14.2	Seepage Saddle Ditch and Diversion	Install diversion and headgate structure
I-14.3	Seepage Saddle Ditch and Diversion	Install 1,400 feet of 18-inch PIP pipeline
I-14.4	Seepage Saddle Ditch and Diversion	Install 3,000 feet of 12-inch PIP pipeline
I-14.5	Seepage Saddle Ditch and Diversion	Install 1,200 feet of 12-inch PIP pipeline
I-15.1	Carey Ditch No. 2 Ditch	Rehabilitate headgate structure
I-15.2	Carey Ditch No. 2 Ditch	Install headgate structure
I-15.3	Carey Ditch No. 2 Ditch	Install 2,200 feet of 18-inch PIP pipeline
I-15.4	Carey Ditch No. 2 Ditch	Install 2,800 feet of 18-inch PIP pipeline

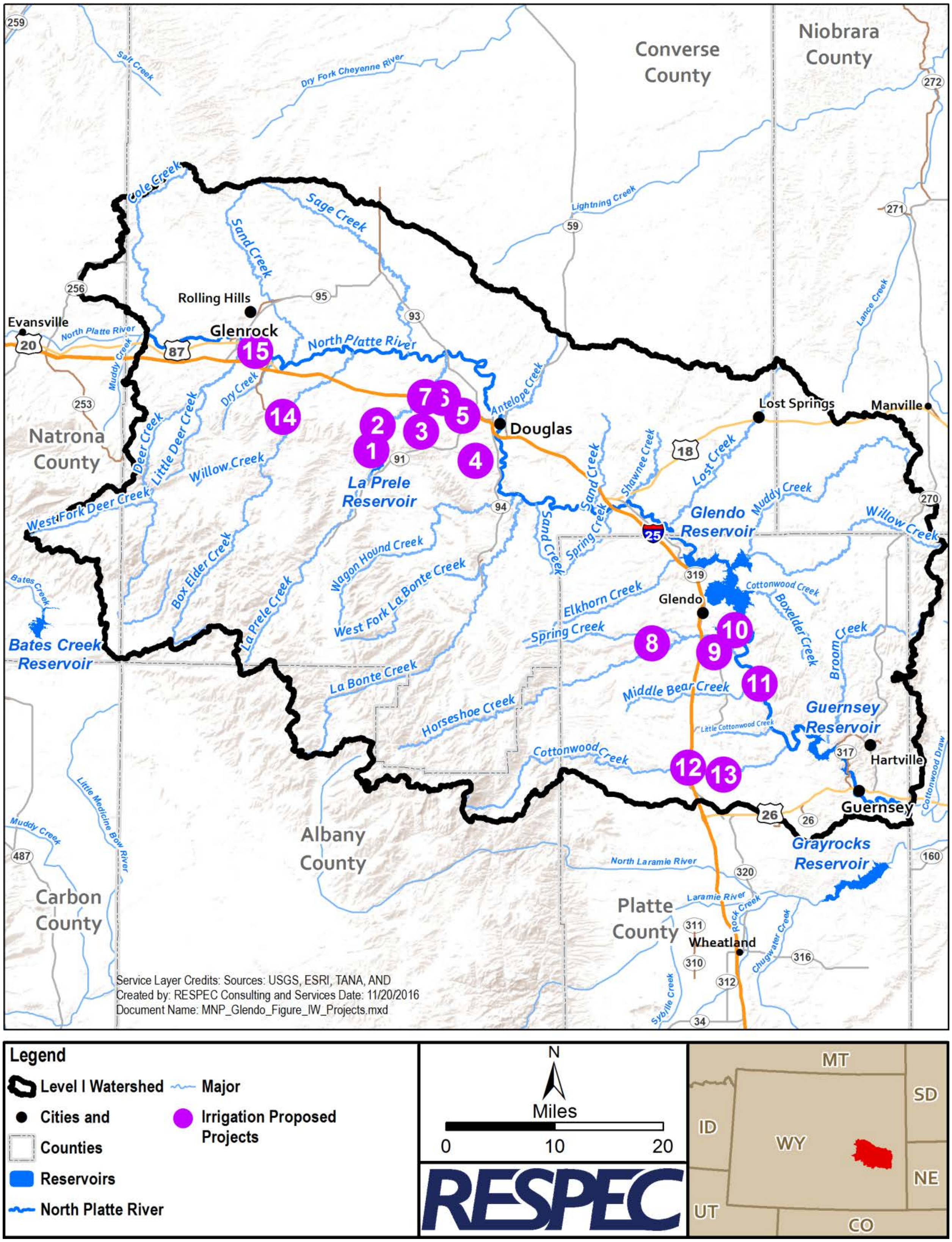


Figure 4.1. Conceptual Irrigation Proposed Projects Within the Study Area.

4.3.1 I-01: LaPrele Main Canal Diversion and Headgates

The LaPrele Main Canal delivers approximately 25–120 cubic feet per second (cfs) of water through approximately 14.5 miles of earthen canal to 22 laterals and over 9,000 irrigated acres. The LaPrele Irrigation District (LID) identified that the LaPrele Main Canal Diversion needed rehabilitation. The diversion is a concrete structure across La Prele Creek approximately 1.6 miles downstream from the LaPrele Reservoir; this structure consists of a weir, main headgate structure, and bypass headgate structure and is located in Section 21 of Township 32 North, Range 73 West in Converse County.

The diversion is functional but needs to be rehabilitated or replaced because of multiple issues. Without improvements to the structures and banks, high-flow induced failures could occur and jeopardize the LID's ability to deliver water to over 9,000 acres.

The purpose of this project is to ensure irrigation water delivery and improve channel stability. The project as shown in Figure 4.2 could involve the following recommendations and components:

- Item No. I-01.1: rehabilitate weir structure on La Prele Creek and stabilize channel
- Item No. I-01.2: rehabilitate main headgate structure
- Item No. I-01.3: rehabilitate bypass headgate structure
- The proposed project is located entirely on state land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.3.2 I-02: LaPrele Westside Canal Diversion and Headgates

The LaPrele Westside Canal delivers approximately 10-60 cfs of water through approximately 14.5 miles of earthen canal to 2 laterals and approximately 2,000 irrigated acres. The canal is also operated and maintained by the LaPrele Irrigation District. The Westside Canal Diversion was identified by the LID as needing rehabilitation. The diversion is a concrete structure across La Prele Creek downstream from the Main Diversion and is located in Section 16 of Township 32 North, Range 73 West in Converse County. The diversion structure has had issues with erosion.

Based on a field evaluation, the diversion is functioning but is threatened by high-flow erosion around the weir structure and scour below the weir. The purpose of this project is to ensure irrigation-water delivery. The project as shown in Figure 4.2 could involve the following components:

- Item No. I-02.1: rehabilitate diversion weir and stabilize banks
- Item No. I-02.2: rehabilitate headgate structure
- The proposed project is located entirely on state land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

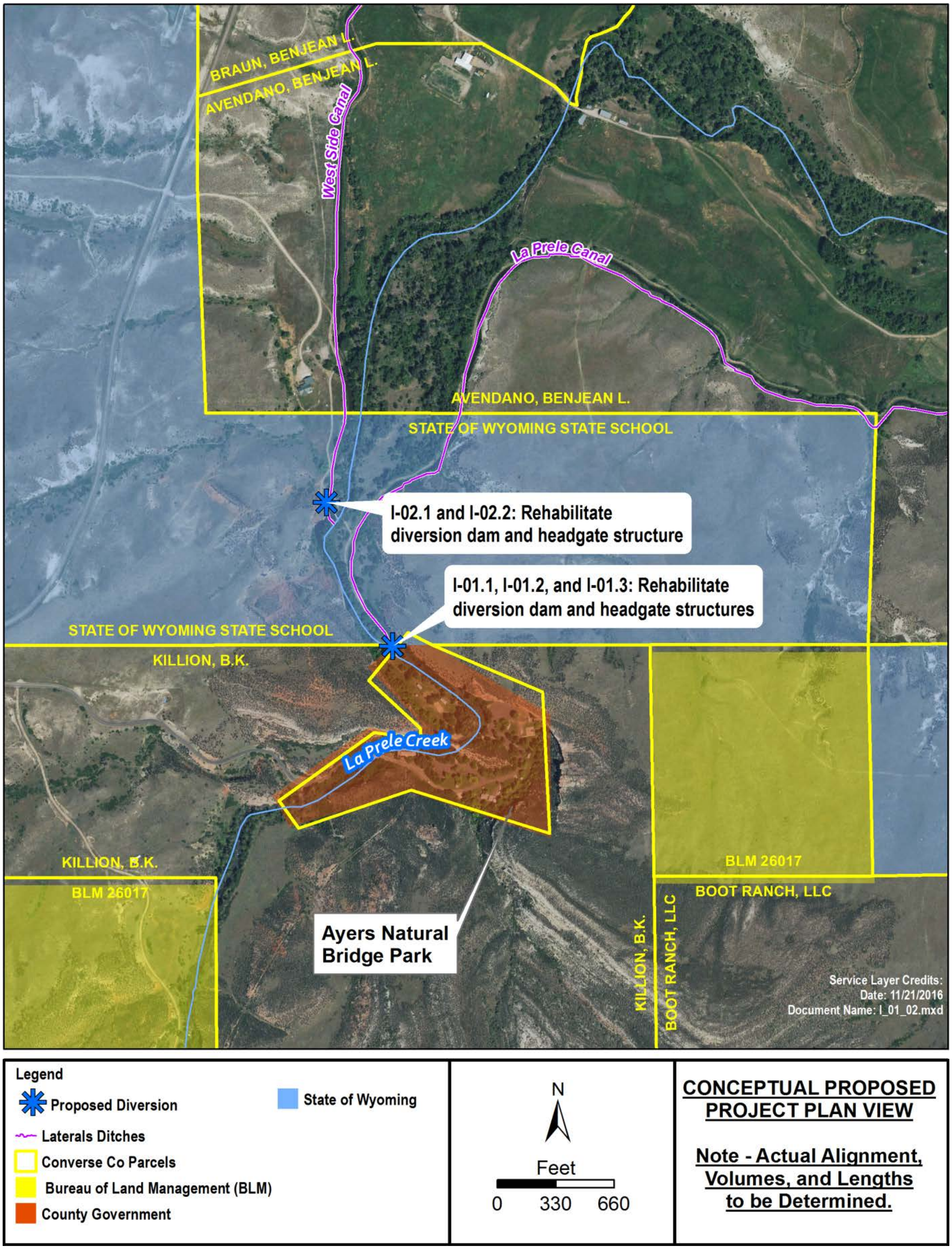


Figure 4.2. Proposed I-01 and I-02: LaPrele Main and Westside Diversions Projects.

4.3.3 I-03: LaPrele Lateral No. 1

The LaPrele Lateral No. 1 diverts water from the LID Main Canal in Section 7 of Township 32 North, Range 72 West in Converse County. The lateral delivers approximately 5.2 cfs through almost 3.3 miles of earthen ditch, which is operated and maintained by the LID. The lateral has had issues with sedimentation, bank and bed erosion, and leakage. The alternative as shown in Figure 4.3 could involve the following components:

- Item No. I-03.1: rehabilitate headgate structure
- Item No. I-03.2: install approximately 5,300 feet of 18-inch PIP pipeline
- Item No. I-03.3: rehabilitate headgate structure
- Item No. I-03.4: install approximately 5,200 feet of 15-inch PIP pipeline
- The proposed project is located on private and Bureau of Land Management Lands (BLM) lands
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

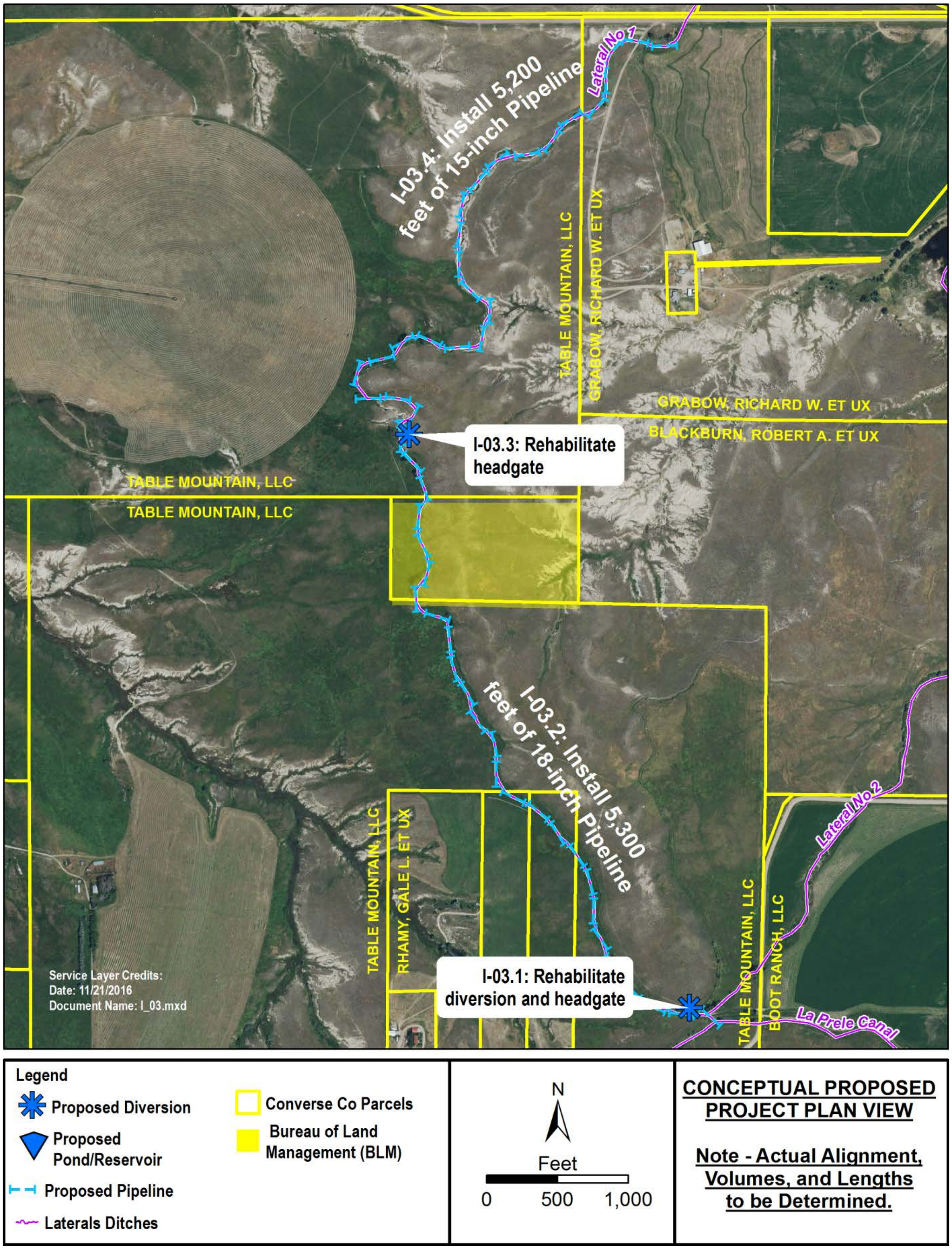


Figure 4.3. Proposed I-03: LaPrele Lateral No. 1 Project.

4.3.4 I-04: LaPrele Lateral No. 9A Sublaterals

The LaPrele Lateral No. 9A sublaterals divert water from the LID Lateral No. 9A in Section 23 of Township 32 North, Range 72 West in Converse County. The sublaterals consist of two earthen ditches that total approximately 8,850 feet (1.68 miles) and deliver irrigation water to hay fields along a minor drainage tributary to Little Bed Tick Creek.

The fields that are served by the Lateral No. 9A sublaterals are hilly and currently irrigated by flooding methods. A series of multiple field ditches are used to convey water from two sublaterals and to catch irrigation tailwater. The landowner identified the existing series of ditches as difficult to manage and control, which results in inefficient application of irrigation water. The purpose of this project is to improve irrigation efficiency and, as shown in Figure 4.4, could involve the following components:

- Item No. I-04.1: rehabilitate the headgate structure
- Item No. I-04.2: install approximately 2,700 feet of 12-inch PIP pipeline
- Item No. I-04.3: install approximately 2,800 feet of 12-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

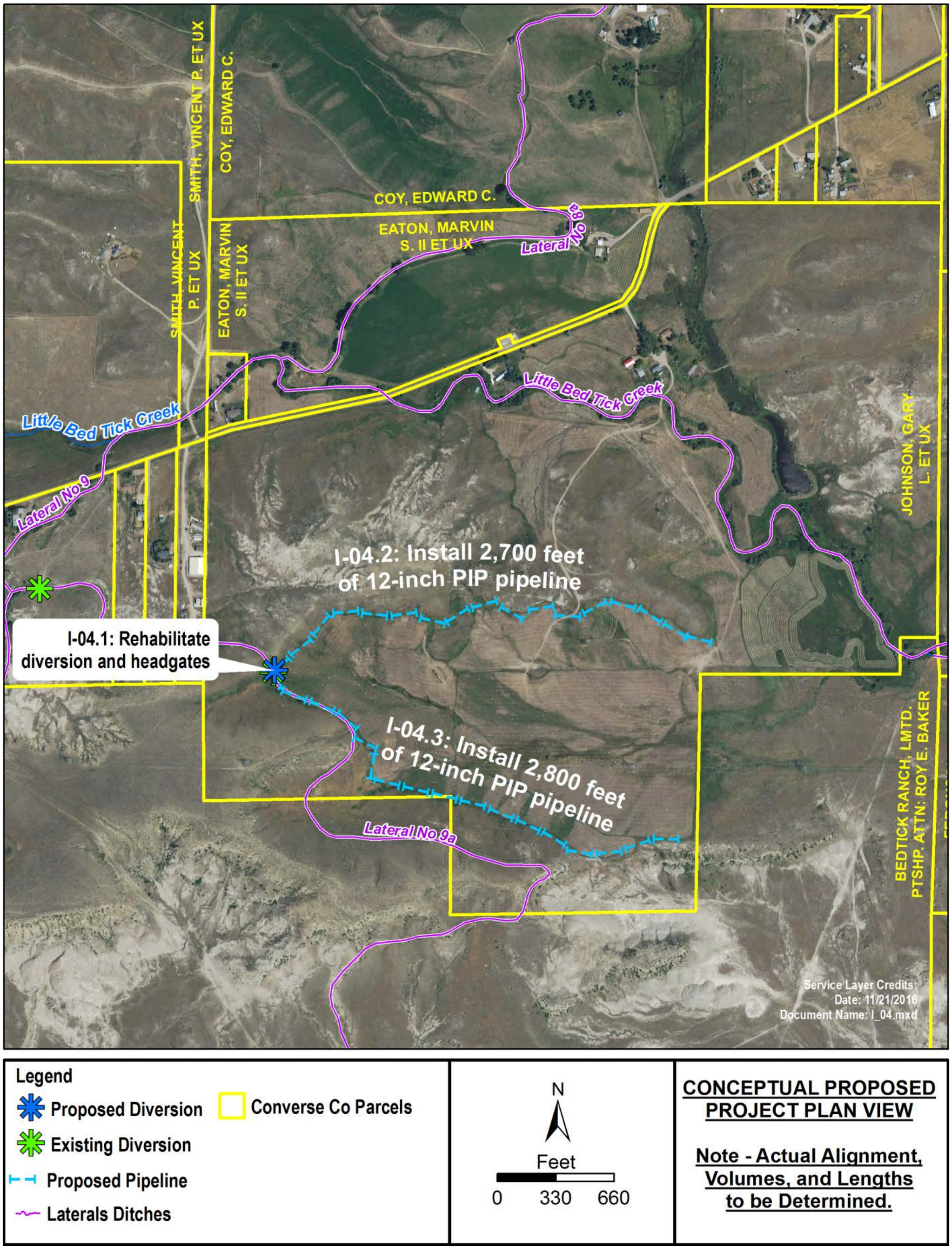


Figure 4.4. Proposed I-04: LaPrele Lateral No. 9A Sublaterals Project.

4.3.5 I-05: LaPrele Lateral No. 4 Sublateral

The LaPrele Lateral No. 4 sublateral diverts water from Lateral No. 4 in Section 3 of Township 32 North, Range 72 West in Converse County. Lateral No. 4 is approximately 17,034 feet (3.2 miles) long and diverts water from the Main Canal of the LID. The Lateral No. 4 sublateral consists of an earthen ditch that totals approximately 1,355 feet (0.3 mile) and delivers water to hay fields along a minor drainage tributary to Fivemile Creek.

The landowner identified the existing series of ditches as difficult to manage and control, which results in inefficient application of irrigation water. The purpose of this project is to improve irrigation efficiency and, as shown in Figure 4.5, could involve the following components:

- Item No. I-05.1: rehabilitate the headgate structure
- Item No. I-05.2: install approximately 1,000 feet of 12-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

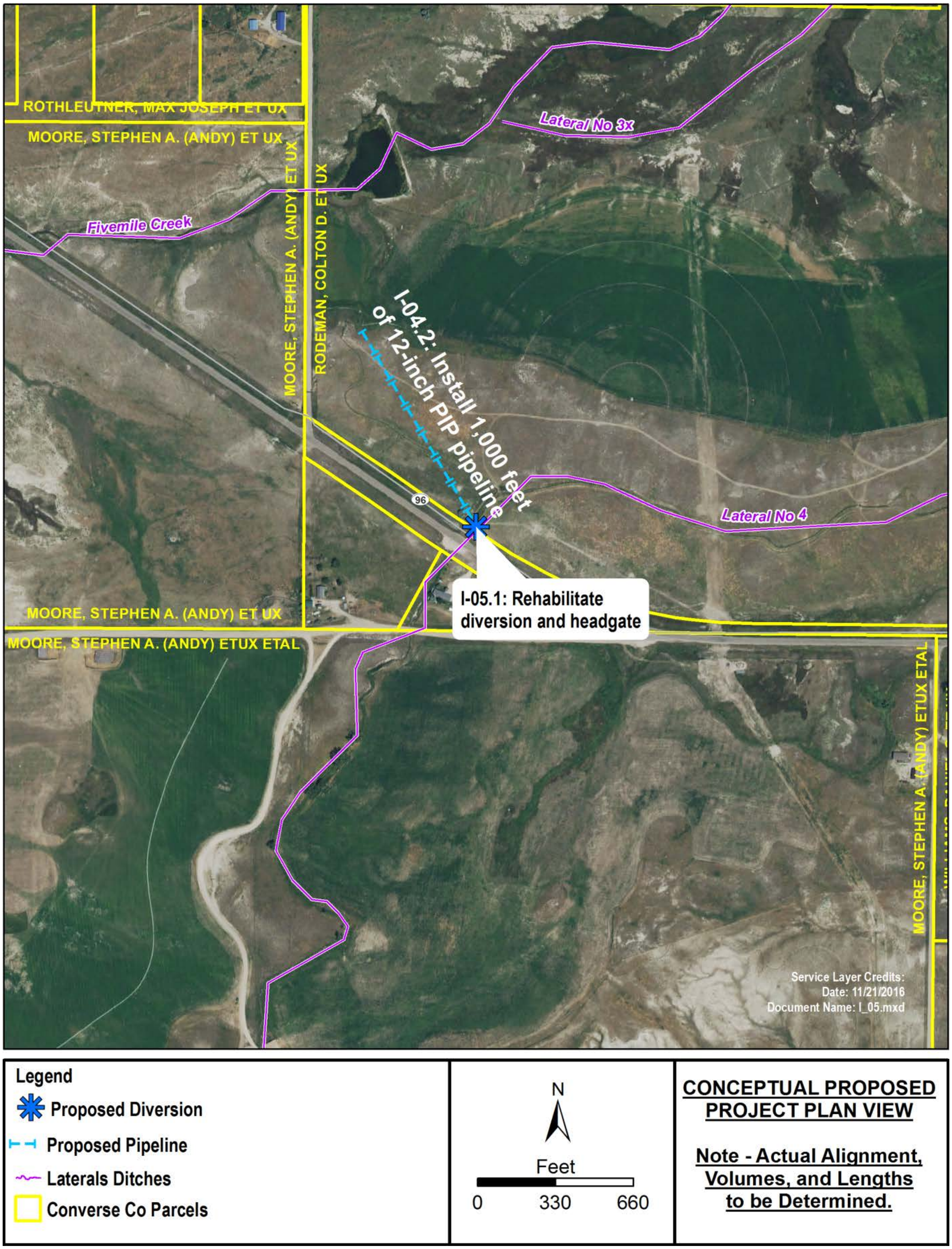


Figure 4.5. Proposed I-05: LaPrele Lateral No. 4 Sublateral Project.

4.3.6 I-06: LaPrele Lateral No. 2A Sublateral

The LaPrele Lateral No. 2A sublateral, as shown in Figures 3.45 and 3.46, diverts water from Lateral No. 2A in Section 5 of Township 32 North, Range 72 West in Converse County. Lateral No. 2A is 5,615 feet (1.1 miles) long and diverts water from Lateral No. 2, which diverts water from the Main Canal of the LID. The Lateral No. 2A sublateral consists of an earthen ditch that totals approximately 1,614 feet (0.3 mile) and delivers water to hay fields along a tributary to Fivemile Creek.

The project shown in Figure 4.6 would involve the following components:

- Item No. I-06.1: rehabilitate the headgate structure
- Item No. I-06.2: install approximately 600 feet of 12-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

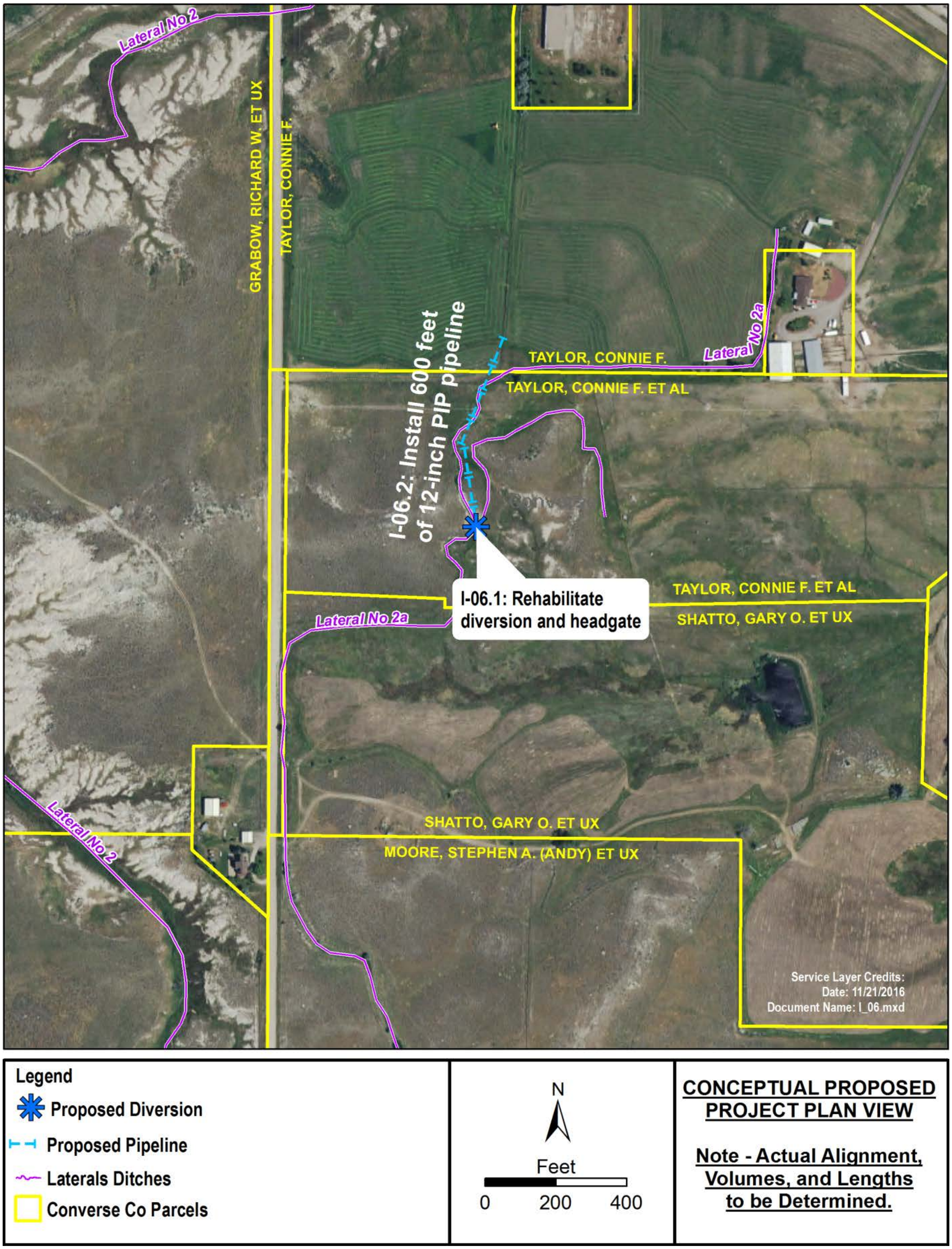


Figure 4.6. Proposed I-06: LaPrele Lateral No. 2A Sublateral Project.

4.3.7 I-07: East Side No. 3 Reservoir

The East Side No. 3 Reservoir (Grabow Reservoir) was identified by the LID as needing rehabilitation. The reservoir consists of an earthen dam with a storage capacity of 116.7 acre-feet, is located in Section 5 of Township 32 North, Range 72 West in Converse County, and is operated and maintained by the LID. The dam lies across the LaPrele Lateral No. 2 and provides storage capacity to downstream irrigated acres.

The reservoir has issues with its outlet facilities as well as sedimentation and shoreline erosion. The purpose of this project is to ensure irrigation water-storage capacity and delivery. The project, as shown in Figure 4.7, could involve the following components:

- Item No. I-07.1: rehabilitate dam and reservoir
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

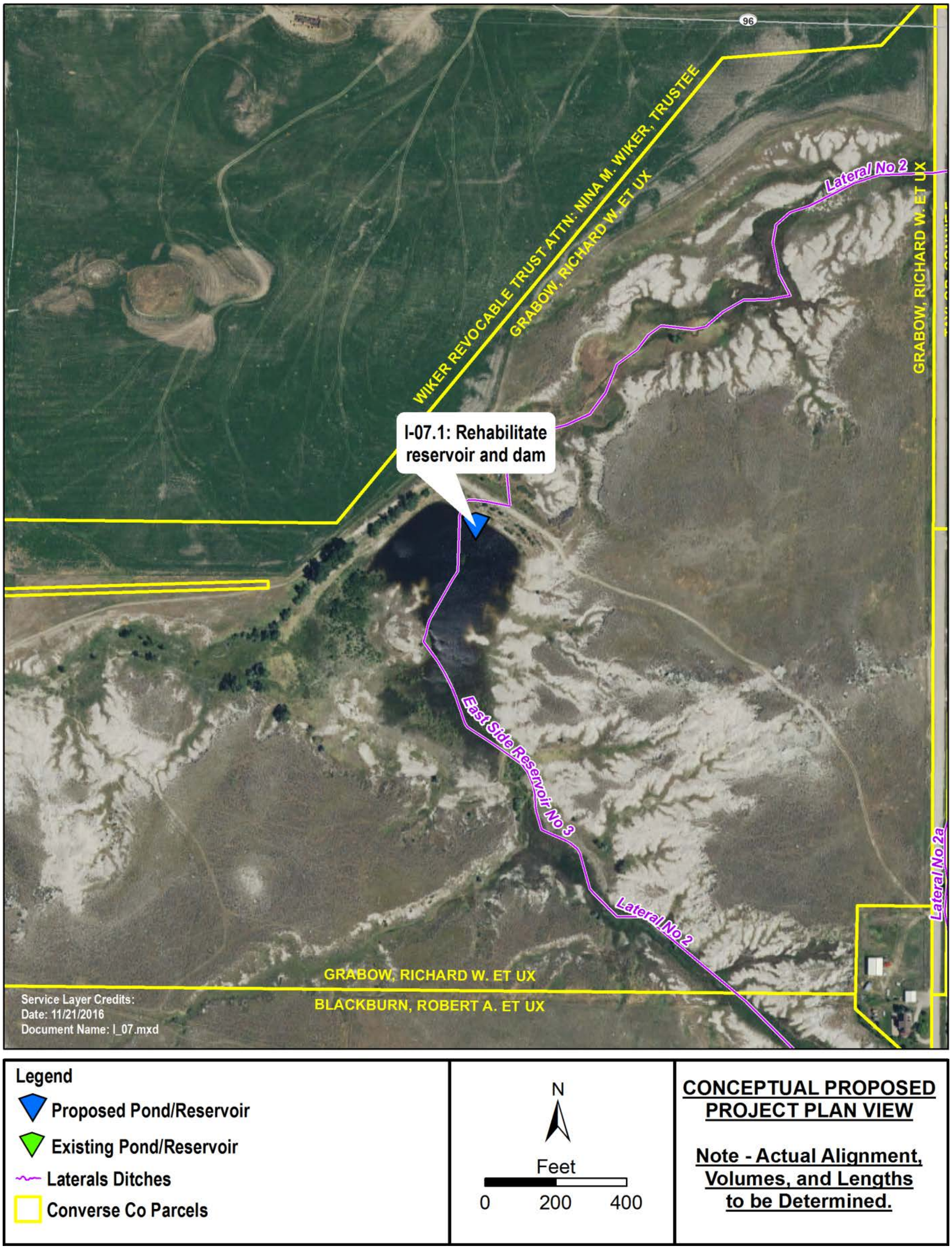


Figure 4.7. Proposed I-07: East Side No. 3 Reservoir Project.

4.3.8 I-08: J A Moran Ditch Irrigation-Regulating Reservoir

The J A Moran Ditch irrigation-regulating reservoir project would be located at the end of the J A Moran Ditch. The proposed site is located on an unnamed, intermittent tributary to Horseshoe Creek in Section 21 of Township 29 North, Range 69 West in Platte County. The water that is delivered from the ditch currently irrigates hay fields along minor drainages tributary to Horseshoe Creek through a series of field ditches and gated pipe. The project would involve constructing a reservoir, which would require investigating soil and geologic conditions and procuring permits. The purpose of this alternative, as shown in Figure 4.8, would involve the following components:

- Item No. I-08.1: construct an irrigation-regulating reservoir with a volume less than 20 acre-feet
- Investigating site-specific soil and geologic conditions to determine site suitability and feasibility of structure installations or other conditions of the underlying formations
- Installing an inlet and outlet control mechanism to control water levels. The installed structures would be stabilized with rock riprap
- Excavating an earthen, grass-lined spillway to adequately convey necessary water volumes, and stabilizing with rock riprap for spillway protection
- Feasibility is contingent on determining adequate sources of borrow material and rock riprap for dam embankment construction and spillway stabilization
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

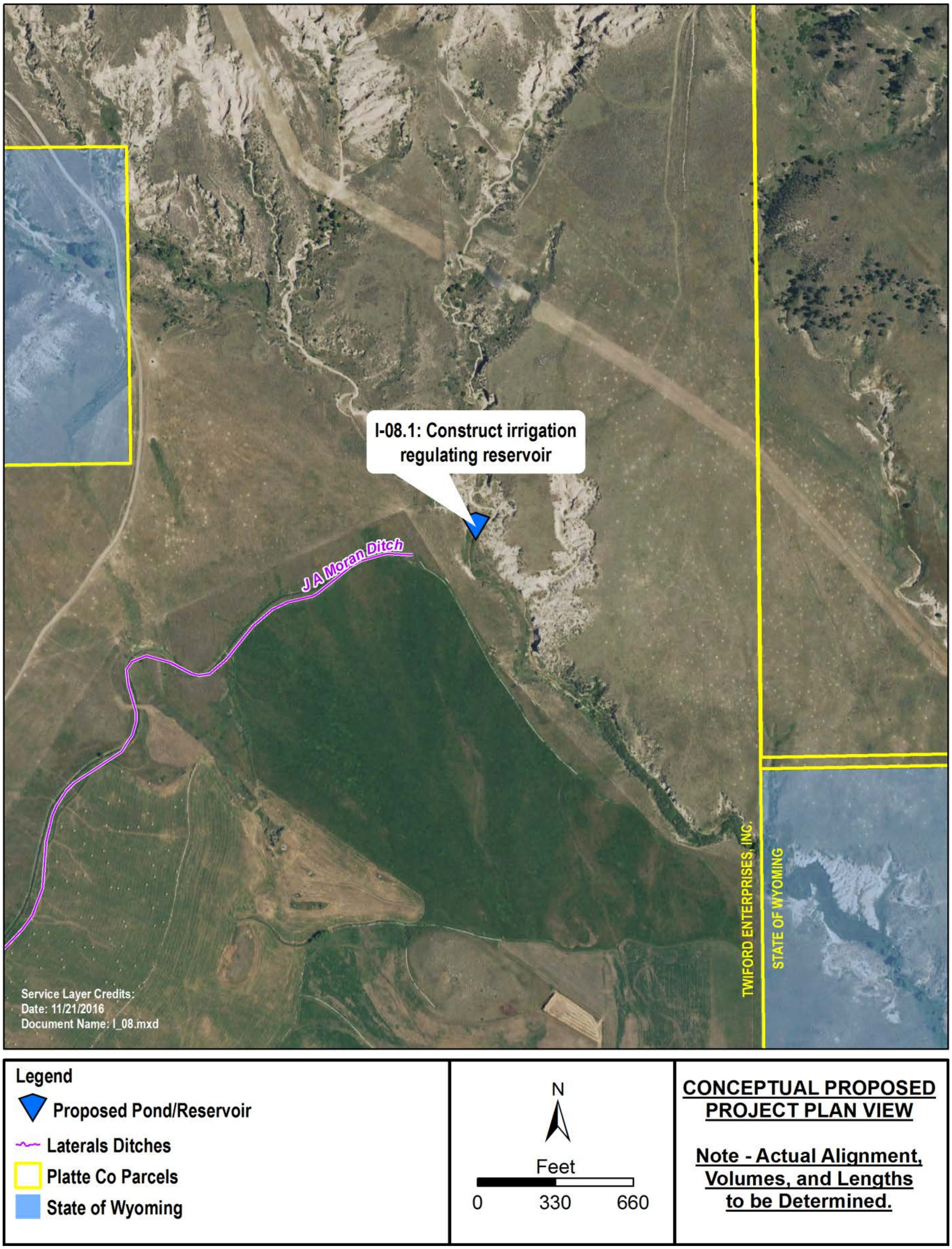


Figure 4.8. Proposed I-08: J A Moran Ditch Irrigation Water Regulation Project.

4.3.9 I-09: Walker No. 3 Ditch

The Walker No. 3 Ditch diverts water from Horseshoe Creek in Section 22 of Township 29 North, Range 68 West in Platte County. The ditch is used to irrigate hay fields along Horseshoe Creek and stretches for 19,570 feet (3.71 mile), and consists of both earthen ditch and pipe sections. The ditch also serves as a livestock watering source.

Based on field evaluation, the diversion is functional and appears stable. The first 3,600 feet (0.68 miles) of Walker No. 3 is earthen ditch through hay fields that experience periodic grazing. This section of the ditch often experiences damage from livestock during grazing periods, which requires repair, sends excess sediment down the ditch, and causes inconsistencies in irrigation. The ditch also has issues with seepage and vegetation. The purpose of this project is to ensure irrigation water delivery. The alternative shown in Figure 4.9 could involve the following components:

- Item No. I-09.1: rehabilitate headgate structure
- Item No. I-09.2: install 3,500 feet of 24-inch PIP pipeline
- Item No. I-09.3: install 5,300 feet of 18-inch PIP pipeline
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.3.10 I-10: Hoffman Ditch and Diversion

The Hoffman Ditch diverts water from Horseshoe Creek in Section 22 of Township 29 North, Range 68 West in Platte County. The ditch is approximately 12,860 feet (2.43 miles) and irrigates hay fields along Horseshoe Creek. The Hoffman Ditch Diversion lies on a meandering section of Horseshoe Creek.

In recent years, the creek has cut the diversion and headgate structures off from the Hoffman Ditch, which required the diversion to be relocated and repaired. The diversion is in poor condition, and the headgate is at risk of being cut off once again. Three additional meandering sections of Horseshoe Creek are threatening the Hoffman ditch itself, downstream from the diversion. During the field evaluation, one actively-cutting bank was measured within 30 feet of the ditch, while the other two threatened sections were identified by using areal imagery. The purpose of this project is to ensure irrigation water delivery and stabilize streambanks on Horseshoe Creek. The project as shown in Figure 4.9 could involve the following components:

- Item No. I-10.1: rehabilitate diversion and headgate structure
- Item No. I-10.2: install 3,500 feet of 12-inch PIP pipeline
- Item No. I-10.3: install approximately 725 feet of streambank stabilization
- The proposed project is located entirely on private lands.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

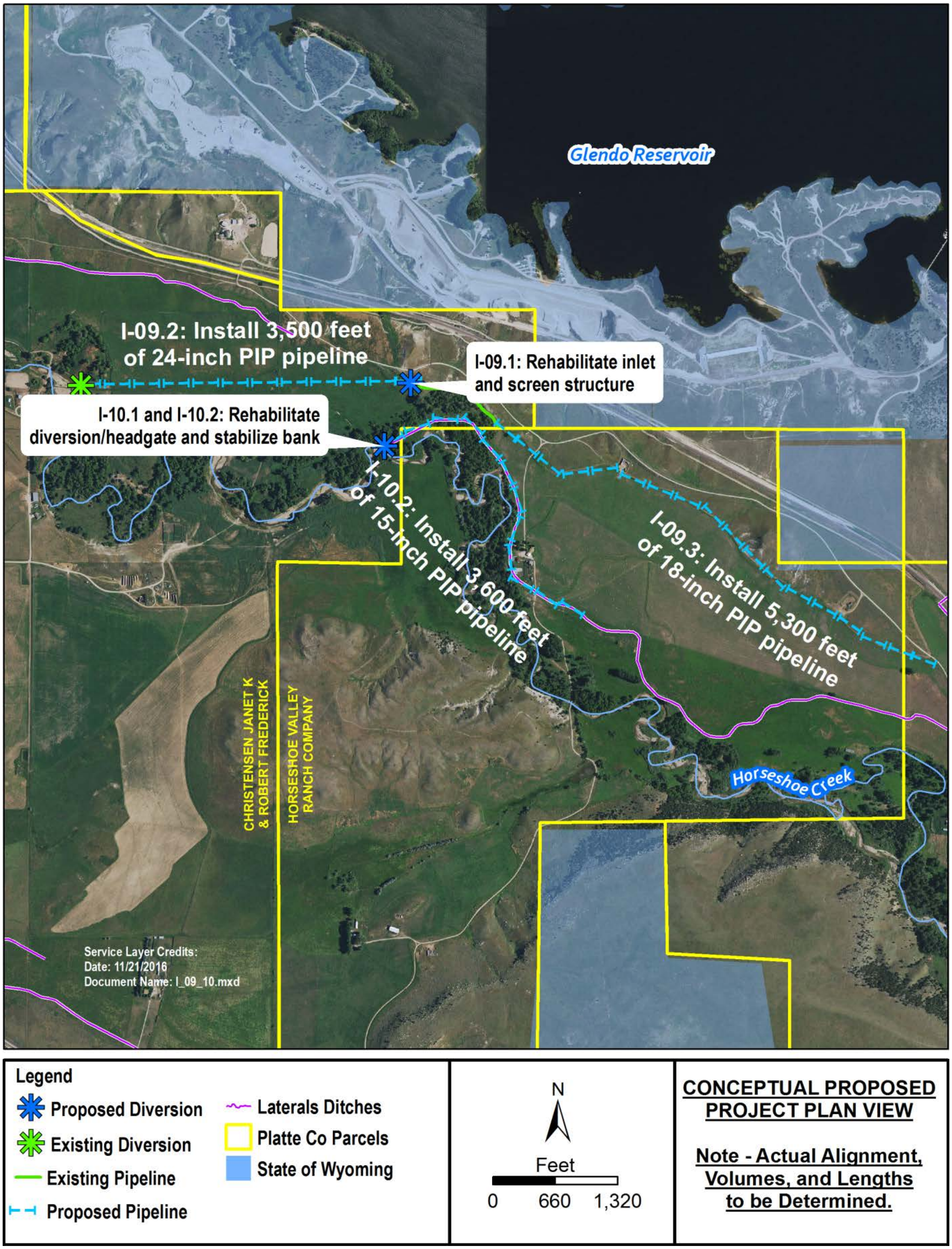


Figure 4.9. Proposed I-09 and I-10: Walker No. 3 Ditch and Hoffman Ditch Projects.

4.3.11 I-11: Johnson Pump Lift (Cassa Ditch)

The Johnson Pump Lift As Changed To (ACT) Cassa Ditch diverts water directly from the North Platte River in Section 12 of Township 28 North, Range 68 West in Platte County and is approximately 10,090 feet (1.91 miles) long. The diversion consists of a vertical turbine pump elevated over a concrete diversion box on the riverbank. Irrigation water is pumped through a 740-foot (0.14-mile) section of 15-inch PIP to a concrete-lined ditch. The ditch runs the remaining 9,350 feet (1.77 miles) and delivers water to two different irrigation regulation reservoirs that are used for center-pivot and sideroll sprinkler systems, and directly to field ditches for flood irrigation.

The existing concrete ditch has accumulated significant amounts of sediment and vegetation growth, and the existing irrigation regulating reservoirs experience significant seepage and evaporation. The purpose of this project is to improve irrigation water efficiency. The project, as shown in Figure 4.10, could involve the following components:

- Item No. I-11.1: rehabilitate regulating reservoir inlet and screen structure
- Item No. I-11.2: rehabilitate regulating reservoir inlet and screen structure
- Item No. I-11.3: install approximately 1,200 feet of 18-inch PIP pipeline
- Item No. I-11.4: install approximately 2,200 feet of 15-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

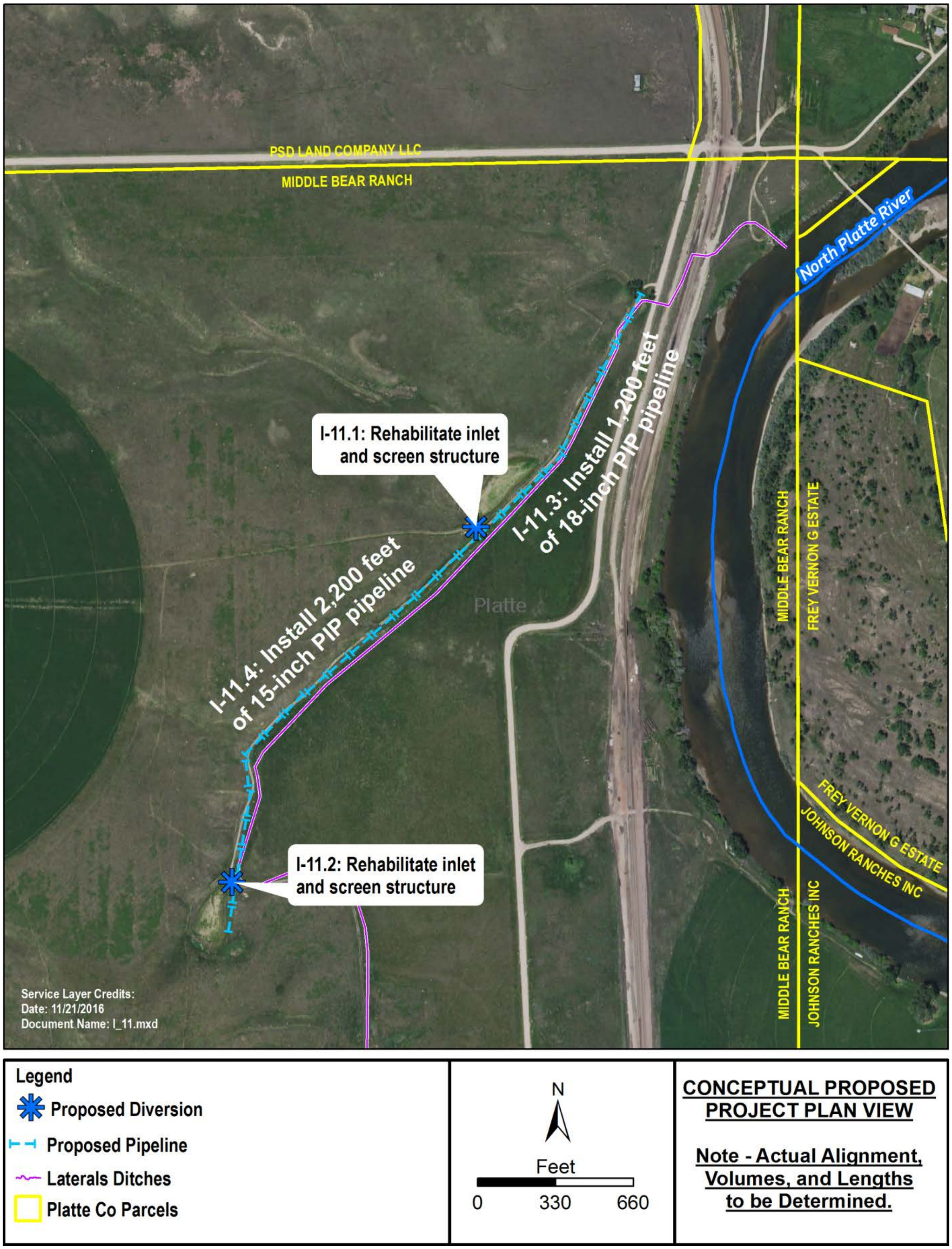


Figure 4.10. Proposed I-11: Johnson Pump Lift (Cassa Ditch) Project.

4.3.12 I-12: Wright No. 2 Ditch

The Wright No. 2 Ditch diversion and headgate are located on Cottonwood Creek in Section 28 of Township 27 North, Range 68 West in Platte County. This diversion is located upstream from the proposed project, I-13 Wright No. 2 Ditch (Enlargement) diversion, and across the channel on Cottonwood Creek. The diversion consists of a rock weir and concrete headgate structure and supplies irrigation water to hay fields along Cottonwood Creek. The rock weir has deteriorated and is unable to divert sufficient water through the headgate to meet irrigation demands. The earthen ditch is used to irrigate hay fields along the north side of Cottonwood Creek and stretches for 19,570 feet (3.71 miles).

Based on field evaluation, the diversion structure has failed and needs to be rehabilitated to ensure irrigation-water delivery. The project, as shown in Figure 4.11, could involve the following components:

- Item No. I-12.1: rehabilitate diversion and headgate structure
- Item No. I-12.2: install 3,500 feet of 12-inch PIP pipeline
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.3.13 I-13: Wright No. 2 Ditch (Enlargement)

The Wright No. 2 Ditch (Enlargement) diversion is located in Section 28 of Township 27 North, Range 68 West in Platte County. This diversion is located downstream from the proposed project; I-12 Wright No. 2 Ditch diversion, and across the channel on Cottonwood Creek. The diversion consists of a rock cross-vane weir and sheet piling with a steel headgate and bypass structure and supplies irrigation water to hay fields along Cottonwood Creek. The rock weir was scattered during high flow, which also scoured the left streambank. The structure is currently unable to divert sufficient water through the headgate to meet irrigation demands. The earthen ditch is used to irrigate hay fields along the south side of Cottonwood Creek and stretches for 19,570 feet (3.71 miles).

Based on a field evaluation, the diversion structure has failed and needs to be replaced and the channel bank needs to be stabilized to ensure irrigation-water delivery. The project, as shown in Figure 4.11, could involve the following components:

- Item No. I-13.1: rehabilitate diversion structure
- Item No. I-13.2: install 2,800 feet of 12-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

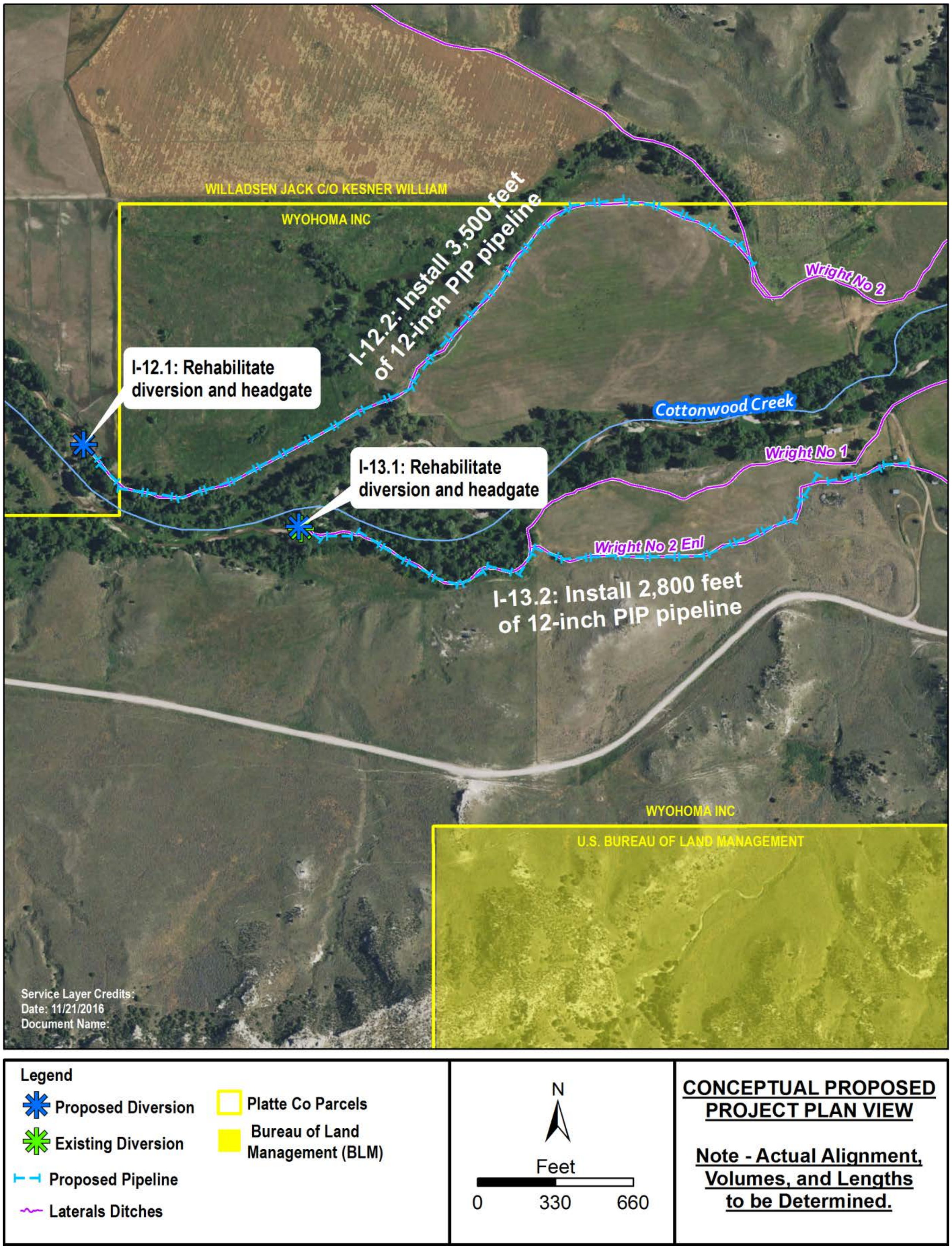


Figure 4.11. Proposed I-12 and I-13: Wright No. 2 Ditch and Wright No. 2 (Enlargement) Projects.

4.3.14 I-14: Seepage Saddle Ditch and Diversion

The Seepage Saddle Ditch diversion is located on Hunton Creek in Section 35 of Township 33 North, Range 75 West in Converse County. The diversion consists of a concrete structure and supplies irrigation water via the Seepage Saddle Ditch to hay fields along a tributary to East Fork Dry Creek and Vernon Creek. The fields are irrigated by a combination of flooded field ditches and gated pipe.

High flows on Hunton Creek have caused significant scour around the concrete diversion structure. The existing system of ditches and gated pipe is difficult to manage and control, which results in inefficient application of irrigation water. Based on a field evaluation, the diversion structure on Hunton Creek is functional but needs to be rehabilitated and stabilized. The purpose of this project is to ensure irrigation-water delivery and improve efficiency. The project, as shown in Figure 4.12, could involve the following components:

- Item No. I-14.1: rehabilitate diversion structure and install stability measures
- Item No. I-14.2: install diversion and headgate structure
- Item No. I-14.3: install approximately 1,400 feet of 18-inch PIP pipeline
- Item No. I-14.4: install approximately 3,000 feet of 12-inch PIP pipeline
- Item No. I-14.5: install approximately 1,200 feet of 12-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

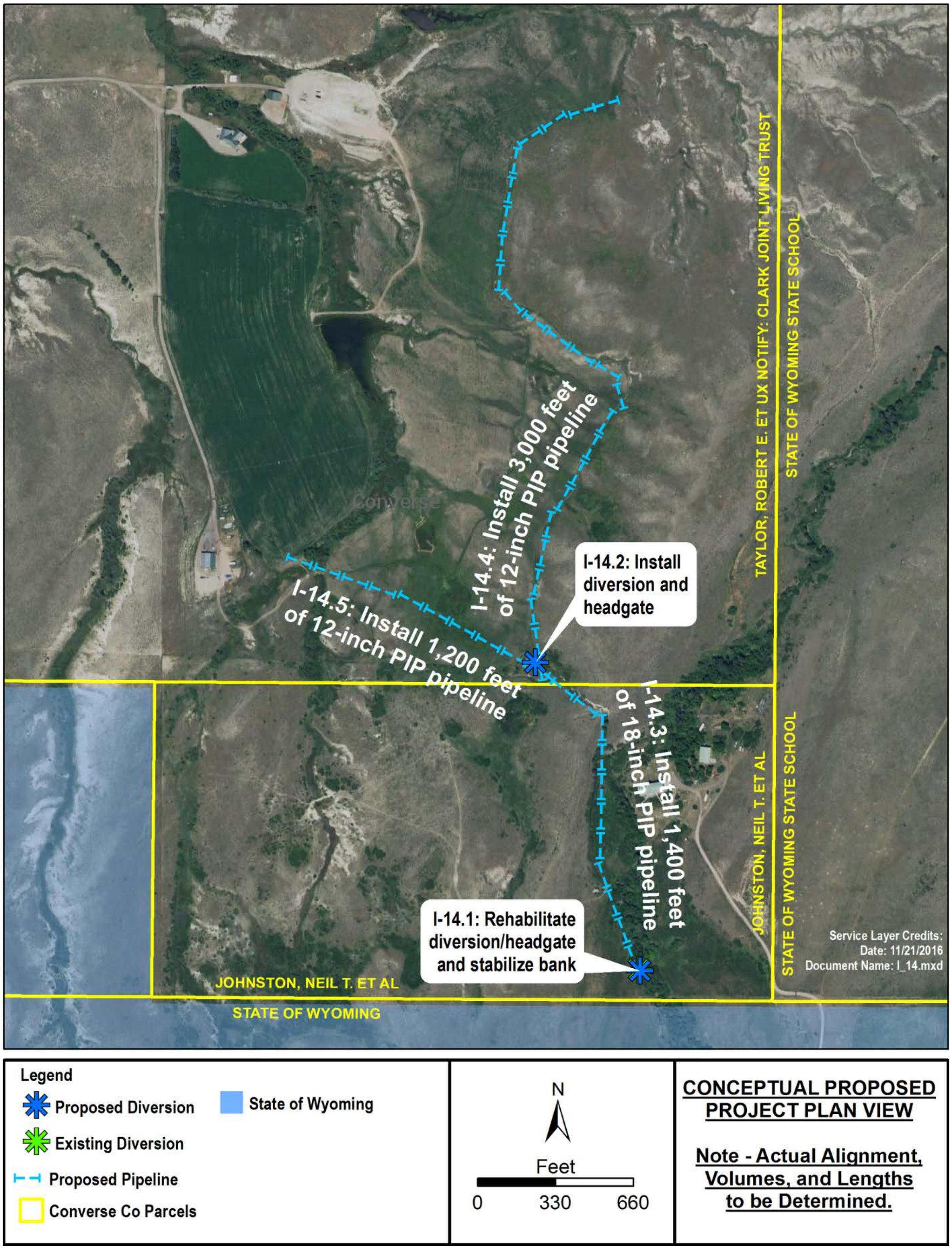


Figure 4.12. Proposed I-14: Seepage Saddle Ditch and Diversion Project.

4.3.15 I-15: Carey Ditch No. 2 Ditch

The Carey Ditch No. 2 diversion is located on Deer Creek in Section 9 of Township 33 North, Range 75 West in Converse County. The Carey Ditch No. 2 is approximately 13,100 feet (2.5 miles) in total length. The original appropriation for the ditch is 3.06 cfs that irrigates 214 acres. The Carey Ditch No. 2 diversion dam is functioning and is constructed of heavy-gage steel sheet piling. The headgate consists of a concrete structure with wood framing, and the original slide gate is no longer operational, so improvised methods have been in use.

Carey Ditch No. 2 consists of several different sections of pipe, open ditch, and culvert road crossings. Seepage, evaporation, sedimentation, vegetative transpiration, erosion, and encroachment issues exist all along Carey Ditch No. 2. In 2005, the NRCS investigated the ditch and evaluated alternatives for lining or piping the sections of earthen ditch, between 9,000 and 10,000 feet in total. Alternatives ranged from $100,000 for a concrete lining to $245,000 for 24-inch corrugated high-density polyethylene (HDPE) (in 2005 dollars).

Based on a field evaluation, the headgate structure is in poor condition and needs to be rehabilitated to ensure irrigation-water delivery. The project, as shown in Figure 4.13, could involve the following components:

- Item No. I-15.1: rehabilitate headgate structure
- Item No. I-15.2: install headgate structure for new pipe
- Item No. I-15.3: install approximately 2,200 feet of 18-inch PIP pipeline
- Item No. I-15.4: install approximately 2,800 feet of 18-inch PIP pipeline
- The proposed project is located entirely on private land
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

Figure 4.13. Proposed I-15: Carey Ditch No. 2 Project.

4.4 LIVESTOCK/WILDLIFE WATERING OPPORTUNITIES

4.4.1 Livestock/Wildlife Water Requirements

Water requirements for livestock/wildlife depend on the type, density, and seasonality of the grazing animals, along with the topography, water availability, and plant communities. Existing livestock/ wildlife water sources that were evaluated in the study area were presented and discussed in Section 3.4.8.5 and are illustrated in Figure 3.67. The purpose of evaluating viable livestock/wildlife watering sources and facilities is to identify possible alternatives to unreliable supplies, inconsistently used rangelands, and nonfunctioning riparian areas.

The study area also contains areas where water sources are insufficient to meet the requirements for livestock/wildlife. A large portion of these sources are reservoirs that are located on intermittent streams that have inconsistent and unreliable runoff patterns. Because of this uncertainty, some areas could benefit from upland water development. Participating landowners identified places where existing water sources could be improved.

Many springs that are located within the study area could be developed as livestock/wildlife water sources. However, before initiating any spring development project, a site-specific assessment should be performed to confirm that sufficient yield is present and to identify necessary conservation measures. Moreover, any final plan and design of a livestock/wildlife water project should consider the available water yield, topography of the site, component material and specifications, and number of animals served by the system.

For the purposes of this study, conceptual livestock/wildlife water components and associated facilities were created and located on parcels, allotments, and pastures for landowners who participated in the study. The typical project component was assumed to consist of a rubber tire stock tank that provides approximately 2,000 gallons of livestock/wildlife water supplied by a well and solar pump via a 1.5-inch HDPE pipeline. The stock tank would provide a volume of water for approximately 130 cattle per day, assuming a daily requirement of 15 gallons per head per day. The tanks could also provide water for antelope and mule deer, assuming a daily requirement of 2 gallons per animal per day. Also, closed storage tanks were included in the components to better use existing sources. Pipeline sizes were assumed based on potential future needs for expanding the distribution system requirements.

The project components in this study are conceptual only and are described in general for this report. Before installation, the actual locations; specifications; alignments; volumes; and lengths of pipelines, tanks, wells, and pumps should be determined. Installing wildlife escape ramps and/or devices in the proposed water tanks and incorporating all of the valves, fittings, and appurtenances to facilitate managing flows and water levels are also recommended.

4.4.2 Conceptual Livestock/Wildlife Water Proposed Projects

Meetings held in Douglas, Glendo, Lusk, and Wheatland provided an opportunity to meet interested landowners and grazing allotment permittees, gain study area input, hear local resource concerns, and answer questions about the study. Participation in the study was voluntary and a list of interested participants was created after these meetings. On-site, individual meetings were scheduled and conducted with study participants. During these meetings, the study team listened to the participants' concerns about water needs and visited potential project sites.

The participant meetings and the information about existing water sources resulted in identifying areas within the study area that need livestock/wildlife water development and several conceptual water-development projects. These proposed projects were developed to provide reliable water sources for livestock/wildlife in areas that lack sufficient sources within the watershed. These project designs are conceptual only, and, if initiated, would require additional design work before installation. The proposed projects and components in the Watershed Management Plan are summarized in Table 4.2. Figure 4.14 displays the general location of all of the proposed livestock/wildlife water projects.

Because state lands cover approximately 11 percent of the study area and are intermingled with private lands, some of the upland water-development projects would involve coordination with the Wyoming Office of State Lands and Investments (OSLI) before initiating construction. Additionally, some projects could potentially involve cooperation among multiple landowners because of the locations of wells and routes for pipelines. For these projects that span multiple landowners, written agreements would be necessary to outline the specific responsibilities and liabilities of the parties involved with each individual project. Moreover, environmental evaluations would be required for any potential effects that are identified for a specific project or project component, especially on federal and state lands. Therefore, coordination is necessary with the BLM and US Forest Service (USFS) before implementing any project on federal land, and coordination with the OSLI is required before constructing any improvements on state land.

A total of 19 proposed livestock/wildlife water-development projects with 53 components are described in Sections 4.4.2.1 through 4.4.2.2. These sections summarize well construction, stock pond/reservoir construction or rehabilitation, pipeline installation, and watering or storage tank components. Figures 4.15 through 4.28 display the conceptual plan maps of these proposed livestock/wildlife water-development and rehabilitation projects within the study area.

Future livestock/wildlife water projects are eligible for application funding through the WWDC's SWPP because of their location within the study area. However, these projects would need additional information and coordination with interested landowners before applications are submitted to the Wyoming Water Development Office (WWDO) by a sponsoring entity such as a conservation district, watershed improvement district, water conservancy district, irrigation districts, municipality, or a tribal business council. The additional information needed for pursuing program funding could, but is certainly not limited to the following: program application, detailed project description, description of public benefit, outline of financial and technical contributions, project location map, project cost estimates, and any letters of authorization or commitment of participation that may be available from other funding sources.

Table 4.2. Summary of Livestock/Wildlife Water Proposed Plans and Components

Plan Item	Project Name	Solar Pump	Well	Spring Development	Pipeline	Stock Tank	Storage Tank	Pond-Reservoir
LW-01	East Draw							3
LW-02	Lone Tree	1		1	1,810	2		
LW-03	Lawrence #1		1		3,920	2		
LW-04	Section 11		1					
LW-05	Prado 1	1	1		2,850	2		1
LW-06	Section 7		1		500	1		
LW-07	T-J-T #2				3,730	2		
LW-08	Rock House No. 1	1		1	500	2		
LW-09	Buggy Hub	1		1	500	1		
LW-10	Upper Draw	1		1	500	1		
LW-11	Larime #1	1			1,520	2		1
LW-12	Rodeman Livestock #2				500	1		
LW-13	CT 2A							1
LW-14	Pullman							1
LW-15	Westfork No. 1 (Blue Downey)							1
LW-16	Bill Young Spring #1	1		1	920	1	1	
LW-17	Bill Young Spring #2	1		1	1,150	1		
LW-18	Back 55	1			2,530	2		
LW-19	Don Sommers #2	1	1		500	2		
Total		**10**	**6**	**6**	**21,430**	**22**	**1**	**8**

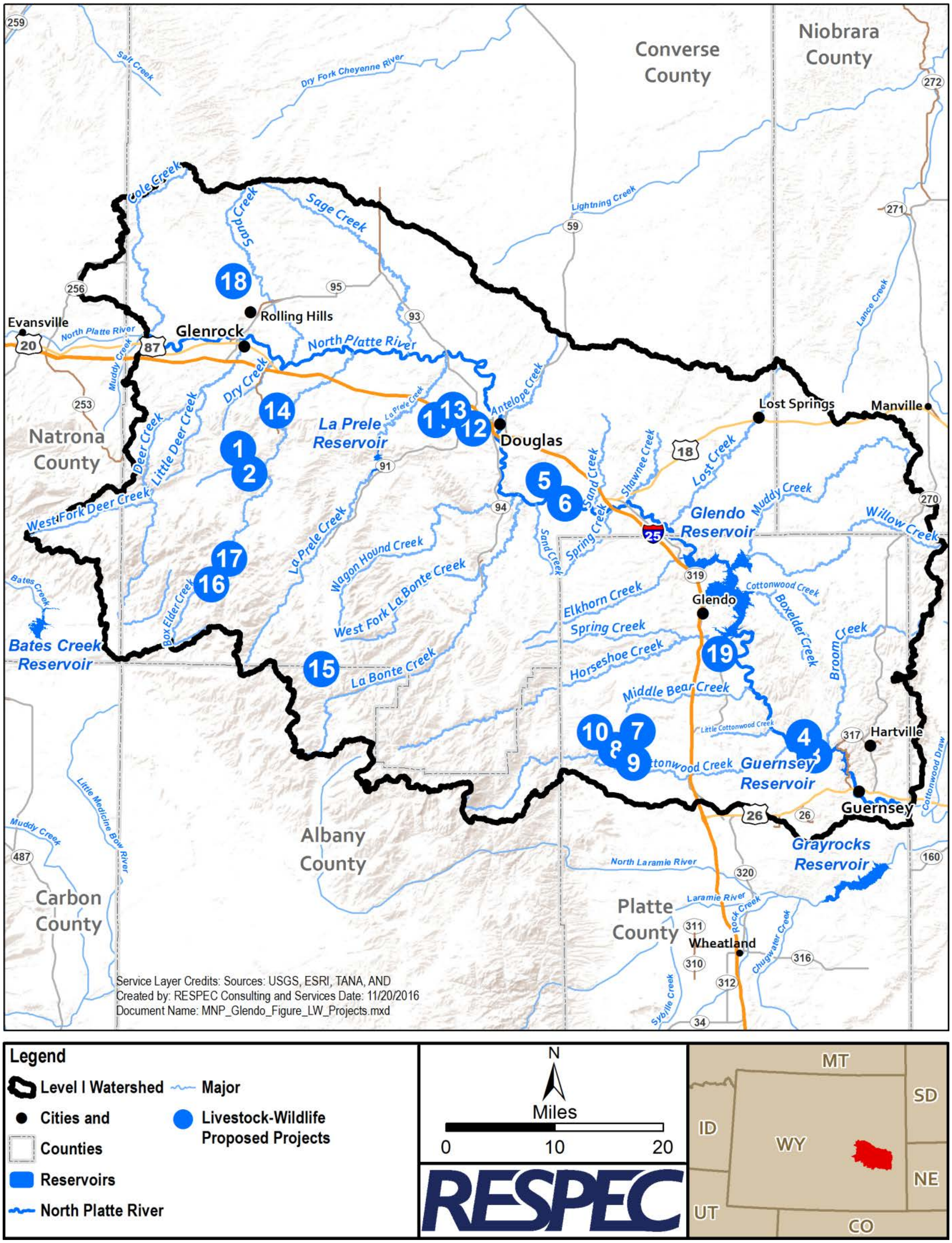


Figure 4.14. Conceptual Livestock/Wildlife Water Proposed Projects Within the Study Area.

4.4.2.1 *LW-01: East Draw Springs and Stock Ponds Project*

Project LW-01 would involve constructing three stock ponds associated with existing springs to provide additional sources of livestock/wildlife water along with associated wetland areas. The project would involve constructing a new pond/reservoir, which would require investigating soil and geologic conditions and procuring permits and/or clearances. The proposed site is located on an unnamed, intermittent tributary to Willow Creek in Sections 29 and 32 of Township 32 North, Range 75 West in Converse County. This alternative, as shown in Figure 4.15, would include the following features:

- Constructing three small stock ponds that would have a capacity of less than 3 acre-feet.
- Investigating site-specific soil and geologic conditions to determine site suitability and feasibility of structure installations or other conditions of the underlying formations.
- Installing an inlet and outlet control mechanism to control water levels. The installed structures would be stabilized with rock riprap.
- Excavating an earthen, grass-lined spillway to adequately convey necessary water volumes and stabilizing with rock riprap for spillway protection.
- Determining adequate sources of borrow material and rock riprap for dam embankment repairs and spillway stabilization.
- As proposed, the project involves private lands only.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.4.2.2 *LW-02: Lone Tree Spring Development and Tank Project*

Project LW-02 would involve rehabilitating an existing spring and installing a solar platform to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.15, would be installed:

- An existing spring would be developed and equipped with a solar platform that consists of solar panels; a solar-powered pump; batteries; and all of the regulators, connections, and appurtenances.
- From that source, approximately 1,810 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply two stock tanks (1,200-gallon capacity each).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

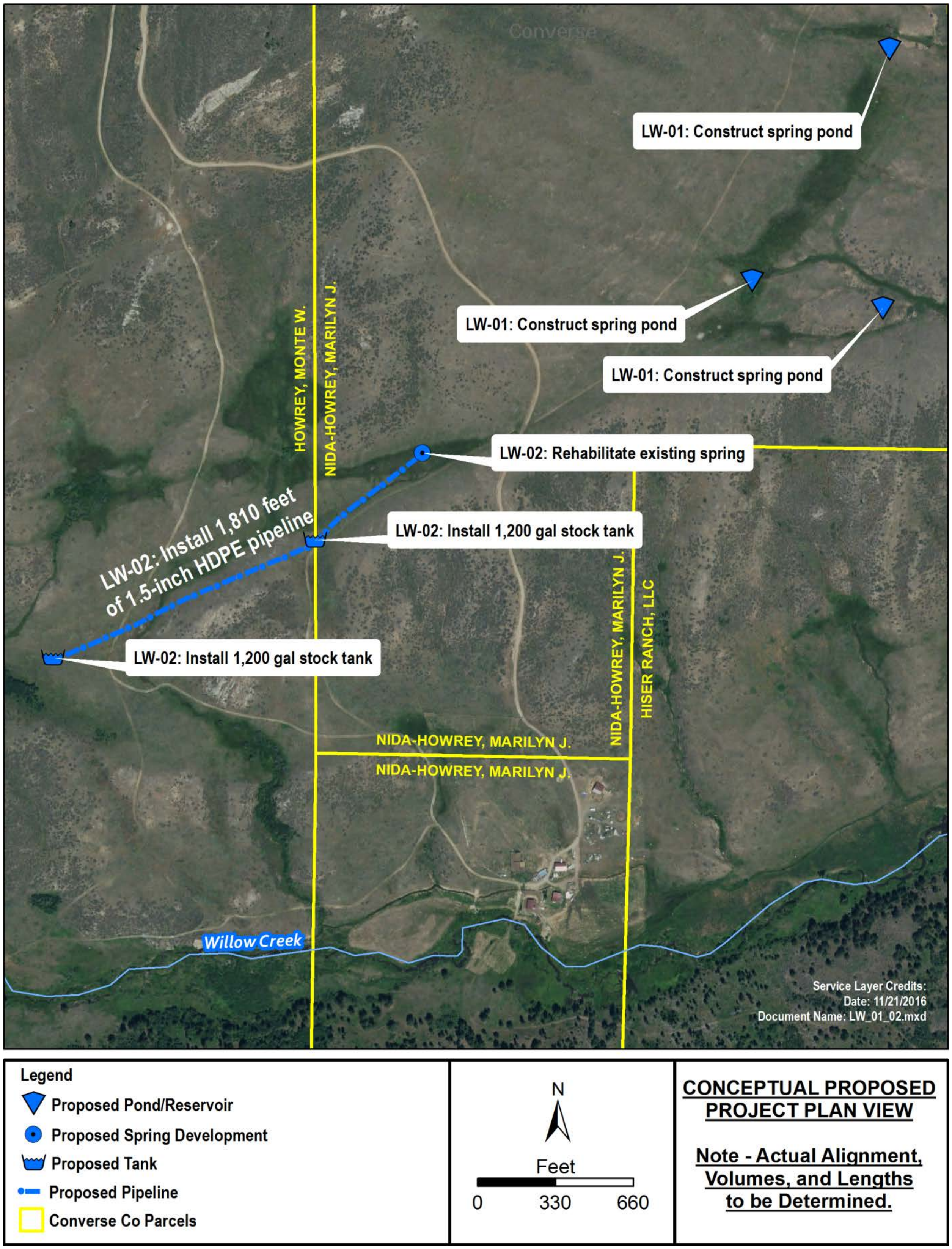


Figure 4.15. Proposed LW-01 and LW-02: East Draw Springs and Stock Ponds Project and Lone Tree Spring Development and Tank Project.

4.4.2.3 *LW-03: Lawrence #1 Well, Pipeline, and Tank Project*

Project LW-03 would involve rehabilitating an existing well to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.16, would be installed:

- An existing well would be rehabilitated to supply water. From that source, approximately 3,920 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply two stock tanks (1,200-gallon capacity each).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.4.2.4 *LW-04: Section 11 Well Rehabilitation Project*

Project LW-04 would involve rehabilitating an existing well to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. Under this alternative, the following components as shown in Figure 4.16 would be installed:

- An existing well would be rehabilitated to supply water via an existing buried pipeline supplying two existing stock tanks.
- Required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps are already incorporated in the existing stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

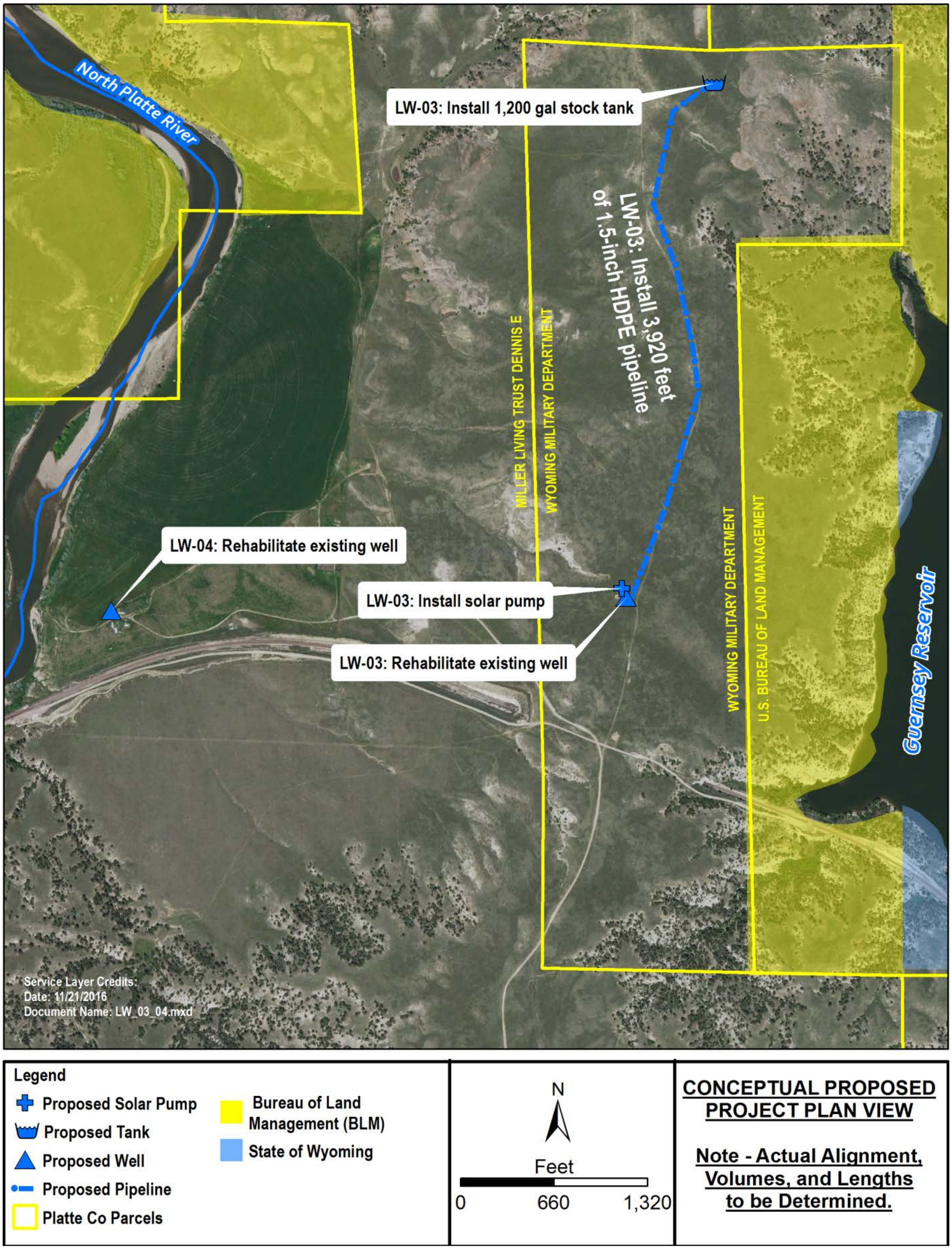


Figure 4.16. Proposed LW-03 and LW-04: Lawrence #1 Well, Pipeline, and Tank Project and Section 11 Well Project.

4.4.2.5 *LW-05: Prado 1 Well, Pipeline, and Tank Projects*

Project LW-05 would involve rehabilitating an existing well to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.17, would be installed:

- An existing well would be rehabilitated to supply water. From that source, approximately 500 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply two stock tanks (1,200-gallon capacity each).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.4.2.6 *LW-06: Section 7 Well, Pipeline, and Tank Projects*

Project LW-06 would involve rehabilitating an existing well to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.17, would be installed:

- An existing well would be rehabilitated to supply water. From that source, approximately 2,850 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

An additional component to this project is installing a stock pond to provide an additional source of livestock/wildlife water. This alternative includes the following features:

- Constructing a small stock pond that would have a capacity of less than 2 acre-feet.
- Investigating site-specific soil and geologic conditions to determine site suitability and feasibility of structure installations or other conditions of the underlying formations.
- As proposed, the project involves private lands only.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

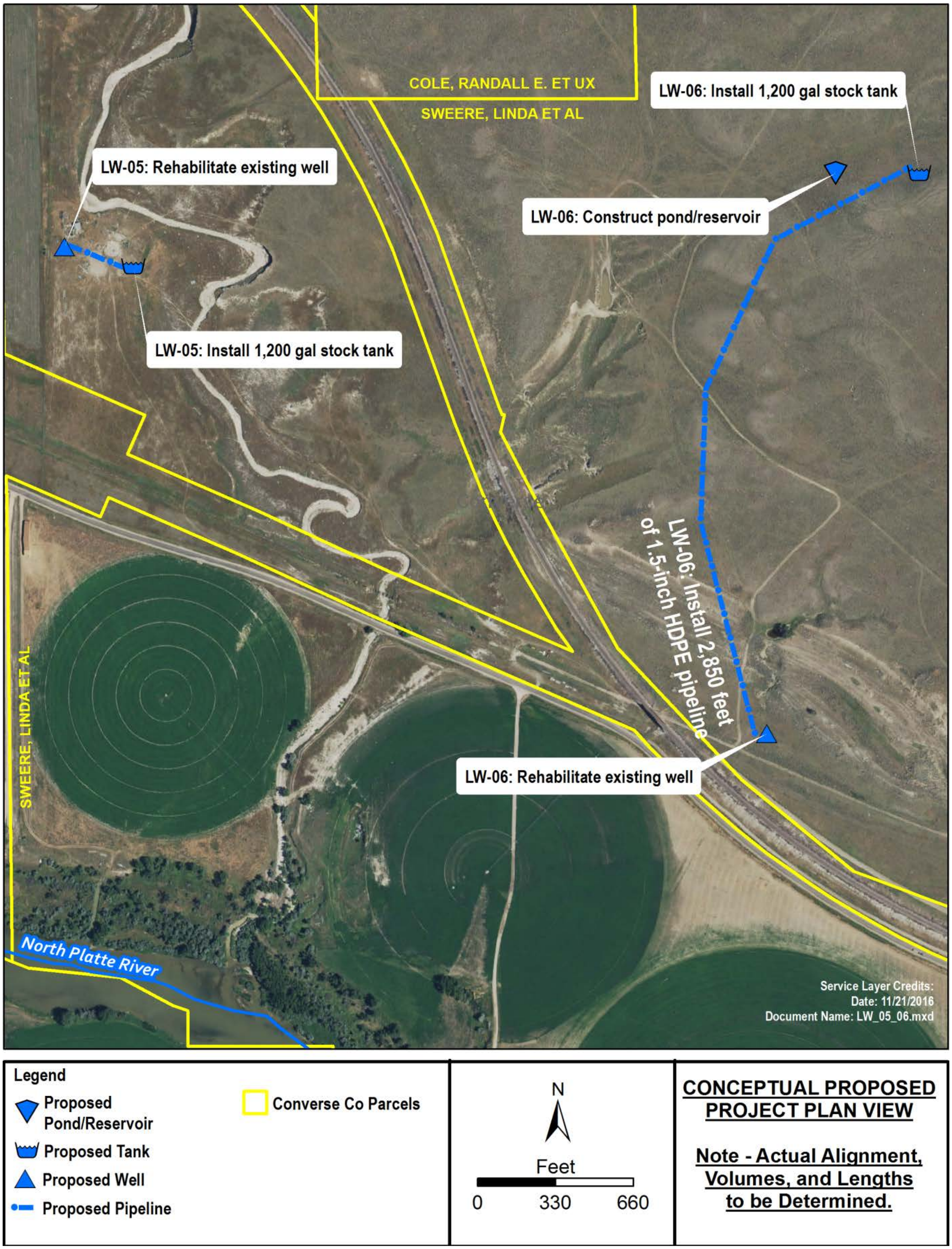


Figure 4.17. Proposed LW-05 and LW-06: Prado 1 Well and Section 7 Well Projects.

4.4.2.7 *LW-07: T-J-T #2 Pipeline and Tank Project*

Project LW-07 would involve installing a pipeline and tank system to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.18, would be installed:

- From an existing well, solar pump, and storage tank, 3,730 feet of buried 1.5-inch HDPE low-pressure pipeline, and 10,000 gallon storage tank would be installed to supply two stock tanks (1,200-gallon capacity each).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.4.2.8 *LW-08: Rock House No. 1 Spring Development and Tank Project*

Project LW-08 would involve rehabilitating an existing spring to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.18, would be installed:

- An existing spring would be rehabilitated to supply water. From that source, approximately 500 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply two stock tanks (1,200-gallon capacity each).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

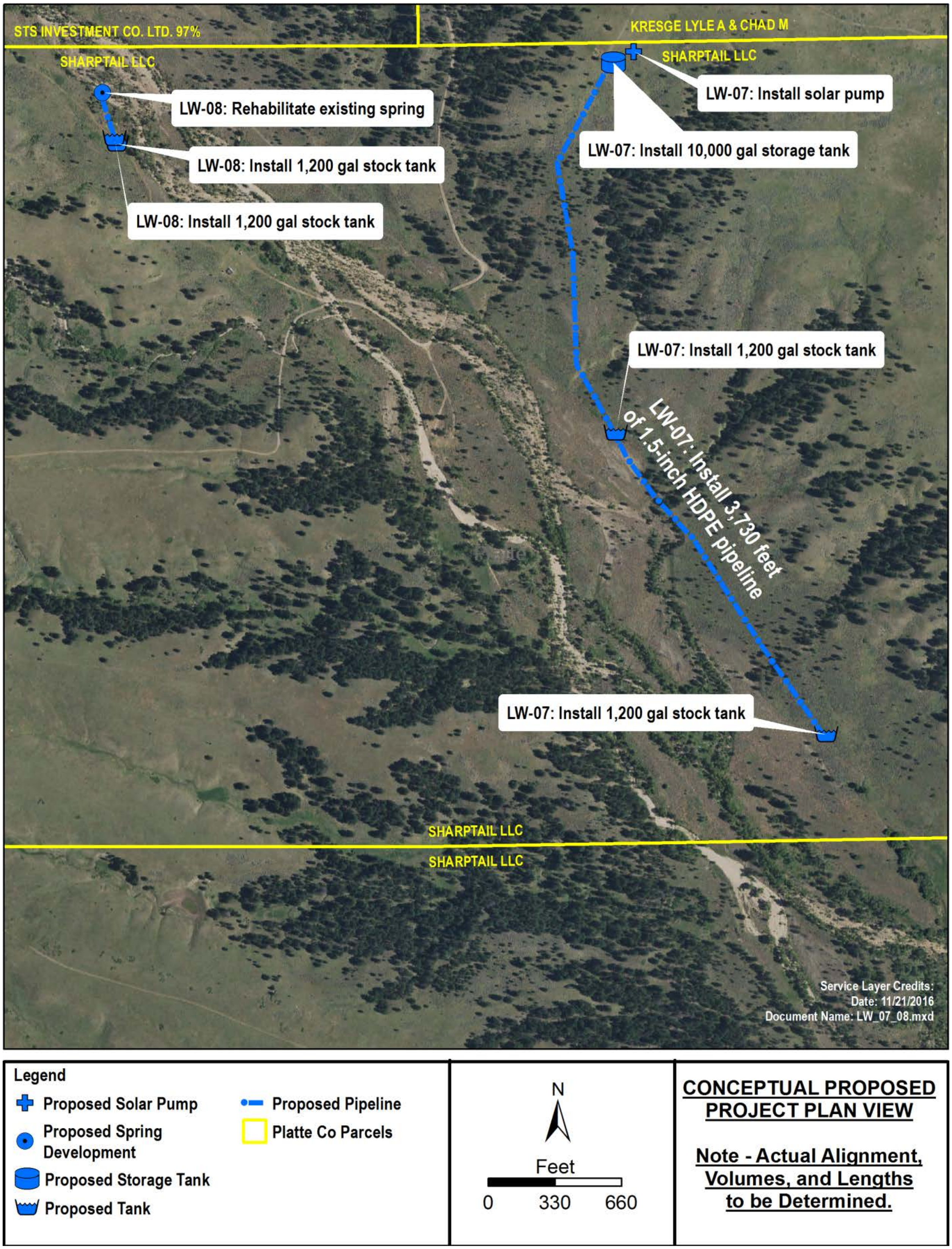


Figure 4.18. Proposed LW-07 and LW-08: T-J-T #2 Pipeline and Tank Project and Rock House No. 1 Spring Development and Tank Project.

4.4.2.9 *LW-09: Buggy Hub Spring Development and Tank Project*

Project LW-09 would involve rehabilitating an existing spring and installing a solar platform to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.19, would be installed:

- An existing spring would be developed and equipped with a solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances.
- From that source, approximately 500 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

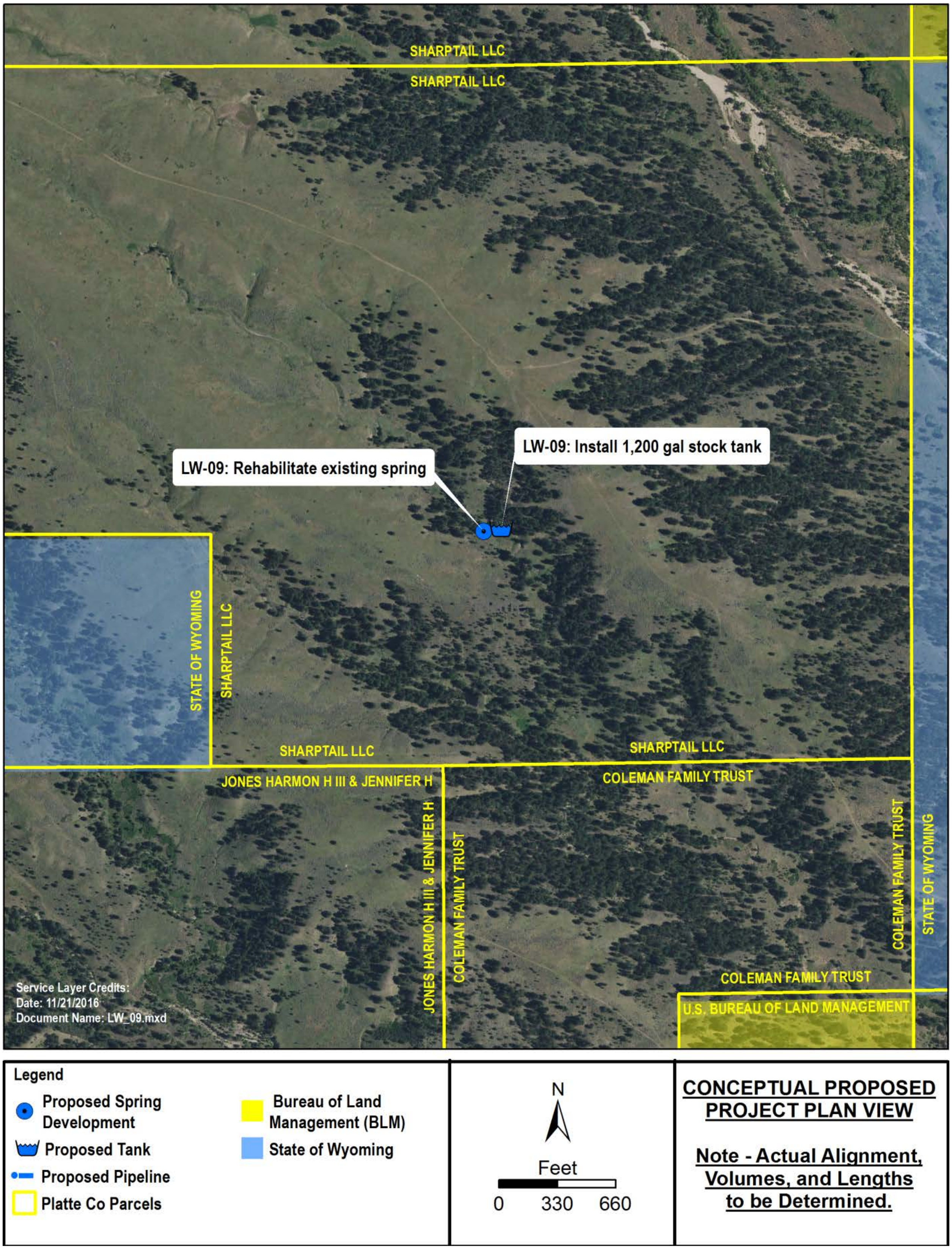


Figure 4.19. Proposed LW-09: Buggy Hub Spring Development and Tank Project.

4.4.2.10 *LW-10: Upper Draw Spring Development and Tank Project*

Project LW-10 would involve rehabilitating an existing spring and installing a solar platform to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.20, would be installed:

- An existing spring would be developed and equipped with a solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances.
- From that source, approximately 500 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

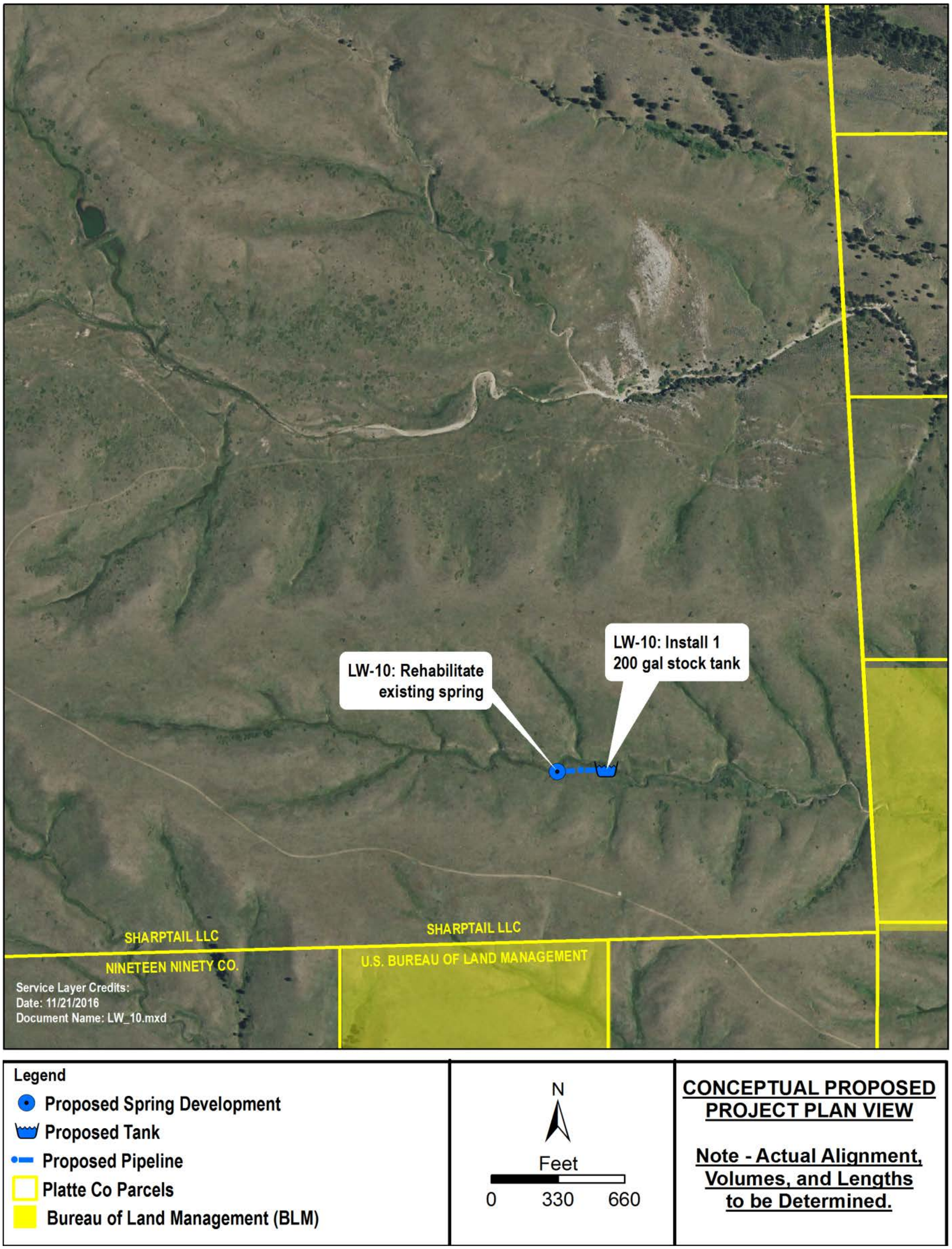


Figure 4.20. Proposed LW-10: Upper Draw Spring Development and Tank Project.

4.4.2.11 *LW-11: Larime #1 Stock Reservoir Rehabilitation and Tank Project*

Project LW-11 would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. The Larime #1 Stock Reservoir is located on Fivemile Creek in the Section 3 of Township 72 North, Range 32 West in Converse County. The Larime #1 Stock Reservoir (Permit No. P11848.0S) had a permitted total capacity of 3.0 acre-feet. This stock reservoir could be rehabilitated to provide livestock/wildlife water along with restoring functions of the associated wetland and riparian areas. This alternative would involve installing an inlet and outlet pipe-control structure in the embankment and stabilizing the installed structures and spillway with rock riprap. This alternative, as shown in Figure 4.21, includes the following features:

- Inspecting the embankment and rehabilitating problem areas as needed.
- Rehabilitating the outlet facilities to control reservoir water levels. The installed structures would be stabilized with rock riprap.
- Excavating the earthen spillway to adequately convey necessary water volumes and stabilizing with rock riprap for spillway protection.
- Determining adequate sources of borrow material and rock riprap for dam embankment repairs and spillway stabilization.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

An additional component to this project would involve installing a solar platform from the existing stock reservoir to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.21, would be installed:

- A solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances would be installed to pump from an existing stock reservoir equipped with a control structure to supply livestock/wildlife.
- From that rehabilitated reservoir, approximately 1,520 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply two stock tanks (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

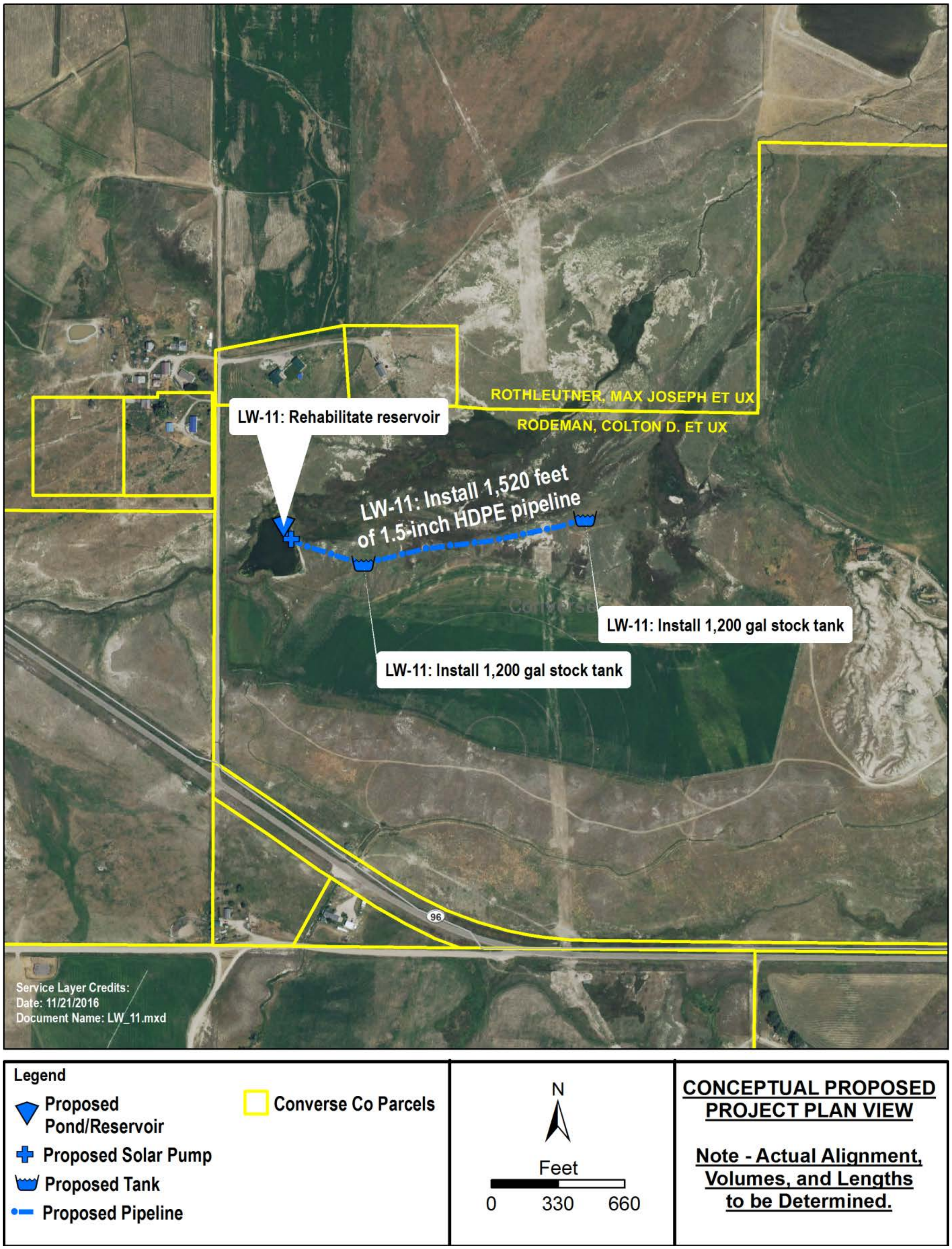


Figure 4.21. Proposed LW-11: Larime #1 Stock Reservoir Rehabilitation and Tank Project.

4.4.2.12 *LW-12: Rodeman Livestock #2 Pipeline and Tank Project*

Project LW-12 would involve installing a pipeline and tank system to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.22, would be installed:

- From an existing well, 5 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tank.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

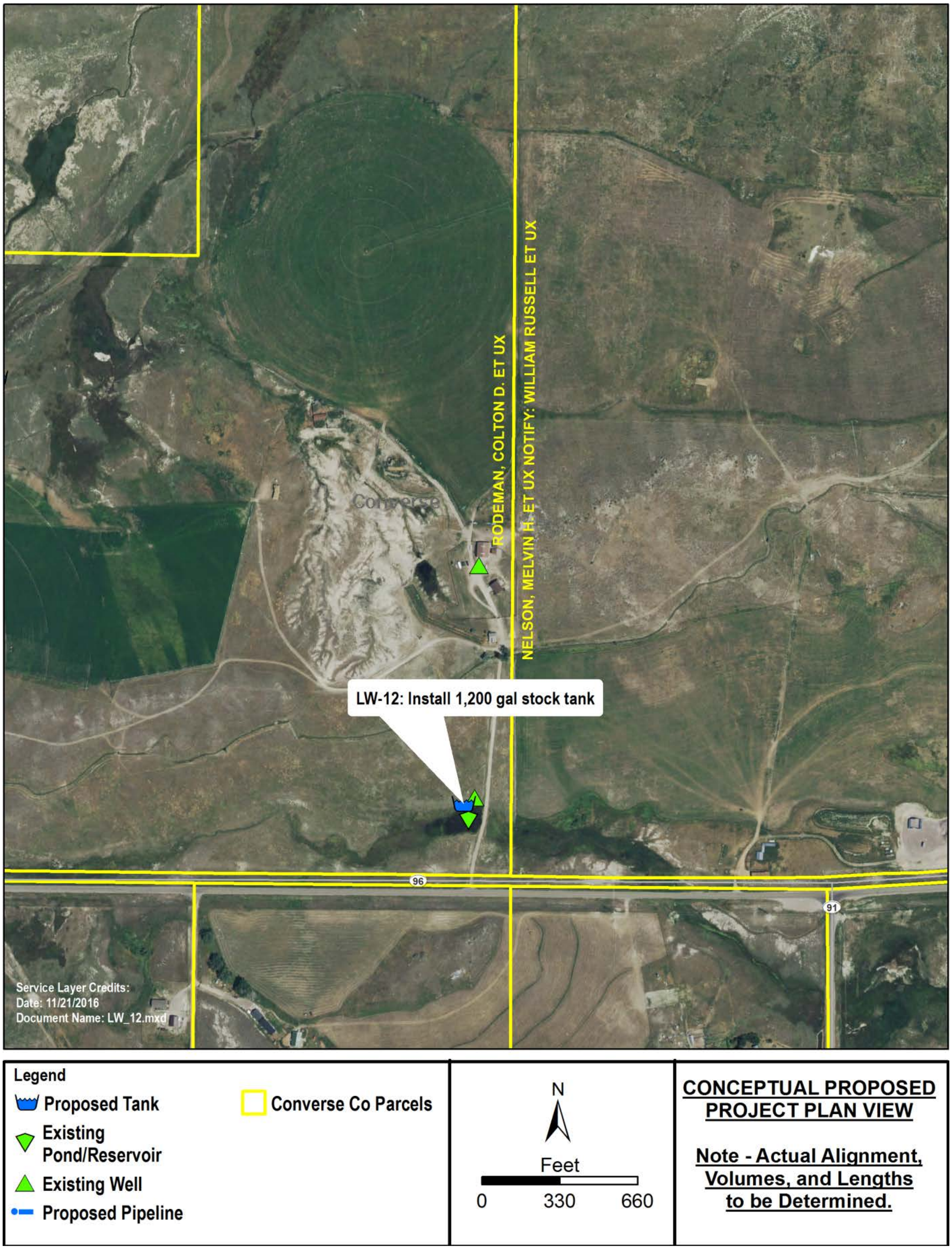


Figure 4.22. Proposed LW-12: Rodeman Livestock #2 Pipeline and Tank Project.

4.4.2.13 *LW-13: CT 2A Stock Pond/Reservoir Project*

Project LW-13 would involve constructing a stock pond/reservoir to provide an additional source of livestock/wildlife water along with associated wetland areas. The project would involve constructing a new pond/reservoir, which would require investigating soil and geologic conditions and procuring permits. The proposed site is located on an unnamed, intermittent tributary to Shatto Draw, which is an intermittent tributary to Fourmile Creek in Section 5 of Township 32 North, Range 72 West in Converse County. This alternative, as shown in Figure 4.23, would include the following features:

- Constructing a small stock pond/reservoir that would have a capacity of less than 2 acre-feet.
- Investigating site-specific soil and geologic conditions to determine site suitability and feasibility of structure installations or other conditions of the underlying formations.
- Installing an inlet and outlet control mechanism to control water levels. The installed structures would be stabilized with rock riprap.
- Excavating an earthen, grass-lined spillway to adequately convey necessary water volumes and stabilizing with rock riprap for spillway protection.
- Determining adequate sources of borrow material and rock riprap for dam embankment repairs and spillway stabilization.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

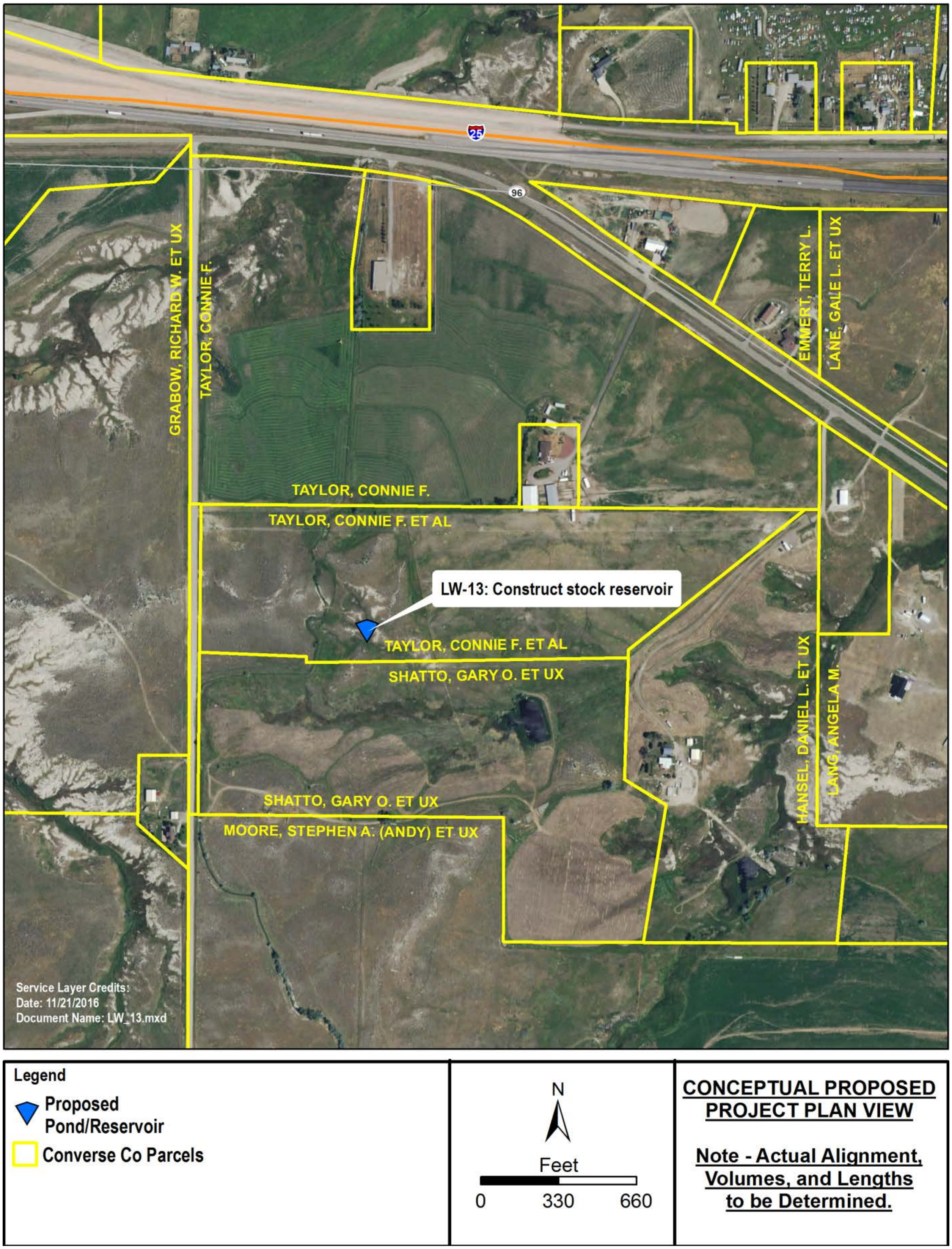


Figure 4.23. Proposed LW-13: CT 2A Stock Pond/Reservoir Project.

4.4.2.14 *LW-14: Pullman Stock Reservoir Project*

Project LW-14 would involve constructing a stock reservoir to provide an additional source of livestock/wildlife water along with associated wetland areas. The project would involve constructing a new reservoir, which would require investigating soil and geologic conditions and procuring permits. The proposed site is located East Fork Dry Creek, intermittent tributary to Vernon Creek in Section 35 of Township 32 North, Range 75 West in Converse County. This alternative, as shown in Figure 4.24, would include the following features:

- Constructing a reservoir that would have a capacity of less than 8 acre-feet.
- Investigating site-specific soil and geologic conditions to determine site suitability and feasibility of structure installations or other conditions of the underlying formations.
- Installing an inlet and outlet control mechanism to control water levels. The installed structures would be stabilized with rock riprap.
- Excavating an earthen, grass-lined spillway to adequately convey necessary water volumes, and stabilizing with rock riprap for spillway protection.
- Determining adequate sources of borrow material and rock riprap for dam embankment repairs and spillway stabilization.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

Figure 4.24. Proposed LW-14: Pullman Stock Reservoir Project.

4.4.2.15 *LW-15: Westfork No. 1 Reservoir (Blue Downey Park Reservoir)*

Project LW-15 would involve rehabilitating an existing reservoir to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. The Westfork No. 1 Stock Reservoir, known locally as the Blue Downey Park Reservoir (Permit No. P5919.0R), is located on an unnamed tributary to Rock Ford Creek in the NW¼ of Section 35 of Township 29 North, Range 74 West in Converse County, as shown in Figure 4.25. The reservoir had a permitted total capacity of 22.4 acre-feet.

The reservoir is a destination for trout fishing and wildlife viewing activities within Downey Park of the Laramie Range. The reservoir is located entirely on state land and has been the subject of recent investigations by the Wyoming Game and Fish Department (WGFD) along with local and state partners for rehabilitating the existing reservoir, dam embankment, spillway, and stream channel. Preliminary engineering surveys, designs, and geotechnical investigations have been completed for the proposed reservoir rehabilitation.

This reservoir could be rehabilitated to provide an additional source of livestock/wildlife water along with restoring functions associated with the fishing, wildlife, and wetland/riparian areas. While this reservoir was identified for potential rehabilitation, agreements between the WGFD, OSLI, and state land lessee are necessary to determine responsibilities for any construction costs and operation and maintenance responsibilities. This alternative includes the following features:

- Rehabilitating the existing dam embankment or constructing a new reservoir that would have a capacity of less than 20 acre-feet.
- Rehabilitating the existing outlet facilities or construction of new facilities to control reservoir water levels. The installed structures would be stabilized with rock riprap.
- Rehabilitating or relocating the eroded and unprotected earthen spillway to adequately convey necessary water volumes and stabilizing with rock riprap for spillway protection.
- Determining adequate sources of borrow material and rock riprap for dam embankment repairs and spillway stabilization.
- The reservoir is located entirely on state land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

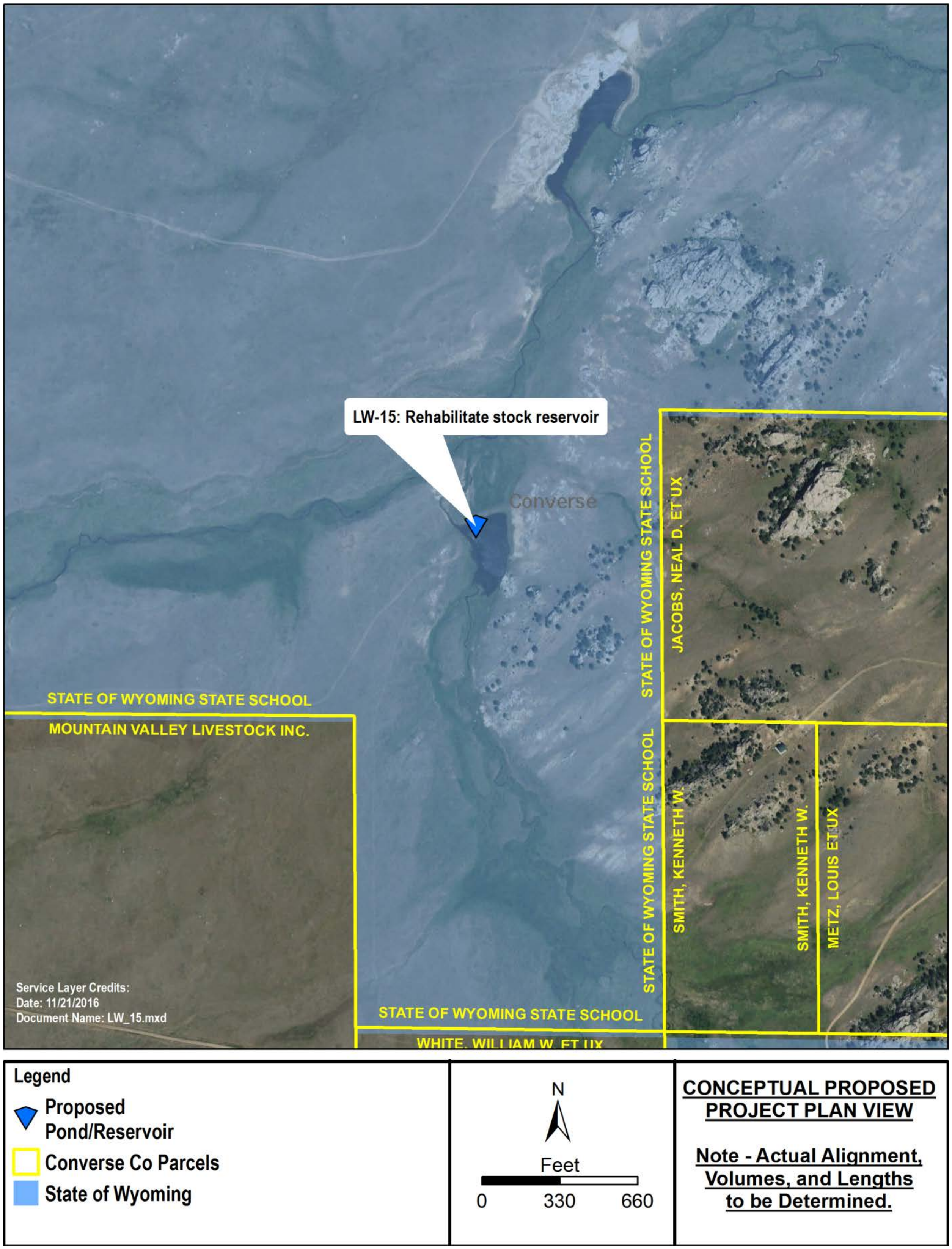


Figure 4.25. Proposed LW-15: Westfork No. 1 Reservoir (Blue Downey Park Reservoir) Rehabilitation Project.

4.4.2.16 *LW-16: Bill Young Spring #1 Spring Development and Tank Project*

Project LW-16 would involve rehabilitating an existing spring and installing a solar platform to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.26, would be installed:

- An existing spring would be developed and equipped with a solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances.
- From that source, an existing 3,600-gallon storage tank would be rehabilitated, and approximately 920 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- Required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tank.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

4.4.2.17 *LW-17: Bill Young Spring #2 Spring Development and Tank Project*

Project LW-17 would involve rehabilitating an existing spring and installing a solar platform to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.26, would be installed:

- An existing spring would be developed and equipped with a solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances.
- From that source, approximately 1,150 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tank.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

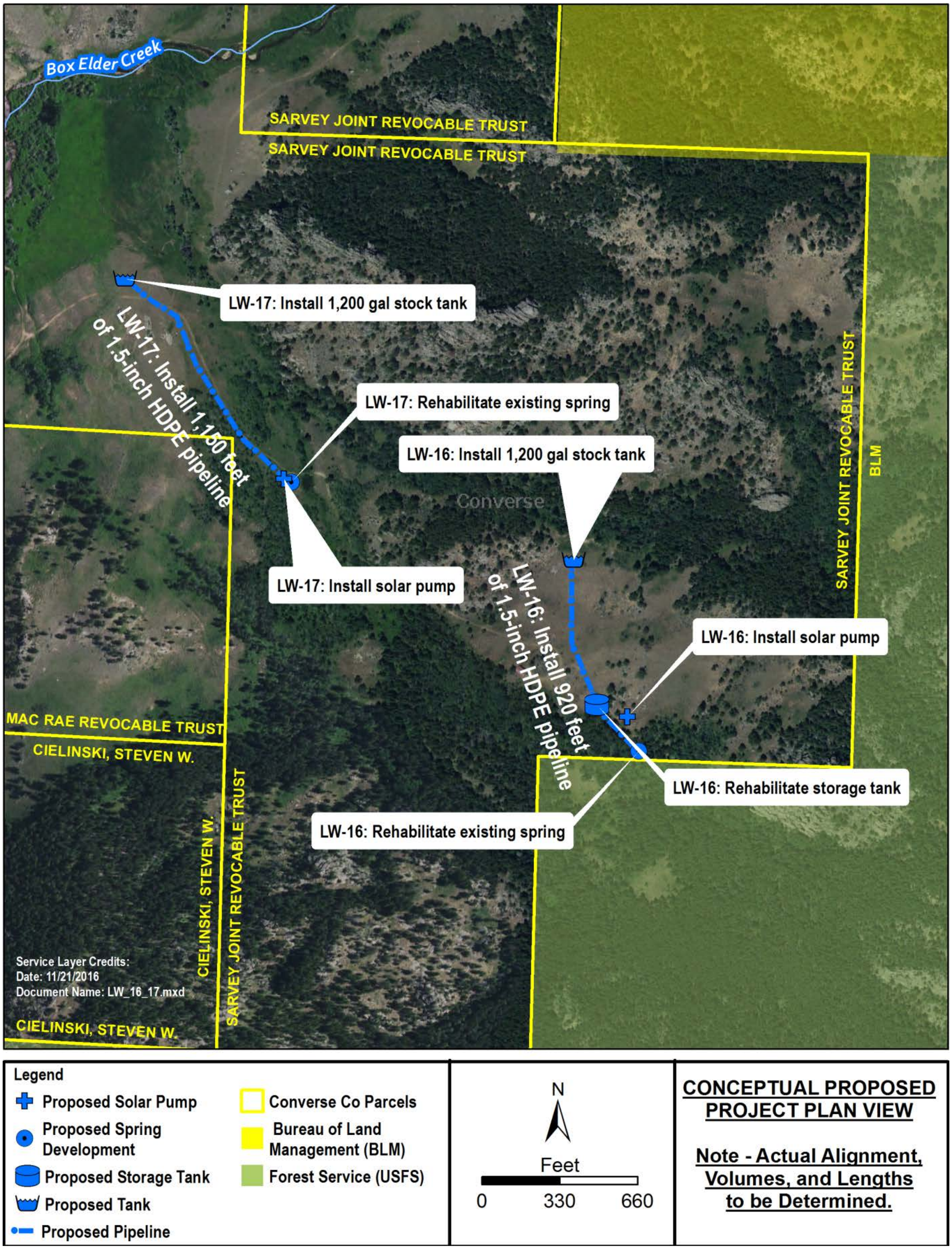


Figure 4.26. Proposed LW-16 and LW-17: Bill Young Spring #1 and #2 Spring Development Projects.

4.4.2.18 *LW-18: Back 55 Pipeline and Tank Project*

Project LW-18 would involve installing a solar platform on an existing water well to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.27, would be installed:

- An existing well would be rehabilitated to supply water and equipped with a solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances.
- From that well, approximately 2,530 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply two stock tanks (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located entirely on private land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

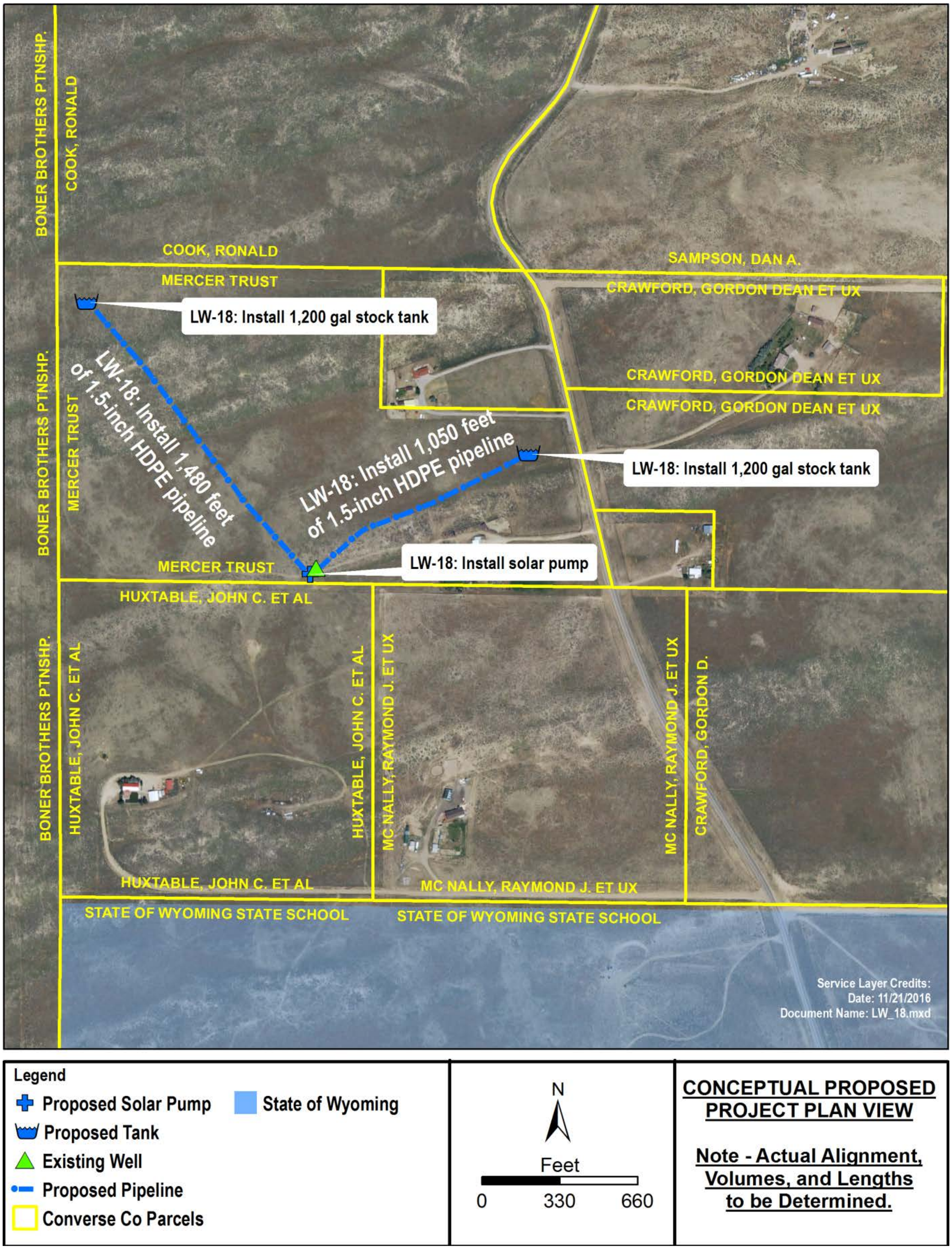


Figure 4.27. Proposed LW-18: Back 55 Pipeline and Tank Project.

4.4.2.19 *LW-19: Don Sommers #2 Well, Pipeline, and Tank Project*

Project LW-19 would involve rehabilitating an existing well and installing a solar to supply water to a portion of the watershed that lacks adequate livestock/wildlife water sources. Under this alternative, the following components, as shown in Figure 4.28, would be installed:

- An existing well would be rehabilitated to supply water and equipped with a solar platform that consists of solar panels; solar-powered pump; batteries; and all of the regulators, connections, and appurtenances. This well would deliver water to an existing stock tank.
- From that well, approximately 500 feet of buried 1.5-inch HDPE low-pressure pipeline would be installed to supply a stock tank (1,200-gallon capacity).
- The required valves, fittings, and appurtenances would be incorporated to facilitate managing flow, pressure, and water level.
- Wildlife escape ramps or devices would be incorporated in the proposed stock tanks.
- The proposed project is located on state land.
- Additional engineering design, permits, clearances, and constructions specifications are required before commencing construction on this project.

Figure 4.28. Proposed LW-19: Don Summers #2 Well, Pipeline, and Tank Project.

4.4.2.20 *Additional Wildlife Water-Development Opportunities*

Guzzlers are artificial catchments that provide sources of water in remote areas for wildlife. Larger systems could be employed for livestock-watering purposes. These systems rely entirely on precipitation; therefore, their reliability is only as good as can be expected in a water-short region. Installing guzzler water systems may be considered in areas where wildlife water is needed and other options are unavailable, however no sites were identified as part of the study. Figure 4.29 shows a guzzler near Thermopolis, Wyoming. A guzzler system requires the following major components:

- **Catchment apron** – typically made of textured HDPE; secured with rocks that are placed on a grid and protected by fencing from trampling by wildlife or livestock
- **Catchment outlet** – pipe boot, clamps, and well screen
- **HDPE pipe** – typically 1.5-2 inches, 160 pounds per square inch (psi), SDR 11
- **Catchment tank** – HDPE tank sized to accommodate wildlife or livestock watering needs with integral drinker (ideally with no float valve required) and overflow adapter
- **Small animal escape ladder** – installed in the storage tank
- **Overflow pipe** – with erosion protection at discharge.

Figure 4.29. An Example of an Installed Wildlife Guzzler System.

4.5 GRAZING MANAGEMENT OPPORTUNITIES

4.5.1 State and Transition Models

In Section 3.4.8.6 of Chapter 3.0, the ecological sites within the watershed were presented and the concept of the ESD was discussed. The ESD for a given ecological site contains a wealth of information that pertains to the site and its vegetative community. Each ESD contains a State and Transition Model (STM), which describes the patterns, causes, and indicators that cause vegetation to change from one plant community to a different group of plant species, as well as the management actions needed to restore to a desirable plant community. An STM is a diagram that shows the current understanding of vegetation responses on a given site to grazing practices, range-management, or environmental disturbances.

STMs help landowners and managers determine changes in vegetation and soils that are reversible compared to changes that are costly or unlikely. In addition to grazing management, an STM can also be useful in developing management options for wildfire and prescribed burns, watershed infiltration and runoff, invasive and pest species, recreation, woodlands, and forests. When landowners and managers become aware of the predicted responses shown in an STM on a particular range site, they can then use the information to develop appropriate rangeland treatments and implement necessary grazing practices to begin the transition from undesirable vegetation to a desirable plant community.

The STM also includes a Historic Climax Plant Community (HCPC), which describes the potential plant community that generally has the greatest forage production or ecological potential for a given site. The HCPC can be used to compare the current vegetation that grows on a site to what plant community could potentially be grown on the site. Consequently, land-management strategies can be developed that results in restoring the HCPC, given the right conditions.

The ESDs and their associated STMs for the three predominant ESDs within the watershed were obtained directly from the NRCS and are detailed in Sections 4.5.1.1 through 4.5.1.3. The three predominant ESDs within the soil survey mapped area of the watershed include the following:

- R058BY122WY Loamy (Ly) 10 to 14 inch Northern Plains Precipitation Zone (PZ)
- R058BY150WY Sandy (Sy) 10 to 14 inch Northern Plains PZ
- R058BY162WY Shallow Loamy (SwLy) 10 to 14 inch Northern Plains PZ.

4.5.1.1 *Loamy (Ly) 10 to 14 Inch North Plains Precipitation Zone*

The most predominant ESD is the Loamy (Ly) 10 to 14 inch Northern Plains PZ site (R058BY122WY), which covers approximately 347,793 acres (16.6 percent) of the study area. The Loamy (Ly) 10 to 14 inch Northern Plains PZ ESD's STM is shown Figure 4.30.

Rhizomatous wheatgrasses/Needle-and-thread/Blue Grama Plant Community

The interpretive plant community for this site is considered to be the HCPC. This plant community evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. This plant community can be found on areas that are properly managed with grazing and/or prescribed burning and sometimes on areas that receive occasional short periods of rest. The potential vegetation is approximately 75 percent grasses or grass-like plants, 15 percent forbs, and 10 percent woody plants. This state is dominated by cool season midgrasses.

The major grasses include western wheatgrass, needle-and-thread, and green needlegrass. Other grasses that occur in this state include Cusick's and Sandberg's bluegrass, bluebunch wheatgrass, and blue grama, as well as a variety of forbs and half-shrubs. Big sagebrush is a conspicuous element of this state, occurs in a mosaic pattern, and makes up 5 to 10 percent of the annual production. Plant diversity is high.

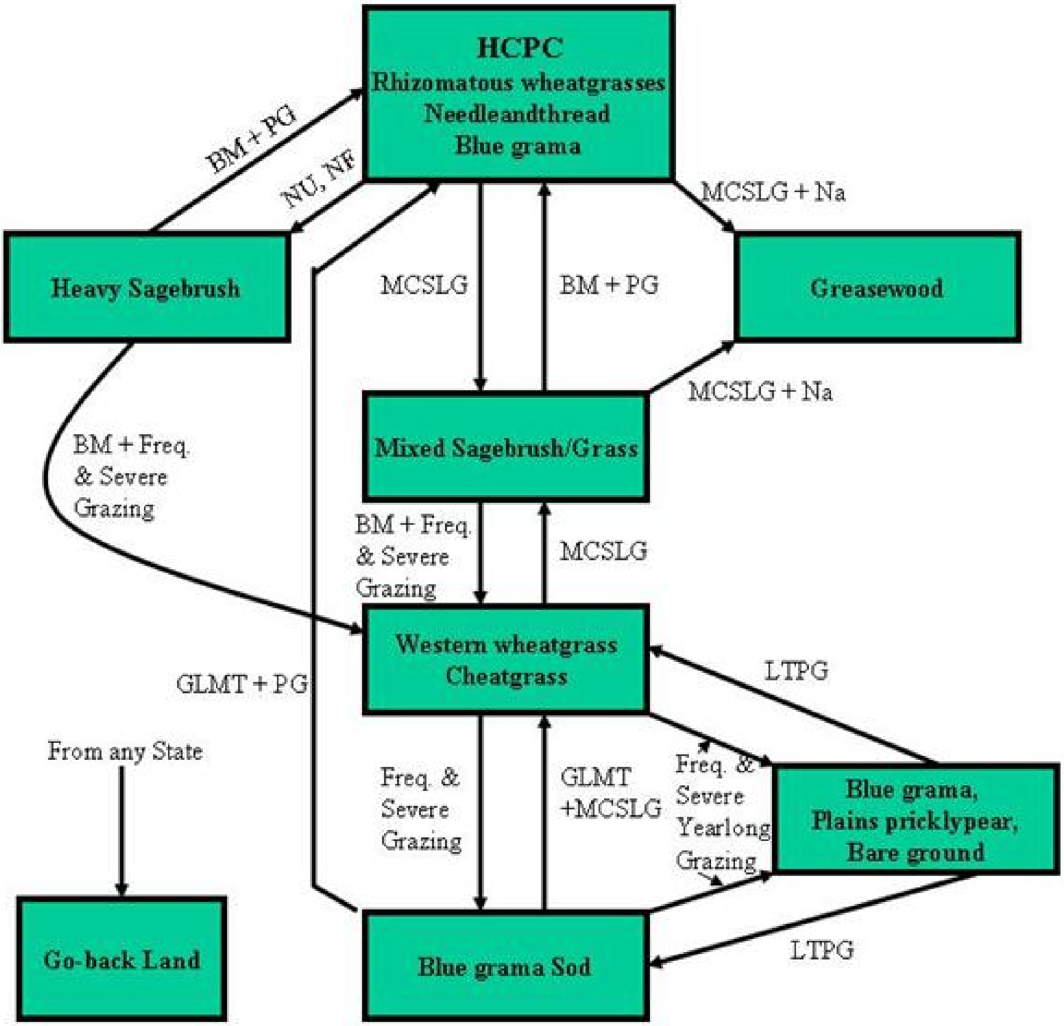
The total annual production (air-dry weight) of this state is approximately 1,200 pounds per acre but can range from approximately 700 pounds per acre in unfavorable years to approximately 1,500 pounds per acre in above-average years. This plant community is extremely stable and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This plant community is sustainable (site/soil stability, watershed function, and biologic integrity).

Transitions, or pathways, that lead to other plant communities are as follows:

- No use and no fire for 20 years or more will convert this plant community to the Heavy Sagebrush Plant Community.
- Moderate, continuous season-long grazing will convert the plant community to the Mixed Sagebrush/Grass Plant Community.
- Moderate continuous season-long grazing, where greasewood occurs adjacent to the site, will convert the plant community to the Greasewood Plant Community.
- When cropped annually and then abandoned without reseeding, the site is converted to the Go-back Land Plant Community, which is devoid of native plants, has reduced soil organic matter, has a changed soil structure, and has a compacted soil layer.

Site Type: Rangeland
MLRA: 58B – Northern Rolling High Plains

Loamy 10-14" P.Z.
R058BY122WY



BM - Brush Management (fire, chemical, mechanical)
Freq. & Severe Grazing - Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season
GLMT - Grazing Land Mechanical Treatment
LTPG - Long-tem Prescribed Grazing
MCSLG - Moderate, Continuous Season-long Grazing
NU, NF - No Use and No Fire
PG - Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)
VLTPG - Very Long-term Prescribed Grazing (could possibly take generations)
Na - found adjacent to a saline site

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Figure 4.30. State and Transition Model: Loamy (Ly) 10- to 14-Inch Northern Plains Precipitation Zone.

4.5.1.2 *Sandy (Sy) 10 to 14 Inch Precipitation Zone, High Plains Southeast*

The second most predominant ecological site in the watershed is the the Sandy (Sy) 10 to 14 inch Northern Plains PZ site (R058BY150WY), which covers approximately 177,038 acres (8.4 percent) of the study area. The Sandy (Sy) 1014 inch Northern Plains PZ ESD's STM is shown in Figure 4.31.

Needle-and-thread/Prairie Sandreed Plant Community

The interpretive plant community for this site is the HCPC. This state evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. Potential vegetation is approximately 75 percent grasses or grass-like plants, 15 percent forbs, and 10 percent woody plants. The state is a mix of warm- and cool- season midgrasses. The major grasses include needle-and-thread, prairie sandreed, little bluestem, and Indian ricegrass. Other grasses that occur in the state include rhizomatous wheatgrasses, Sandberg bluegrass, blue grama, and threadleaf sedge. Silver sagebrush and green rabbitbrush are conspicuous components of this state.

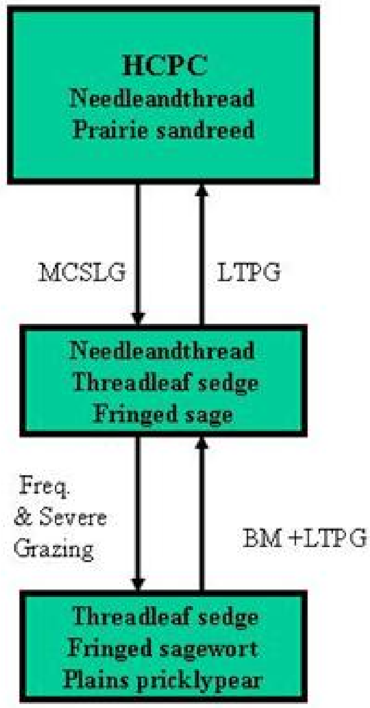
The total annual production (air-dry weight) of this state is approximately 1,200 pounds per acre but can range from approximately 750 pounds per acre in unfavorable years to approximately 1,600 pounds per acre in above-average years. The state is stable and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought resistance. This plant community is sustainable (site/soil stability, watershed function, and biologic integrity).

Transitions, or pathways, leading to other plant communities are as follows:

- Moderate, continuous season-long grazing will convert the plant community to the Needle-and-Thread/Threadleaf Sedge/Fringed Sagewort Vegetation State.
- Frequent and severe grazing will convert the plant community to the Threadleaf Sedge/Fringed Sagewort/Plains Pricklypear Vegetation State.

Site Type: Rangeland
MLRA: 58B – Northern Rolling High Plains

Sandy 10-14" P.Z.
R058BY150WY



BM - Brush Management (fire, chemical, mechanical)
Freq. & Severe Grazing - Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season
GLMT - Grazing Land Mechanical Treatment
LTPG - Long-tem Prescribed Grazing
MCSLG - Moderate, Continuous Season-long Grazing
NU, NF - No Use and No Fire
PG - Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)
VLTPG - Very Long-term Prescribed Grazing (could possibly take generations)
Na - found adjacent to a saline site

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Figure 4.31. State and Transition Model: Sandy (Sy) 10- to 14-Inch Northern Plains Precipitation Zone.

4.5.1.3 *Shallow Loamy (SwLy) 10-to 14 Inch Precipitation Zone, High Plains Southeast*

The third predominant ecological site in the watershed is the Shallow Loamy (SwLy) 10 to 14 inch Northern Plains PZ (R058BY162WY) site, which covers approximately 113,626 acres (5.4 percent) of the study area. The Shallow Loamy (SwLy) 10 to 14 inch Northern Plains PZ (R058BY162WY) ESD's STM is shown in Figure 4.32.

Rhizomatous wheatgrasses/Needle-and-thread/Blue Grama Plant Community

The interpretive plant community for this site is the HCPC. This state evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. Potential vegetation is approximately 75 percent grasses or grass-like plants, 15 percent forbs, and 10 percent woody plants. The state is dominated by cool season midgrasses. The major grasses include western wheatgrass, bluebunch wheatgrass, needle-and-thread, and little bluestem. Other grasses occur on the state include Cusick's and Sandberg bluegrass, blue grama, and prairie Junegrass.

Big sagebrush is a conspicuous element of this state, occurs in a mosaic pattern, and makes up 5-10 percent of the annual production. Big sagebrush may become dominant on some areas with absence of fire. Natural fire occurred frequently in this community and prevented big sagebrush from being the dominant landscape. Wildfires are actively controlled in recent times so chemical control that uses herbicides has replaced the historic role of fire on this state. Recently controlled burning has regained some popularity.

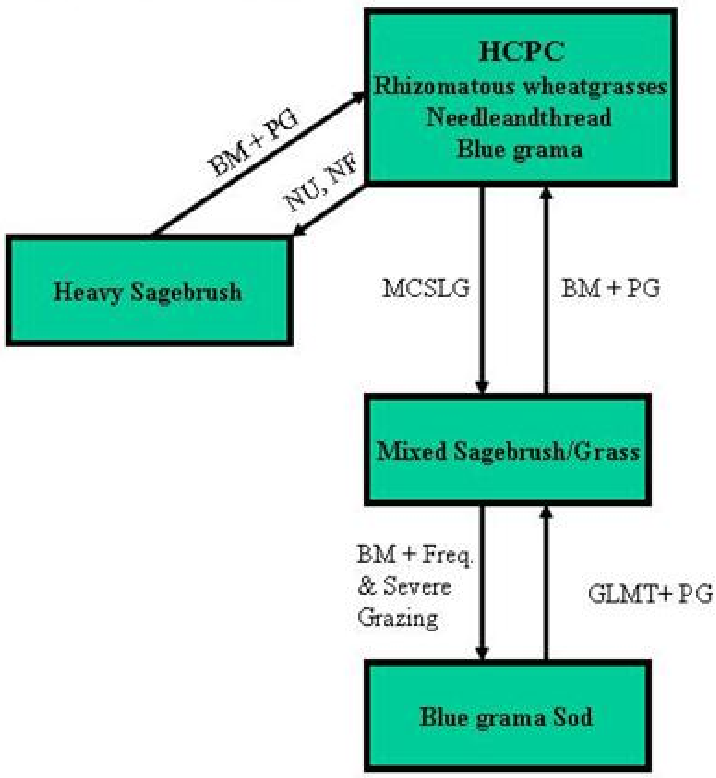
The total annual production (air-dry weight) of this state is approximately 900 pounds per acre but can range from approximately 450 pounds per acre in unfavorable years to approximately 1,200 pounds per acre in above average years. The state is extremely stable and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought resistance. This plant community is sustainable (site/soil stability, watershed function, and biologic integrity).

Transitions, or pathways, that lead to other plant communities are as follows:

- Protection from grazing and fire will convert this plant community to the Heavy Sagebrush Vegetation State.
- Moderate, continuous season-long grazing will convert the plant community to the Mixed Sagebrush/Grass Vegetation State.
- Frequent and severe grazing and brush management will convert the plant community to the Blue Grama Vegetation State.

Site Type: Rangeland
MLRA: 58B – Northern Rolling High Plains

Shallow Loamy 10-14" P.Z.
R058BY162WY



BM - Brush Management (fire, chemical, mechanical)
Freq. & Severe Grazing - Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season
GLMT - Grazing Land Mechanical Treatment
LTPG - Long-tem Prescribed Grazing
MCSLG - Moderate, Continuous Season-long Grazing
NU, NF - No Use and No Fire
PG - Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)
VLTPG - Very Long-term Prescribed Grazing (could possibly take generations)
Na - found adjacent to a saline site

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Figure 4.32. State and Transition Model: Shallow Loamy (SwLy) 10- to 14-Inch Northern Plains Precipitation Zone.

4.5.2 Grazing-Management Components of the Watershed Management Plan

These tools can be used to maintain and/or improve watershed function, particularly in conjunction with implementing appropriate grazing-management strategies. Based on the information presented previously, the following items are presented for inclusion in the Watershed Management Plan:

- **Watershed Plan Component G-1:** Water developments can be used to expand grazing distribution to areas that do not currently have reliable water. Riparian area plant community conditions can be enhanced by water development into upland areas.
- **Watershed Plan Component G-2:** Fencing can be used to enhance grazing management options and to facilitate the planned grazing system.
- **Watershed Plan Component G-3:** Strategic salting and herding are other tools that can be used to enhance grazing distribution.
- **Watershed Plan Component G-4:** Most range-improvement practices that improve watershed conditions may also improve wildlife habitat. Wildlife needs should be considered when installing practices such as wildlife-friendly fences, wildlife escape ramps from tanks, and wildlife watering facilities.
- **Watershed Plan Component G-5:** Strategies that are recommended in the STMs that are associated with NRCS descriptions of the ecological sites that are found within the watershed should be adopted and employed to optimize range conditions through prescribed grazing management and BMPs.
- **Watershed Plan Component G-6:** Prescribed fire may be used as a tool to assist in restoring range health areas that benefit from this treatment according to the STMs. Delineating specific areas that potentially benefit from this practice was beyond the scope of this Level I study.
- **Watershed Plan Component G-7:** Applying chemicals may be a tool to assist in restoring range health areas that benefit from this treatment according to the STMs. Delineating specific areas that potentially benefit from this practice was beyond the scope of this Level I watershed study.

4.6 SURFACE-WATER STORAGE OPPORTUNITIES

Investigations to identify large water-storage reservoirs within the watershed have been the subject of several past studies and are summarized in Section 3.9.1 of this report. During this study, the scope of investigating water-storage opportunities focused on existing stock ponds and reservoirs that have less than 20 acre-feet storage capacity. Field visits and initial reviews were conducted on some of the stock ponds and irrigation reservoirs identified by participants.

These facilities were previously discussed in Section 3.4.7 (Irrigation Inventory) and Section 3.9.2 (Minor Reservoirs and Stock Ponds) in Chapter 3.0. Table 4.2 is a summary of the eight surface-water opportunities included in the proposed irrigation system projects in Section 4.3 and for the livestock/wildlife water projects in Section 4.4 of this chapter.

Table 4.3. Summary of Surface-Water Storage Opportunities for Proposed Irrigation and Livestock/Wildlife Projects

Plan Item	Project Name	Component
I-07.1	East Side No. 3 Reservoir	Rehabilitate dam and reservoir that would have a capacity of less than 116.7 acre-feet
I-08.1	J A Moran Ditch Regulating Reservoir	Construct an irrigation-regulating reservoir with a volume less than 20 acre-feet
LW-01	East Draw Springs and Stock Ponds Project	Construct 3 small stock ponds that would have a capacity of less than 3 acre-feet
LW-06	Section 7 Well, Pipeline, Tanks, and Stock Pond Project	Construct a small stock pond that would have a capacity of less than 2 acre-feet
LW-11	Larime #1 Stock Reservoir Rehabilitation and Tank Project	Rehabilitate a small stock reservoir that would have a capacity of less than 3 acre-feet
LW-13	CT 2A Stock Pond/Reservoir Project	Construct a small stock pond that would have a capacity of less than 2 acre-feet
LW-14	Pullman Stock Reservoir Project	Construct a small stock pond that would have a capacity of less than 8 acre-feet
LW-15	Westfork No. 1 Reservoir (Blue Downey Park Reservoir)	Rehabilitate dam and reservoir or construct a new reservoir that would have a capacity of less than 20 acre-feet

4.7 CHANNEL STABILITY OPPORTUNITIES

Stream-Channel Rehabilitation

Various approaches for stabilizing streams can be used during channel-restoration efforts, including "hard" engineering, "soft" approaches, and combinations of the two methods. Examples of "hard" approaches include constructing channel structures or reconstructing channels themselves. Selecting the appropriate mitigation and restoration technique depends on site-specific information and a critical review of hydrologic and hydraulic data. Installing inappropriate structures or improper installation could exacerbate conditions.

For instance, methods of restoring incised channels may include constructing gradient restoration facilities (i.e., drop structures and check structures) within the incised channel as a "hard" approach. A cross vane structure is a "hard" component that can be placed within a problematic reach to serve as a grade-control structure as well as directing and centralizing streamflow. Figure 4.33 is a photograph of a cross vane installed on the lower Blanco River in Colorado [NRCS, 2007].

Figure 4.34 is a diagram of the cross section, profile, and plan views of a cross vane structure that is typically installed on a stream channel, which experienced downcutting or bank erosion. Reestablishing pre-incision channel elevations can be accomplished by means of gradient-stabilizing or control structures, which can be used to restore irrigation water delivery at diversions and headgates that were rendered inoperable by changes in channels.

Examples of "soft" approaches include a variety of BMPs. Examples of applicable BMPs designed for channel-restoration activities include those that result in reducing, or at least temporarily excluding, wildlife and livestock from accessing designated riparian zones, as well as establishing riparian buffers. The proposed livestock/wildlife water developments that were discussed previously (and others that may be identified in the future) can be considered grazing-management BMPs that will help restore, over time, those areas of channel impairment that have resulted from overusing riparian areas or adjacent uplands. Bioengineering techniques could be employed on stream channels where sufficient flow exists to support the vegetation to restore riparian habitat and stabilize streambanks.

Examples of these "hard" and "soft" approaches represent both extremes of the continuum of channel-restoration strategies that exist. In practice, a combination of strategies that are integrated into a cohesive plan provides the most effective solution. Based on the information presented above, the following items are presented for inclusion in the Watershed Management Plan:

- **Channel-Stabilization Recommendation 1:** Install stream-channel stabilization measures in conjunction with the proposed diversion and headgate rehabilitation projects for the facilities discussed in Section 3.4.7 (Irrigation Inventory) in Chapter 3.0 and included in Section 4.3 of this chapter. Based on site-specific evaluation of these facilities and channel conditions, the recommended measures should be "hard" engineering components (i.e. boulder/rock riprap) in order to promote irrigation structure and channel stability.

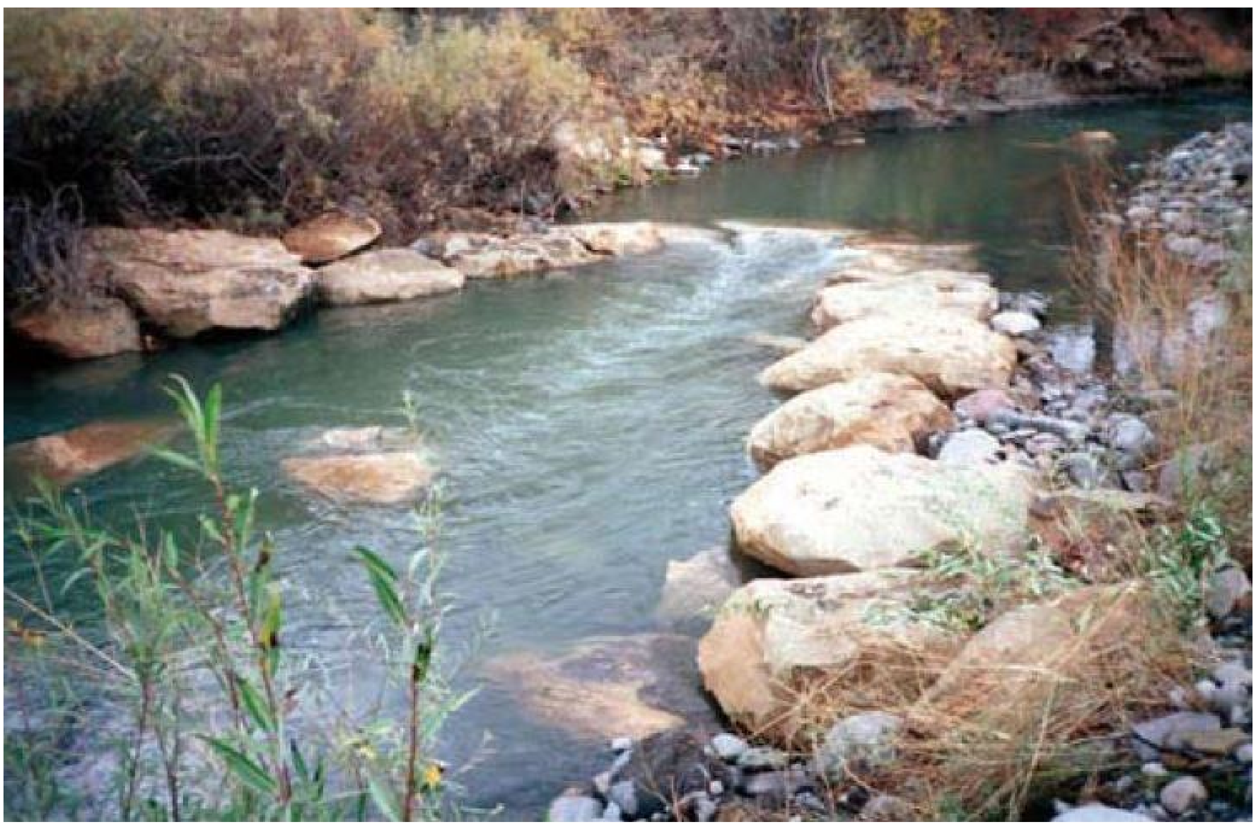


Figure 4.33. Cross Vane Installed on the Blanco River in Colorado (Adapted From NRCS [2007]).

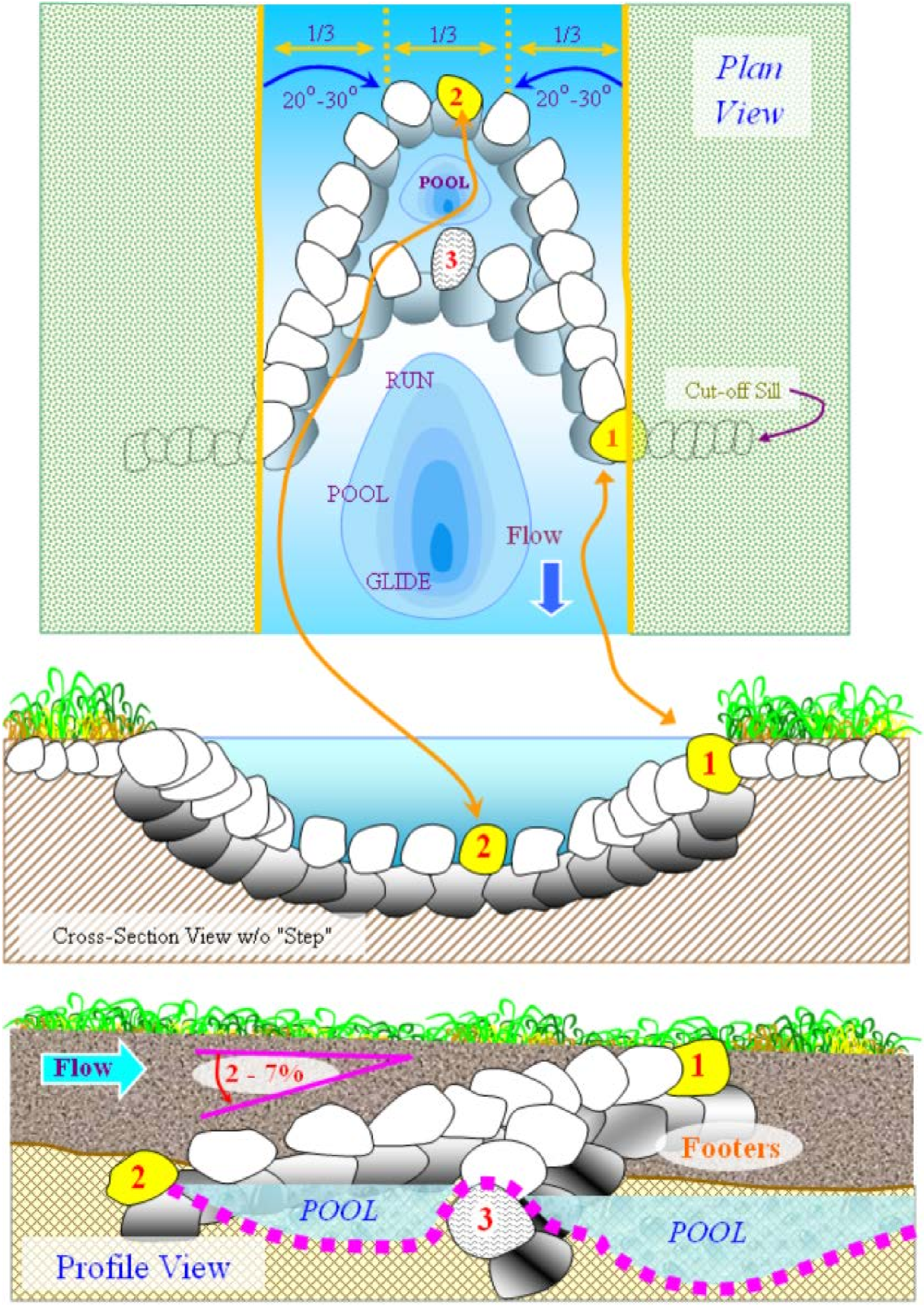


Figure 4.34. Cross Vane Structure Diagram (Adapted From NRCS [2007]).

4.8 WETLANDS ENHANCEMENT OPPORTUNITIES

Wetland creation and enhancement opportunities exist within the watershed; however, no wetland-proposed projects or alternatives were identified by study participants. As explained in Section 3.3.5, existing wetland locations represent a variety of sites where wetlands could either be established or enhanced by restoring channel or hydric soil conditions. Some sites are disconnected floodplains and associated wetland features along the North Platte River and its tributaries.

Wetlands in the watershed have been influenced by regulated flows, geomorphic changes, and agricultural activities, but they still provide important habitat values. Figure 3.12 delineates the existing wetlands within the watershed to delineate areas where wetland enhancement could occur. Furthermore, potential wetland creation and enhancement projects in the study area should consider site-specific conditions regarding the contributing surface water, groundwater, soil, and underlying geologic formation.

4.9 OTHER WATERSHED MANAGEMENT OPPORTUNITIES

County Weed and Pest Districts in Albany, Converse, Goshen, Niobrara, Natrona, and Platte Counties have effective programs for detecting, treating, and controlling noxious and invasive weeds and pests. The districts are adept at encouraging landowners and managers to participate in control and treatment programs. Based on the information presented in Section 3.3.4.3 of Chapter 3.0, the following items are presented for inclusion in the Watershed Management Plan:

- **Watershed Management Recommendation 1:** Coordinate with the county Weed and Pest Districts, landowners, NRCS, USFS, and BLM on noxious and invasive species control areas where livestock water development and improved grazing techniques could avoid reinfestation and improve preferred forage vegetation.

4.10 THE MIDDLE NORTH PLATTE–GLENDO WATERSHED MANAGEMENT PLAN

The information presented in this section provides recommendations for improvements associated with the following:

- Irrigation system rehabilitation components
- Livestock/wildlife upland watering opportunities
- Grazing-management opportunities
- Storage opportunities
- Stream-channel condition and stability opportunities
- Wetland-enhancement opportunities
- Other watershed-management opportunities.

Table 4.4 lists the itemized proposed project components of the Middle North Platte–Glendo Watershed Management Plan. The conceptual cost estimates are tabulated in Chapter 6.0 of this report. To assist the local sponsors and the WWDC, the potential funding program eligibility for each of the proposed projects was included in Table 4.4.

Table 4.4. Middle North Platte–Glendo Watershed Management Plan

Plan Item	Project Name	Potential Funding Source
	Irrigation Components	
I-01	LaPrele Main Canal Diversion	WWDC Rehabilitation, USBR WaterSMART
I-02	LaPrele Westside Canal Diversion	WWDC Rehabilitation, USBR WaterSMART
I-03	LaPrele Lateral No. 1	WWDC Rehabilitation, USBR WaterSMART
I-04	LaPrele Lateral No. 9A Sublaterals	WWDC Rehabilitation, USBR WaterSMART
I-05	LaPrele Lateral No. 4 Sublateral	WWDC Rehabilitation, USBR WaterSMART
I-06	LaPrele Lateral No. 2A Sublateral	WWDC Rehabilitation, USBR WaterSMART
I-07	East Side No.3 Reservoir	WWDC Rehabilitation, USBR WaterSMART
I-08	J A Moran Ditch Regulating Reservoir	WWDC Rehabilitation, USBR WaterSMART
I-09	Walker No. 3 Ditch	WWDC Rehabilitation, USBR WaterSMART
I-10	Hoffman Ditch and Diversion	WWDC Rehabilitation, USBR WaterSMART
I-11	Johnson Pump Lift (Cassa Ditch)	WWDC Rehabilitation, USBR WaterSMART
I-12	Wright No. 2 Ditch	WWDC Rehabilitation, USBR WaterSMART
I-13	Wright No. 2 Ditch (Enlg.)	WWDC Rehabilitation, USBR WaterSMART
I-14	Seepage Saddle Ditch and Diversion	WWDC Rehabilitation, USBR WaterSMART
I-15	Carey Ditch No. 2 Ditch	WWDC Rehabilitation, USBR WaterSMART
	Livestock/Wildlife Water Components	
LW-01	East Draw Springs and Stock Ponds Project	WWDC SWPP, NRCS EQIP
LW-02	Lone Tree Spring Development and Tank Project	WWDC SWPP, NRCS EQIP
LW-03	Lawrence #1 Well, Pipeline, and Tank Project	WWDC SWPP, NRCS EQIP
LW-04	Section 11 Well Rehabilitation Project	WWDC SWPP, NRCS EQIP
LW-05	Prado 1 Well, Pipeline, and Tank Projects	WWDC SWPP, NRCS EQIP
LW-06	Section 7 Well, Pipeline, and Tank Projects	WWDC SWPP, NRCS EQIP
LW-07	T-J-T #2 Pipeline and Tank Project	WWDC SWPP, NRCS EQIP
LW-08	Rock House No. 1 Spring Development and Tank Project	WWDC SWPP, NRCS EQIP
LW-09	Buggy Hub Spring Development and Tank Project	WWDC SWPP, NRCS EQIP
LW-10	Upper Draw Spring Development and Tank Project	WWDC SWPP, NRCS EQIP
LW-11	Larime #1 Stock Reservoir Rehabilitation and Tank Project	WWDC SWPP, NRCS EQIP
LW-12	Rodeman Livestock #2 Pipeline and Tank Project	WWDC SWPP, NRCS EQIP
LW-13	CT 2A Stock Pond/Reservoir Project	WWDC SWPP, NRCS EQIP
LW-14	Pullman Stock Reservoir Project	WWDC SWPP, NRCS EQIP
LW-15	Westfork No. 1 Reservoir (Blue Downey Park Reservoir)	WWDC SWPP, NRCS EQIP
LW-16	Bill Young Spring #1 Spring Development and Tank Project	WWDC SWPP, NRCS EQIP
LW-17	Bill Young Spring #2 Spring Development and Tank Project	WWDC SWPP, NRCS EQIP
LW-18	Back 55 Pipeline and Tank Project	WWDC SWPP, NRCS EQIP
LW-19	Don Sommers #2 Well, Pipeline, and Tank Project	WWDC SWPP, NRCS EQIP

4.11 NETWORK EFFECTS DIAGRAMS FOR POTENTIAL PROJECTS

The potential effects and benefits that are associated with the proposed projects and components of the Watershed Management Plan were discussed in Section 4.2. The most common conservation practices in relation to the various proposed plan components include livestock/wildlife water, irrigation rehabilitation, grazing management, and stream-channel rehabilitation and stability. This section is included to provide the study participants, local sponsors, and decision makers with the background necessary to make informed decisions regarding the potential positive and negative effects of the conceptual proposed projects and components in future planning efforts.

The NRCS prepares network effects diagrams (NEDs) of conservation practices or BMPs that act together to achieve desired purposes. The NEDs "are flow charts of direct, indirect, and cumulative effects resulting from installation of the practices," [NRCS, 2016]. Completed network diagrams are an overview of expert consensus on the direct, indirect, and cumulative effects of installing proposed practice installation.

Benefits that are associated with a particular conservation practice or BMP can be classified as direct, indirect, or cumulative. Direct and indirect benefits would be considered measureable or tangible benefits. For example, constructing a reservoir that is designed to augment late-season irrigation water supply provides the direct or measurable benefit of providing a supply of water that is commensurate with its storage capacity. An indirect benefit could be the habitat provided to wildlife. Likewise, the same reservoir could provide the cumulative benefit of increased income to producers and improved health of the local economy.

As discussed, such benefits can be quantitative, qualitative, or both. Benefits can be local or global and specific or surrogate, depending on multiple factors unique and specific to the BMP, ecological site, watershed, or major land-resource area. Project benefits can be related to ecological enhancement, water quantity, economic stability, stream-corridor or riverine stability, or maintenance of open spaces. Where appropriate, the NRCS NED for the conservation practice is presented within this document.

4.11.1 Irrigation Rehabilitation Projects

The Watershed Management Plan includes various forms of conceptual irrigation projects.

Irrigation Water Conveyance—Pipeline

The rehabilitation and replacement of existing irrigation system delivery conveyance structures help to efficiently deliver or convey water from a source of supply or diversion structures to areas of application or storage to facilitate in managing irrigation water. The practice reduces erosion, conserves water, and protects water quality. Underground pipelines serve as an integral part of the irrigation water distribution and significantly improve the overall efficiency of the system.

The following strategies are typically included to define the placement of irrigation water conveyance pipelines:

- Rehabilitation/replacement of existing structures
- Mitigation of seepage losses
- Enhanced delivery of irrigation water
- Reduced annual operation and maintenance costs
- Improved ditch management and efficiency through water management
- Facilitation of irrigation water management plans
- Economic practicality
- Physical feasibility.

Many effects and benefits of rehabilitating and improving water conveyance for irrigation systems exist and are displayed in the NRCS's NED in Figure 4.35. As shown in this figure, direct and indirect benefits that are associated with this BMP include the following:

- Water availability for irrigation
- Plant growth and productivity
- Infiltration and evaporation losses
- Increased plant growth and productivity
- Decreased leaching of nutrients
- Erosion associated with practice
- Decreased sediment delivery to surface waters.

Providing reliable water supplies has the following cumulative effects/benefits:

- Positive impacts to income and stability of individual producers and the community
- Improved aquatic health of humans, domestic animals, and wildlife
- Improved stream fauna and environmental quality.

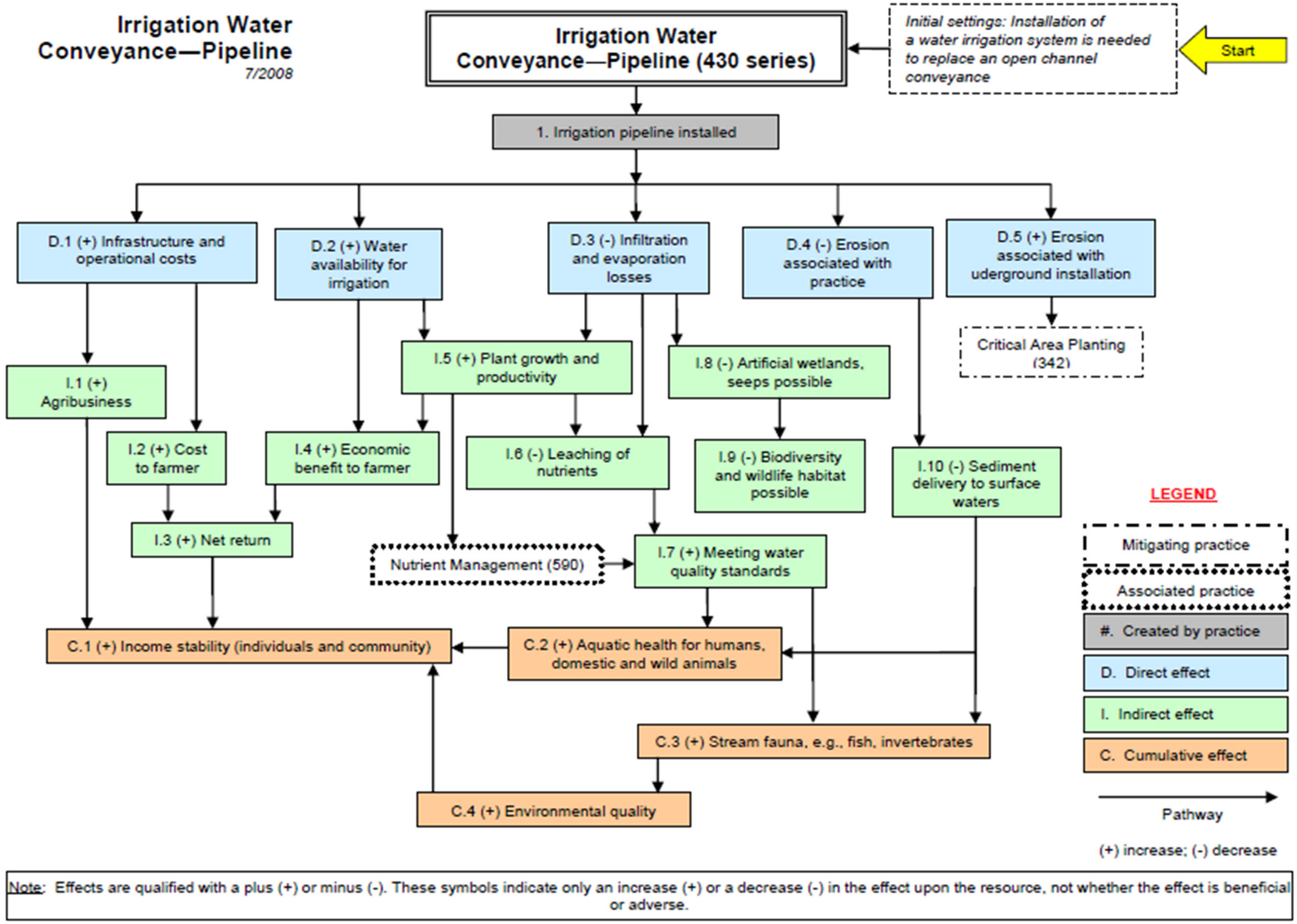


Figure 4.35. Network Effects Diagrams for Irrigation Water Conveyance—Pipeline.

4.11.2 Livestock/Wildlife Water Supply Projects

The Watershed Management Plan includes various conceptual livestock/wildlife water projects.

Water Facilities

Developing reliable watering facilities in areas that otherwise lack these facilities for livestock and wildlife help to promote improved rangeland conditions in several ways. Water facilities may be associated with wells, springs, streams, ponds, or hauled water. Reliable sources of water are integral aspects of any range-management plan that involves distributing livestock.

Placing water facilities typically involves the following strategies:

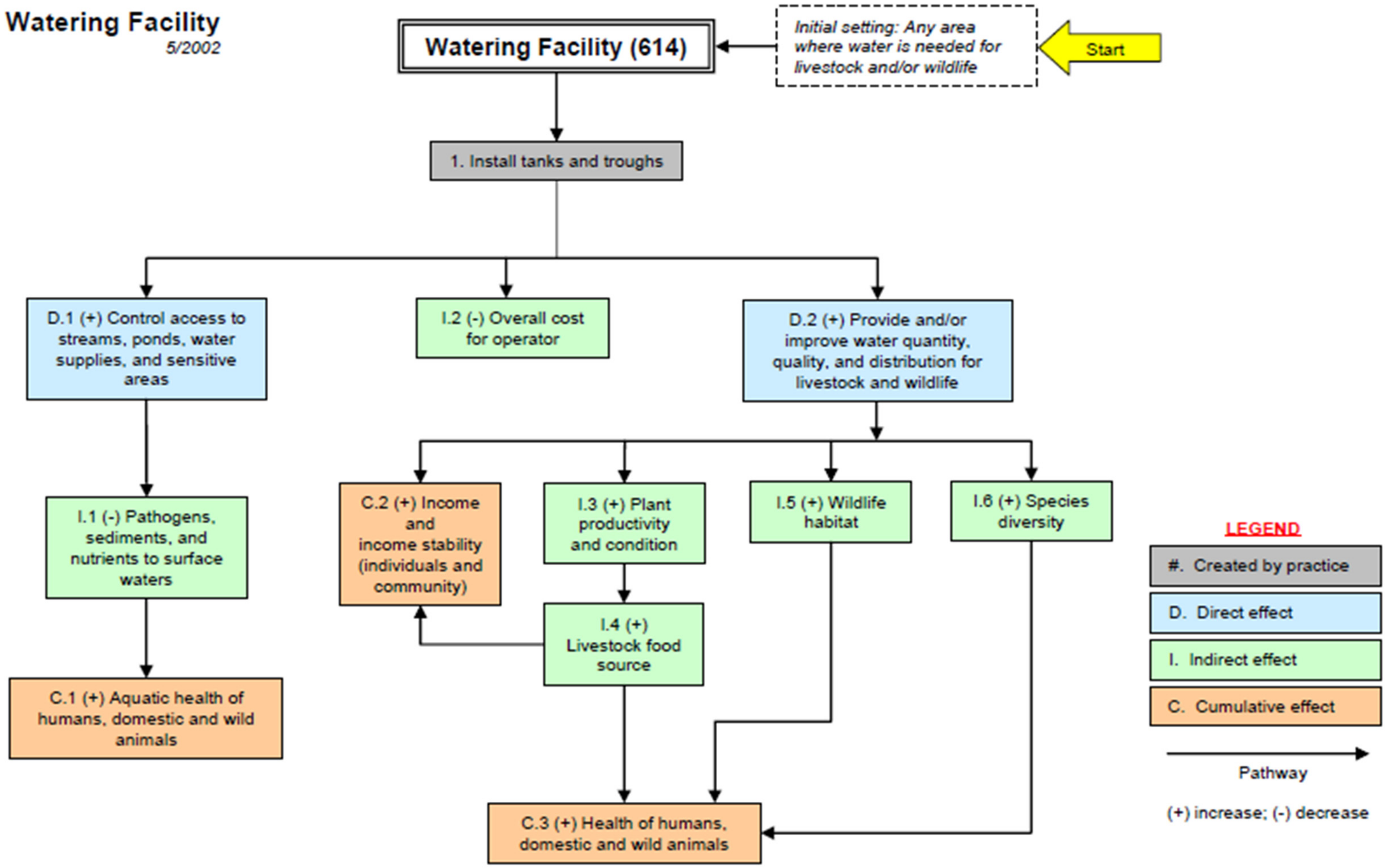
- Facilitating prescribed grazing management plans
- Providing alternative water supplies to riparian sources
- Providing a reliable source where no other sources may exist
- Optimizing upland range resources.

Many benefits of providing reliable water facilities for livestock and wildlife exist and are displayed in the NRCS's NED in Figure 4.36. As shown in this figure, direct and indirect benefits that are associated with this BMP include the following:

- Controlled access to streams, ponds, water supplies, and sensitive areas (when combined with proper fencing)
- Decreased loading of pathogens, sediments, and nutrients to existing surface waters
- Improved water quality, quantity, and distribution of livestock and wildlife
- Increased plant productivity
- Improved wildlife habitat
- Increased species diversity
- Increased livestock food sources

Cumulative benefits of provision of reliable water supplies include the following:

- Positive impacts to income and stability of individual producers and the community
- Improved aquatic health of humans, domestic animals, and wildlife
- Improved health of humans, domestic animals, and wildlife.



Note: Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Figure 4.36. Network Effects Diagrams for Watering Facility.

4.11.3 Grazing Management Alternatives

The Watershed Management Plan includes conceptual alternatives and conservation practices such as water developments and other tools that can be used to facilitate and enhance grazing distribution and optimize range conditions through prescribed grazing practices.

Prescribed Grazing

Prescribed grazing is the controlled harvest of vegetation by grazing animals that are managed with the intent to achieve a specific objective. Prescribed grazing may be applied on lands where grazing and/or browsing animals are managed. A grazing schedule is prepared for allotments and pastures to be grazed. Vegetation removal by the grazing animals conforms with realistic yield goals, plant growth needs, and management goals. Grazing duration and intensity are based on desired plant health and expected productivity of the forage species to meet management objectives. Strategies for applying prescribed grazing involve managing the intensity, frequency, duration, distribution, and season of grazing through the following:

- Defining landowner and/or manager goals and objectives
- Identifying needs for reliable water sources and supplies
- Conducting feed and forage inventories and analyses
- Conducting range condition and health evaluations and assessments
- Managing desirable and undesirable plant communities to meet grazing objectives.

Many benefits of implementing prescribed grazing and associated BMPs and conservation practices exist and are displayed in the NRCS's NED in Figure 4.37. As shown in this figure, direct and indirect benefits associated with this BMP include the following:

- Increased control of livestock grazing, feeding, and watering locations
- Decreased loading of pathogens, sediments, and nutrients to surface waters
- Increased manure distribution
- Increased soil quality
- Reduced contaminants, pathogens, and sediments to receiving waters
- Soil erosion and compaction
- Increased plant productivity and maintenance
- Increased livestock production and health
- Increased wildlife health and populations.

Implementing prescribed grazing could include the following:

- Positive impacts to income and stability of individual producers and the community
- Improved water quality and aquatic habitat
- Improved health of humans, domestic animals, and wildlife.

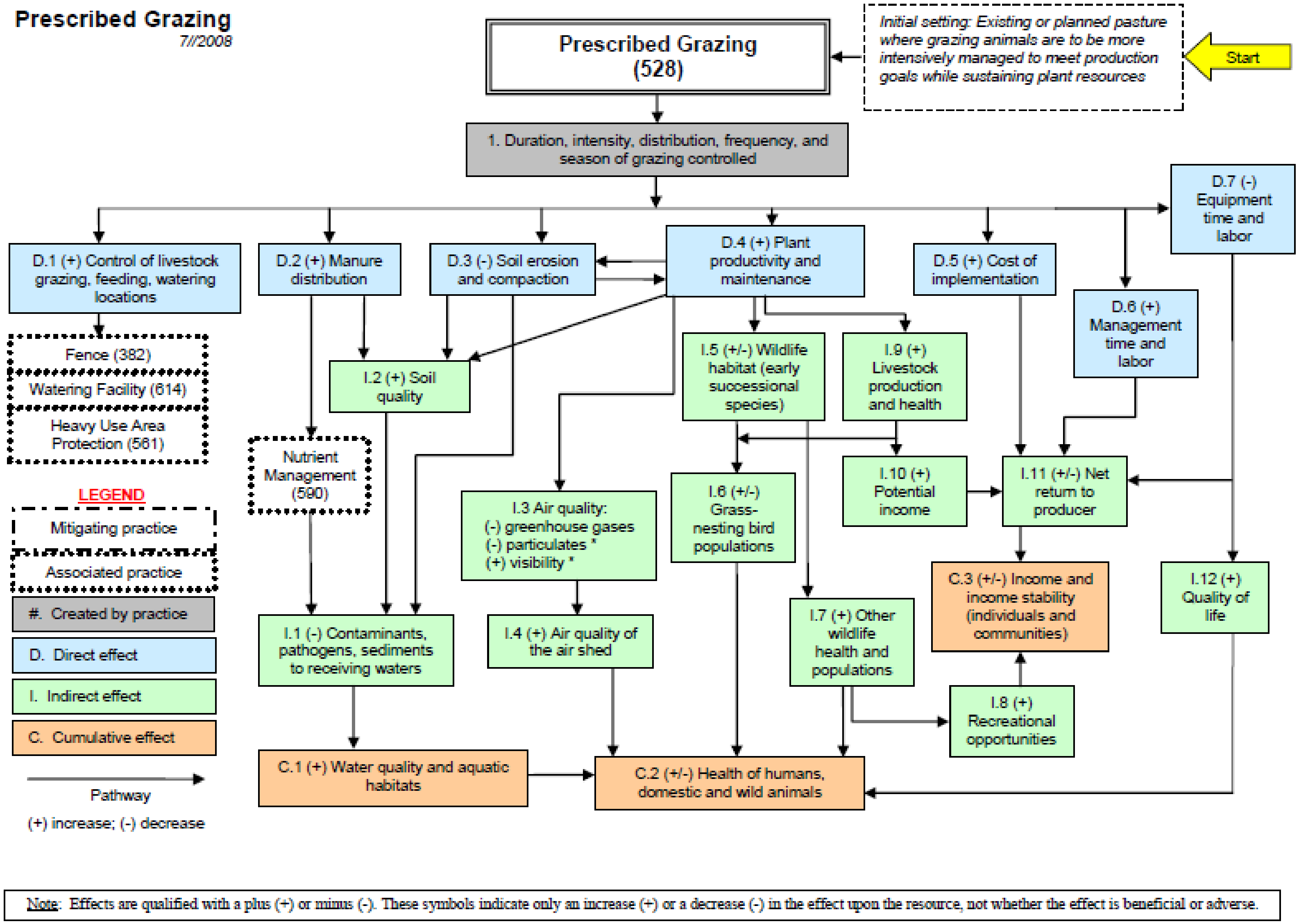


Figure 4.37. Network Effects Diagram for Prescribed Grazing.

4.11.4 Stream-Channel Rehabilitation Projects

The Watershed Management Plan includes four recommendations. These alternatives include conservation practices and BMPs such as installing stream-channel degradation/incision and streambank-erosion mitigation measures. These measures are based on a site-specific evaluation of conditions, along with routine monitoring of completed stream projects to identify maintenance repairs and determine their effectiveness. Appropriate measures could be "hard" engineering, "soft" approaches, or combinations of both.

Streambank and Shoreline Protection

Streambank and shoreline protection is stabilization and protection of streambanks, constructed channels, and shorelines of lakes and reservoirs. Strategies for applying streambank and shoreline protection involve the following:

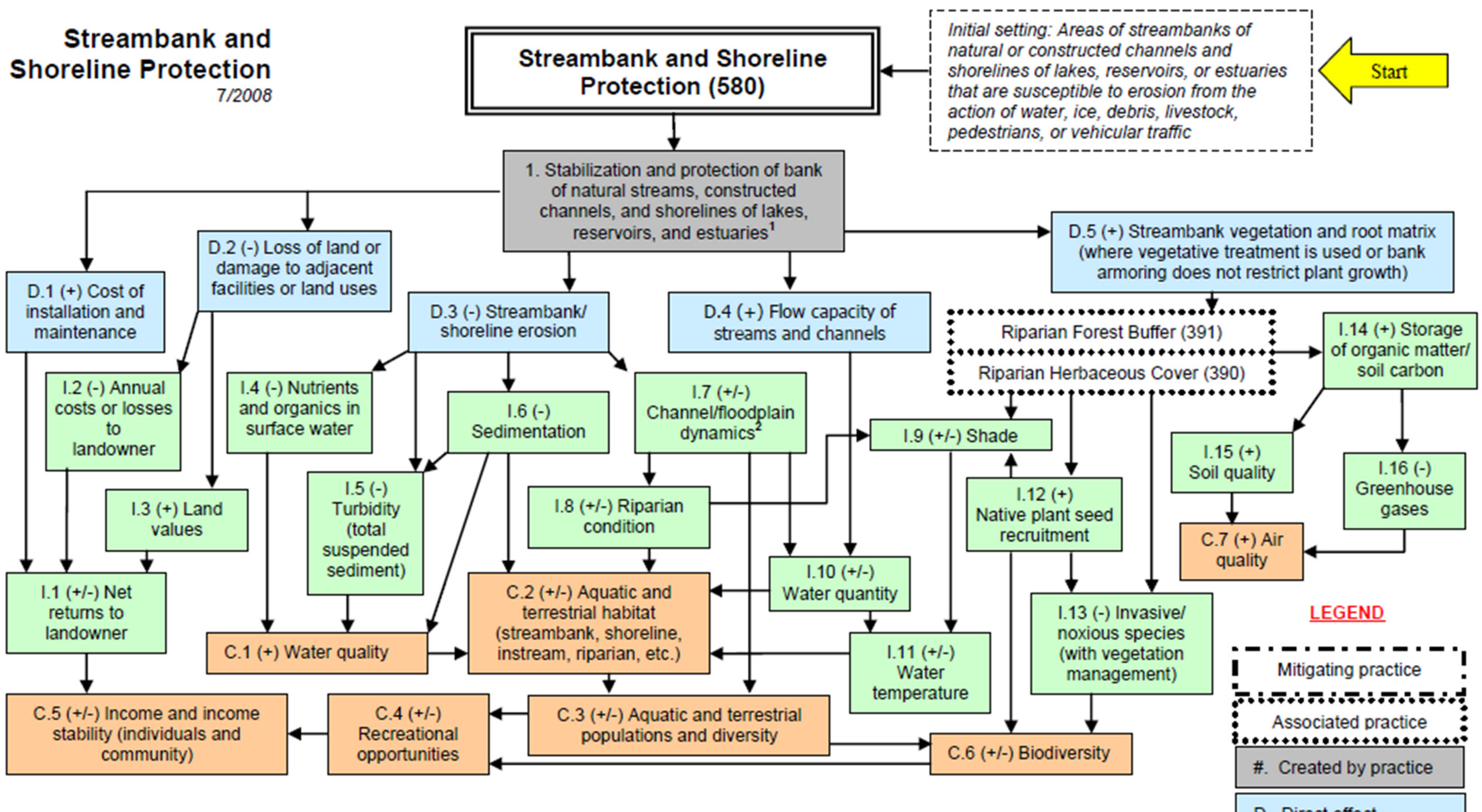
- Creating streambanks of natural or constructed channels and shorelines of lakes and reservoirs where they are susceptible to erosion
- Using various materials to protect of streambanks and shorelines
- Creating a site-specific assessment to determine if the causes are local or systemic and that will be used to select appropriate treatment to achieve the desired objective
- Implementing functional and stable treatments for designs and that sustain higher flows
- Preventing the loss of adjacent land or damage to land uses or other facilities
- Protecting historical, archeological, and traditional cultural properties
- Reducing the off-site or downstream effects of sediment that result from bank erosion
- Improving the stream corridor for fish and wildlife habitat, aesthetics, and recreation.

Benefits of implementing streambank and shoreline protection and associated BMPs and conservation practices are many and are displayed in the NRCS's NED in Figure 4.38. As shown in this figure, direct and indirect benefits associated with this BMP include the following:

- Decreased streambank and/or shoreline erosion
- Increased soil quality
- Decreased sedimentation
- Increased flow capacity of streams and channels
- Increased streambank vegetation and root matrices
- Increased soil quality
- Increased native plant recruitment
- Decreased invasive/noxious species.

Implementing streambank and shoreline protection could include the following cumulative benefits:

- Positive impacts to income and stability of individual producers and the community,
- Improved water quality and aquatic and/or terrestrial habitat
- Improved recreational opportunities.



Notes: Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Projects involving long lengths of bank or shoreline, structural controls, substantial earth moving and/or fill, or sensitive waters may need to be evaluated in a site-specific EA or EIS.

[1] Additional information about potential protection measures and their impacts is available in the EIS for the Emergency Watershed Protection (EWP) Program.

[2] Conventional bank armoring (e.g., rip rap, gabions) may result in decreased (-) channel/flood plain dynamics, and associated impacts, while other less intrusive methods (e.g., stream barbs, stone toes with sloped, vegetated banks) may result in increased (+) channel/flood plain dynamics.

Figure 4.38. Network Effects Diagram for Streambank and Shoreline Protection.

5.0 PERMITS

5.1 OVERVIEW

Information regarding the permits, easements, and clearances for the proposed projects presented in Chapter 4.0 of this report are contained in the following sections. The purpose of this task is to identify the permits and clearances that may be required for implementing and/or constructing the proposed projects outlined in Chapter 4.0. Reviews or assessments, permits and clearances, and other requirements may be encountered in pursuing implementation of the proposed projects and watershed management recommendations within the watershed. These processes usually involve permit application and environmental evaluation; coordinating with local, state, and federal agencies for review and/or approval; and determining potential impacts.

In general, irrigation and livestock/water project activities on private lands are not subject to local, state, and federal agency review and/or approval. However, almost all of the proposed projects included within this report would require some amount of review and/or approval from the appropriate local, state, or federal agency depending on the particular features of the proposed project because these projects typically involve constructing a permanent facility such as a water well, irrigation diversion, or storage reservoir. In addition to the statutory requirements, additional review and/or approval may also be necessary if local, state, or federal funds and/or technical services are used in implementing the project. These requirements are program-specific and depend on current programmatic criteria of the funding agency.

Some of the proposed projects described in this study could involve permitting and funding programmatic requirements and would be subject to state agency review and approval that requires application, coordination, and/or notification with the Wyoming State Engineer's Office (SEO), Wyoming Department of Environmental Quality (WDEQ), Wyoming State Historic Preservation Office (SHPO), Office of State Lands and Investments (OSLI), and Wyoming Game and Fish Department (WGFD). These proposed projects are also subject to the 2001 Modified Decree, which emplaced stipulations regarding surface water and groundwater use in areas that are hydrologically connected to surface water (see Section 3.6.1.6). "Green Area" maps have been developed and are available at the SEO's website (*http://seo.wyo.gov/documents-data/maps-and-spatial-data*). These maps depict the areas in which the groundwater at any depth is deemed nonhydrologically connected and, therefore, well construction and groundwater use are not subject to the 2001 Modified Decree.

Furthermore, Executive Order 2015-4, Greater Sage-Grouse Core Area Protection, which was signed by Governor Mead in July 2015, requires state agencies to follow outlined procedures to minimize disturbances by locating proposed activities or developments in areas already disturbed or naturally unsuitable. Attachment B of Executive Order 2015-4, Permitting Process and Stipulations for Development in Greater Sage-Grouse Core Population Areas, describes the permitting process for activities and developments including the establishment of the Density and Disturbance Calculation Tool (DDCT), which is used to evaluate disturbances for proposed project areas. Attachment C of Executive Order 2015-4, Exempt ("de minimus") Activities, includes activities that are considered to have negligible or no impacts to greater sage-grouse core areas and are exempt from review under the order.

Identified, proposed projects that are described in this study and involve federal lands, federal agency regulations, or federal funding would be subject to the National Environmental Policy Act (NEPA) and/or other appropriate federal regulations. These federal regulations are administered primarily by the Bureau of Land Management (BLM), US Army Corp of Engineers (USACE), US Environmental Protection Agency (EPA), Natural Resources Conservation Service (NRCS), US Forest Service (USFS), Farm Service Agency (FSA), US Bureau of Reclamation (USBR), and US Fish and Wildlife Service (USFWS). A more in-depth discussion of NEPA can found in Section 5.9 of the report section.

There are local zoning ordinances and permit requirements associated with building construction, floodplain development, and road or utility access, which may be applicable within the city and county boundaries of the study area. Current zoning and permitting requirements are known to exist within Albany, Converse, Goshen, Natrona, Niobrara, and Platte counties and are discussed in Sections 5.4.9 through 5.4.14. Zoning requirements also exist when constructing a proposed project within jurisdiction of the City of Douglas. Permits or rights-of-way access are required from WYDOT or utility/energy entities when construction involves their properties. Before excavation begins, notice to the One-Call of Wyoming Notification Center at 811 or 1.800.849.2476 (out-of-state) is required.

5.2 PROPERTY ACCESS, EASEMENTS, AND LAND PROCUREMENT

Permission should be obtained from the landowner, lessee, or management agency before any fieldwork is initiated on any proposed project area within the watershed. Verbal permission from landowners is sufficient for initial site visits. However, if project-specific field data needs to be collected and potential project alternatives developed, then written permission should be acquired. Other negotiations could be necessary for securing easements, rights-of-way, and property access for planning or construction activities associated with a proposed project.

The Enterprise Technology Services' (ETS) Wyoming Statewide Parcel Viewer can be accessed via the website (*http://gis.wyo.gov/parcels/*) to help determine ownership information for any parcels that may be involved with a proposed project. Information regarding state land parcels and surface leases can be accessed from the OSLI's State Land Access website (*http://gis.statelands.wyo.gov/GIS/OSLIGIS/StateLandAccess/*) and OSLI's Search Surface Plat Book website (*http://statelands.wyo.gov/surfaceplatbook/*). County parcel data could also be obtained from Albany, Converse, Goshen, Natrona, Niobrara, and Platte counties as discussed in Section 5.4.9 through Section 5.4.14. Permits or right-of-way access are required for the WYDOT and numerous utility and energy entities when project construction involves their properties.

5.2.1 Trespassing to Collect Data

In 2015 and 2016, Senate File 12 and Senate File 75 (Trespassing to Collect Data), respectively, were passed by the Wyoming Legislature and signed into law by Governor Mead. These state laws protect landowners' property rights by allowing law enforcement officials to file criminal charges if an individual or entity trespasses onto private property for the purpose of collecting data. These state laws also prohibit any information from being used by a government entity if it is collected by someone who trespassed on or across private land. If data were illegally collected and provided to a government agency, the data will be expunged by the agency but retained to use as evidence against the trespasser.

Because participation in the watershed study is voluntary, the consultant worked with the Wyoming Water Development Commission (WWDC), local sponsors, and landowners to gain verbal permission before entering private land and written permission to collect any resource data on participant-controlled lands. Obtaining landowner permission to collect resource data for the watershed study is required according to Wyoming Statute (W.S.) 6-3-414, Trespassing to Unlawfully Collect Resource Data. Consequently, the consultant secured necessary written permission and authorization from landowners and disclosed the specifics of the kind of information to be collected on their property during the study. Also, the consultant used global positioning system (GPS) units with 2015 parcel data and a GPS-enabled camera to collect field data, which ensured that field data collection occurred only on the participating landowners' properties.

5.2.2 Land Procurement, Right-of-Way, or Easement Acquisition

The proposed projects described in this study predominantly involve private lands and are situated within the parcel boundaries of the participating landowners. A small number of the proposed projects' components would involve access to rights-of-way along a county road or access to irrigation district infrastructure and would require temporary or conditional-use permits to be obtained from those entities. If a proposed project were to be located entirely or partially on federal lands, crossing federal lands, or funded by federal agencies or programs, additional requirements for compliance with the NEPA would apply, which is described more in Section 5.9. However, no proposed projects are currently located on state or federal land or on property not controlled by participating landowners. For the purposes of this study, the proposed projects included in the watershed management and rehabilitation plan do not require any additional land procurement or easement acquisitions. If these proposed projects are modified or revised in future efforts, then additional access requirements may need to be reevaluated before commencing construction activities.

5.2.3 Utilities

Permits or right-of-way access are required for many utility and energy entities when project construction involves their easements or properties. In the state of Wyoming, the state's *Wyoming Underground Facilities Notification Act* requires everyone who owns underground facilities in the state to be a member of One-Call of Wyoming. Before any excavation begins, the excavator is required to provide advance notice (at least 2 business days before intending to dig) to the One-Call of Wyoming Notification Center at 811 (or if calling from out-of-state, 1.800.849.2476) [Wyoming State Legislature, 2013]. For more information about One-Call of Wyoming, please visit their website (*http://www.onecallofwyoming.com/*).

5.3 PERMITTING FOR PROPOSED PROJECTS

5.3.1 Livestock/Wildlife Water Projects

Permits, clearances, and approvals that possibly need to be obtained on livestock/wildlife water projects for a typical project component (e.g., a water well, stock reservoir/pond, solar panel and pump, pipeline, and stock tank) are identified in Sections 5.3.1.1 through 5.3.1.4. Additional requirements from various entities may also exist and involve further investigation for some of the proposed projects. The extent of involvement and the nature of coordination would be determined on a project-by-project basis. More detailed discussions of those requirements are included in Section 5.4 through 5.9.

5.3.1.1 *Water Well*

The majority of proposed projects within a watershed study typically include drilling a water well or rehabilitating an existing water well to provide a source of livestock/wildlife water within the watershed. In the state of Wyoming, any person who drills a water well must obtain a water right appropriation before constructing any well by submitting an application to the SEO using their *Application for Permit to Appropriate Ground Water (U.W. 5 Form).* Work cannot begin until the permit is approved by the State Engineer according to *Title 41 Water, Chapter 3 Water Rights; Administration and Control* (W.S. 41-3-930). Groundwater applications, regulatory information, and form instructions can be accessed via the SEO's website (*https://sites.google.com/a/wyo.gov/seo/regulations-instructions*).

Also, the drilling and/or pump contactor and the well owner must comply with the requirements of the *Rules and Instructions, Part III of the Water Well Minimum Construction Standards* (W.S. 41-3-909), which can be obtained via the website (*https:// sites.google.com/a/wyo.gov/seo/ground-water/water-well-construction*). Additionally, the water quality of the completed well must be suitable for livestock and cannot exceed suitability constituents for any of the Class III Groundwater standards (Table I) of *Chapter 8, Quality Standards for Wyoming Groundwaters* (W.S. 35-11-302), which can be accessed at the website (*http://deq.wyoming.gov/wqd/groundwater/resources/rules-regs/*).

Spring developments also need to be permitted by the SEO in accordance with either their groundwater or surface-water rules and regulations. If a spring is for stock and/or domestic use, yields 25 gallons per minute or less, includes a man-made development, and is identifiable as groundwater, then the spring is permitted by submitting an application to the SEO using their Application for Permit to Appropriate Ground Water (Form U.W. 5). Work cannot begin until the permit is approved by the State Engineer in accordance with *Title 41 Water, Chapter 3 Water Rights; Administration and Control* (W.S. 41-3-930). If a spring development does not meet any of the described conditions, then the spring is permitted by completing and submitting a surface-water application via the SEO's website (*https://sites.google.com/a/wyo.gov/seo/regulations-instructions*).

5.3.1.2 *Stock Reservoir/Pond*

Some of the proposed projects within the watershed include constructing or rehabilitating a stock reservoir or pond to provide a source of livestock/wildlife water. In Wyoming, a permit from the SEO is required before commencing construction of a dam or reservoir that involves storing or impounding water. Stock reservoirs must not exceed 20 acre-feet in capacity and cannot have a dam height greater than 20 feet; the stored water must be used for stock purposes only pursuant to *Title 41 Water,* *Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs* (W.S. 41-3-301). Any individual or entity who intends to construct a stock reservoir or pond must make application to the SEO using their *Application for Permit to Appropriate Surface Water (S.W.4 Form)* and cannot commence construction until the permit is approved by the State Engineer according to *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs* (W.S. 41-3-301). Necessary surface-water applications including the *SW-4 Stock Reservoirs and SW-4A Stock Reservoir Multiple Points of Storage* forms, regulatory information, and form instructions can be accessed via the SEO's website (*https://sites.google.com/a/wyo.gov/seo/regulations-instructions*).

Wyoming's Safety of Dams legislation (W.S. 41-3-307 through 41-3-318), which is administered by the SEO, typically does not apply to stock reservoirs when the dam height is less than 20 feet high and reservoir capacity is less than 50 acre-feet. Additionally, the water quality of a completed stock reservoir or pond must be suitable for agriculture water supply, including livestock watering, and cannot exceed any of the Class 2D, Class 3D, and Class 4 surface-water quality standards (Appendix B) of *Chapter 1, Wyoming Surface Water Quality Standards* (W.S. 35-11-101), which can be found at the website (*http://deq.wyoming.gov/wqd/surface-water-quality-standards/*).

Because many waterbodies and wetlands are considered waters of the United States, they are subject to the USACE's regulatory authority. Additionally, constructing or rehabilitating a reservoir would typically involve discharging of dredged or fill material into waters of the United States and could require a Section 404 permit under the federal Clean Water Act (CWA). Permit applications can be obtained by contacting the USACE Omaha District Wyoming Regulatory Office in Cheyenne by telephone (307.772.2300) or website (*http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/*). As part of the 404 permitting process, when an applicant submits a preconstruction notification (PCN) to the USACE, the PCN is forwarded to the WDEQ for review under Section 401 of the CWA. The WDEQ then determines compliance with *Chapter 1, Wyoming Surface Water Quality Standards* (W.S. 35-11-101). If the project is compliant, then the WDEQ issues a 401 Water Quality Certification. Information about the WDEQ's 401 Certification process can be obtained by visiting their website (*http://deq.wyoming.gov/wqd/401-certification/*).

5.3.2 Irrigation Projects

A commonly proposed project within a watershed study is rehabilitating an existing diversion, ditch, or pipeline structure for diverting irrigation water from a river, creek, or reservoir to irrigated lands within the watershed. This type of a proposed project would require verifying the applicable water rights to ensure that the appropriation has been approved by the SEO pursuant with *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 1 Generally* (W.S. 41-3-101). If the water rights appropriation has been verified or involves territorial appropriation, and does not enlarge, change the point of use, or conveyance means of the existing diversion, ditch, pipeline, or other facility, then the proposed project typically doesn't require additional approval from the SEO.

However, any enlargement or change in point of use of the structure or facility would require submitting an application and/or petition to the SEO and the Board of Control for approval. Necessary application forms and instructions, including the SW-2 Enlargement of Ditches, Pipelines and Change in Point of

Diversion and Means of Conveyance petition examples, can be obtained via the SEO's website (*https://sites.google.com/a/wyo.gov/seo/regulations-instructions*). Likewise, any individual or entity who intends to construct a new diversion structure, ditch, or pipeline from a stream that does not use an existing, permitted structure or facility must submit an application to the SEO using their Application for Permit to Appropriate Surface Water (S.W.1 Form) and cannot commence construction until the permit is approved by the State Engineer in accordance with *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 1 Generally* (W.S. 41-3-101). Coordination with the SEO should occur with any proposed project before rehabilitating an existing or constructing an irrigation structure. Additional permissions or approvals may be necessary if the structure or facility supplies water to any other irrigators or water users.

In addition to the SEO requirements, constructing or rehabilitating a diversion structure (e.g., a headgate, weir, or diversion dam) along with any associated in-stream or streambank work would involve discharging dredged or fill material into waters of the United States and could require permitting under Section 404 of the CWA. Coordination with the USACE should occur to determine any agricultural exemptions from Section 404 regarding constructing or maintaining irrigation ditches, including any construction or rehabilitation of siphons, pumps, headgates, wingwalls, weirs, screens, or other facilities as are appurtenant and functionally related to irrigation ditches. More information can be obtained by contacting the USACE's Wyoming Regulatory Office by telephone (307.772.2300) or visiting their website at (*http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/*). Again, when an applicant submits a 404 permit PCN to the USACE, the PCN is forwarded to the WDEQ for review under Section 401 of the CWA to determine compliance with surface-water quality standards or approved total maximum daily loads (TMDLs). Information about the WDEQ's 401 Certification is available via the website (*http://deq.wyoming.gov/wqd/401-certification/*).

5.3.3 Water Storage Projects

5.3.3.1 *Dam and Reservoir Permitting*

Proposed projects within the watershed include constructing a new dam and reservoir or the rehabilitating an existing dam and reservoir. Any individual or entity who intends to construct a new reservoir or enlarge an existing reservoir that exceeds 20 acre-feet in capacity or has a dam height greater than 20 feet must submit an application to the SEO using their Application for Permit to Appropriate Surface Water (SW-3 Form) and cannot commence construction until the permit is approved by the State Engineer according to *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-301)*. Applications and instructions (SW-3 Reservoirs and SW-3A Special Application Reservoirs) can be obtained by accessing the website (*https://sites.google.com/a/wyo.gov/seo/applications-forms#Surface*).

Wyoming's Safety of Dams legislation (W.S. 41-3-307 through 41-3-318) requires that the State Engineer ensures the safety and structural integrity of water-storage facilities within Wyoming. Consequently, any individual or entity who proposes to construct, enlarge, repair, alter, or remove a dam with a height greater than 20 feet or a capacity of more than 50 acre-feet of water or a diversion system with headgates or diversion structures that carry 50 cubic feet per second (cfs) must have plans and specifications prepared by a Wyoming licensed professional engineer and shall be submitted to the

State Engineer for approval pursuant to *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs* (W.S. 41-3-308). On-site inspections of any new or rehabilitated facilities are conducted by the SEO personnel.

In addition to the SEO requirements, constructing or rehabilitating a reservoir or pond typically involves discharging dredged or fill material into waters of the United States and could require permitting under Section 404 of the CWA. Because many waterbodies and wetlands within the study area are considered waters of the United States, they are subject to the USACE's Section 404 regulatory authority. Section 404 applications and instructions can be obtained by by visiting the website (*http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/*) or contacting the USACE's Wyoming Regulatory Office by telephone (307.772.2300). When an applicant submits a 404 permit PCN to the USACE, the PCN is forwarded to the WDEQ for review under Section 401 of the CWA to determine compliance surface-water quality standards or TMDLs. Information about the WDEQ's 401 Certification is available via the website (*http://deq.wyoming.gov/wqd/401-certification/*).

5.3.3.2 *National Environmental Policy Act Process for Water Storage Projects*

Within the Platte River Basin and this study area, federal regulations in accordance with the NEPA and the Endangered Species Act (ESA) dictate the permitting requirements and review process of water-related projects including water-storage projects. These review processes are required because of the need to secure permits under the federal CWA and Section 7 consultation under the federal ESA. The timeframe for securing the necessary permits from federal agencies for water-storage projects could take several years depending on the complexity of the proposed facility because of the requirements of the NEPA and the ESA. Federal regulations direct that the USACE evaluate practicable and reasonable alternatives under the NEPA. A 404 permit for a discharge must only be issued for the least environmentally damaging, practicable alternative to the aquatic ecosystem that does not have other significant adverse environmental consequences.

Generally, the effort to comply with NEPA on any proposed reservoir project would probably require the preparation of an environmental impact statement (EIS). The BLM or the USFS would likely be the lead agency for any water-storage project that is situated on federal land; the NRCS would likely be the lead agency for any reservoir project funded by the US Department of Agriculture (USDA) on private lands. For proposed reservoirs on private lands that are funded privately or by state programs, the permitting process still requires that NEPA be addressed and would be led by the appropriate local or state agency or landowner. The most important aspect regarding the permitting process for a new dam and reservoir storage project is developing a valid purpose and demonstrable need for the project.

5.3.3.3 *Platte River Recovery Implementation Program*

In addition to the NEPA process, the requirements under the ESA for the critical habitat of whooping cranes, piping plover, and least terns in the Central Platte River in Nebraska resulted in signing a cooperative agreement in 1997 for the Platte River Recovery Implementation Program (PRRIP) between the United States Department of the Interior (USDOI); the USFWS; and the states of Wyoming, Nebraska, and Colorado. The PRRIP's purpose is to ensure agricultural, municipal, industrial, and other water uses while protecting critical habitat in the Central Platte River in compliance with the ESA. The state of Wyoming has adopted *Wyoming's Depletions Plan* [SEO, 2006b], which describes their current and future water-use management as part of the cooperative agreement with the PRRIP. The SEO's Basin Coordinator for the North Platte River is responsible for determining depletions and approving mitigation requirements. The USFWS has provided general guidance regarding the ESA consultations for developing water-related projects in the Platte River Basin in Wyoming under the PRRIP in the ESA Consultations Involving Platte River Depletions: Information for Project Proponents in Wyoming on the Platte River Recovery Implementation Program, which can be obtained by accessing the USFWS' website (*https://www.fws.gov/platteriver/*) or by visiting the SEO's website (*https://sites.google.com/a/wyo.gov/seo/interstate-streams/know-your-basin/platte-river-basin*).

5.3.4 Other Project Types

Permit and clearance approvals for any proposed projects are ultimately site-specific and depend on the project's location. Generally, the permits, clearances, and approvals discussed in Sections 5.3 through 5.5 could also be applicable for any proposed municipal, rural domestic water, groundwater exploration, weather modification, pipelines and conveyance facilities, wetland development, environmental (streambank, water quality, erosion protection), and solar or windmill projects depending on the specific nature and/or location of the project.

5.3.5 Mitigation

Mitigation requirements may be necessary for a proposed project to address impacts to wetlands, riparian vegetation, stream-channel habitat, cultural resources, fish and wildlife resources, and threatened or endangered species. In developing the proposed projects within this study report, a decided effort was made to avoid potential impacts by evaluating and considering these resources as part of the conceptual plans. When necessary, the plan designs were and should be adjusted accordingly to avoid the need for mitigating significant impacts. Avoiding potential impacts to species of concern and their associated habitats typically can be accomplished by scheduling construction activities outside of the relevant nesting, parturition, breeding, or migration seasons. Greater sage-grouse core area needs are discussed in Section 5.5.3.

5.4 AGENCY REQUIREMENTS AND NOTIFICATIONS

Several permits and clearances would need to be submitted to and approved by federal, state, and local agencies prior to the construction and/or installation of any of the proposed projects presented in the Watershed Management and Implementation Plan along with any future projects. The permits and clearances that could potentially be required from the associated agencies are listed in Table 5.1.

5.4.1 US Army Corps of Engineers

The USACE's Wyoming Regulatory Office administers and enforces Section 404 of the CWA in Wyoming for the Omaha District. Under the CWA, a Section 404 permit is required for discharging dredged or fill material into waters of the United States. Because many waterbodies and wetlands are considered waters of the United States, they are subject to the USACE's regulatory authority. Permit applications can

Table 5.1. Potential Permits and/or Clearances for Proposed Projects

Agency	Potential Permit and/or Clearance
	Federal
USACE	Authorization of permit for discharging dredged or fill material (Section 404 permit) Requires further delineation of jurisdictional wetlands and a wetland mitigation plan
USFWS	PRRIP Endangered Species Act, Section 7 and 10 consultations
BLM	Clearance necessary if located or crossing BLM lands, NEPA review required
USFS	Clearance necessary if located or crossing USFS lands, NEPA review required
NRCS	Approval necessary if funded by Farmbill or USDA, NEPA review required
	State
SEO	Ground Water Division approval of Water Well Permits Ground or Surface-Water Division approval of Spring Development Permits Surface-Water Division approval of ditches, pipelines, and changes in points of diversion Surface-Water Division approval of diversion or headgates carrying 50 cfs Surface-Water Division approval of reservoir permits Safety of dams approval of dam modifications PRRIP
SHPO	Compliance letter for projects on federal land or that include a federal action
WGFD	Coordination for terrestrial and aquatic wildlife under the NEPA, the ESA, Section 404 of the federal CWA, and the Federal Fish and Wildlife Coordination Act Greater sage-grouse core area protection
WDEQ	401 Certification for 404 Permits under the federal CWA WYPDES Construction General Permit (CGP) for large construction activity(> 5 acres) or small construction activity (between 1 and 5 acres) Applicable water quality standards for wells, reservoirs, and streams
OSLI	Construction of Improvements on State Land application approval
Wyoming Department of Fire Protection and Electrical Safety	Electrical wiring permit to install electrical equipment on new construction or remodeling Electrical installations must be performed by licensed electricians unless exempted
	Local
Albany County	Permits for building structures, wind energy systems, aquifer protection, and floodplain development
Carbon County	Permits for building structures, wind and solar energy systems, and floodplain development
Special Districts	Permits or clearances from special districts, including water and sewer, sanitary and improvement, flood control, irrigation, road, and improvement/service districts

be obtained by contacting the USACE's Wyoming Regulatory Office in Cheyenne by telephone (307.772.2300) or via the website (*http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/*). Many nationwide permits have been developed as of 2016; the applicable permit depends on the nature of the proposed activity. Appendix E contains the USACE's description of Nationwide Permit 27.

5.4.2 US Fish and Wildlife Service

The ESA Section 7 requires federal agencies to conserve threatened and endangered species and ensure that these agencies' actions do not adversely affect the listed species or its critical habitat. Informal and formal Section 7 consultations take place between a federal agency and the USFWS when that federal agency implements, finances, or approves a project that may affect a threatened or endangered species or its critical habitat. Typically, an informal consultation between the federal agency and the USFWS is conducted early in the planning of a project or program to ascertain if the agency's proposed project or program may affect the listed species. Normally, the federal agency completes a biological assessment to determine the proposed project's effect on the listed species. If the federal agency's biological assessment findings indicate that the listed species is likely to be adversely affected by the project or program, then the agency would request a formal consultation with the USFWS. After reviewing information about the proposed action and listed species, the USFWS issues an opinion about whether the proposed project would harm the existence of the listed species.

Also, a nonfederal agency can be approved by the USFWS for an incidental take permit of threatened or endangered species under Section 10 of the ESA. However, the USFWS's approval usually depends on a habitat conservation plan (HCP), which when followed would minimize the taking of the listed species to the maximum extent practicable. Information can be obtained by contacting the USFWS's Wyoming Ecological Services Field Office in Cheyenne by telephone (307.772.2374) or website (*https://www.fws.gov/wyominges/index.php*). Additionally, the USFWS's Information for Planning and Conservation (IPaC) is a web-based application and planning tool that is available to anyone who needs assistance in determining how their activity or project may affect migratory birds, ESA-proposed or listed species, or other sensitive resources. The IPaC can be accessed via the website (*https://ecos.fws.gov/ipac/*).

5.4.3 Wyoming State Engineer's Office

The majority of proposed projects that are included in this watershed study would require a permit from the SEO. Proposed wells, livestock/wildlife water, irrigation rehabilitation, and water-storage projects would require obtaining or modifying a water right approved by the State Engineer in accordance with *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 1 Generally* (W.S. 41-3-101). Any project that includes constructing a new dam and reservoir or the rehabilitating an existing dam and reservoir that exceeds 20 acre-feet in capacity or has a dam height greater than 20 feet cannot commence construction until a permit is approved by the State Engineer pursuant to *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs* (W.S. 41-3-301).

The SEO also administers Wyoming's Safety of Dams program (W.S. 41-3-307 through 41-3-318), which applies to reservoirs when the dam height is or will be greater than 20 feet high or with an impounding capacity of fifty (50) acre-feet or greater. Any proposed construction, enlargement, major repair, alteration or removal of a dam or diversion system with headgates or diversion structures that carry 50 cfs must have plans and specifications prepared by a Wyoming licensed registered professional engineer and shall be submitted to the State Engineer for approval pursuant to *Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs* (W.S. 41-3-308). Necessary water-rights applications, regulatory information, and instructions can be accessed via the website (*https://sites.google.com/a/wyo.gov/seo/regulations-instructions*). SEO permits can be accessed via the e-Permit website (*http://seoweb.wyo.gov/e-Permit/*).

5.4.4 Wyoming State Historic Preservation Office

Proposed projects within the watershed that are located on federal land, use federal funding, or need to secure a federal permit should have a review of cultural resources completed by the SHPO in accordance with Section 106 of the National Historic Preservation Act of 1966 and the Wyoming Antiquities Act of 1935 (W.S. 35-1-114 to 116). The SHPO reviews cultural resource reports, issues compliance letters for proposed projects, provides comments on activities that potentially affect historic properties or cultural resources, and recommends additional investigations if necessary. Additional SHPO compliance and review information can be obtained by contacting the SHPO by telephone (307.777.6311) or via the website (*http://wyoshpo.state.wy.us/Section106/Index.aspx*).

5.4.5 Wyoming Game and Fish Department

The Wyoming Game and Fish Commission encourages project sponsors, permitting agencies, and land managers to coordinate with the WGFD in the initial planning stage of a proposed project. The WGFD's involvement is essential in avoiding adverse impacts to wildlife during project development and implementation. The Commission adopted a mitigation policy in 2016 to provide an approach to avoid impacts when possible and to formulate mitigation measures when necessary. The Commission has directed the WGFD to resolve conflicts between land-use activities, wildlife, and their habitats pursuant to Wyoming Statutes and in cooperation with the USFWS and other federal agencies under the NEPA, the ESA, Section 404 of the CWA, and the Federal Fish and Wildlife Coordination Act. The WGFD's habitat information can be obtained via the website (*https://wgfd.wyo.gov/habitat/habitat-information*).

In July 2015, Executive Order 2015-4, Sage-Grouse Core Area Protection was signed by Governor Mead; this order requires state agencies to encourage development outside of the core areas and to focus management to the greatest extent possible on maintaining and enhancing habitat within them. Additional information about Wyoming's greater sage grouse management, including mitigation, *de minimus* activities, core area maps and data, and the Density Disturbance Calculation Tool (DDCT), can be found at the website (*https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management*). Sponsors of a WWDC Small Water Project Program (SWPP) project within the watershed should complete the WWDC's *Sage-Grouse Analysis Sheet* to determine if the proposed project is within the greater sage-grouse core area or is located within 0.6 mile of a greater sage-grouse lek as well as if the proposed project creates any wetlands or surface-water acres or provides enough water for mesic vegetation after construction.

Additional information, forms, and operation criteria for the WWDC's SWPP can be found at the website (*http://wwdc.state.wy.us/small_water_projects/small_water_project.html*). For all other proposed projects within the watershed, sponsors should contact the WGFD at least 60 days before submitting an application for a permit or project so any greater-sage-grouse-related issues can be identified and any stipulations can be incorporated before commencing project activities.

5.4.6 Wyoming Department of Environmental Quality

5.4.6.1 *Section 401 Water Quality Certification*

For a proposed project that requires a USACE Section 404 permit, a PCN is submitted by the applicant to the USACE. The PCN is forwarded to the WDEQ for review under Section 401 of the CWA to determine compliance with *Chapter 1, Wyoming Surface Water Quality Standards* (W.S. 35-11-101). If the project is compliant, the WDEQ issues a 401 Water Quality Certification. WDEQ could require special conditions to the certification in order to guarantee compliance with surface-water quality standards or TMDLs. Information about the WDEQ's 401 Certification process can be obtained by visiting their website (*http://deq.wyoming.gov/wqd/401-certification/*).

5.4.6.2 *Permit to Construct*

Stormwater discharges are regulated under the federal CWA by the WDEQ's WYPDES program. For any proposed project within the watershed, the project sponsor should contact the WDEQ to determine if a CGP is needed to construct the project components. The WYPDES program requires that construction activities that disturb 5 or more acres must obtain a Large Construction General Permit (LCGP), and construction activities that disturb at least 1 acre (but less than 5 acres) must obtain a Small Construction General Permit (SCGP). To obtain a LCGP, the applicant must also complete a Storm Water Pollution Prevention Plan (SWPPP). Additionally, the WDEQ may authorize temporary increases in turbidity above the numeric criteria of *Section 23, Chapter 1, Wyoming Surface Water Quality Standards* (W.S. 35-11-101) for certain short-term, construction-related activities conducted in live waters. Proposed projects involving irrigation diversions or streambank work typically occur in flowing water and would require application for a temporary turbidity waiver. For additional information or to obtain a WYPDES CGP or a temporary turbidity waiver, please contact the WDEQ by telephone (307.777.7781) or the WDEQ's Water Quality Division website (*http://deq.wyoming.gov/wqd/*).

5.4.7 Wyoming Office of State Lands and Investments

Some of the proposed projects within the watershed would be located on Wyoming state lands. When a project is on State land a grazing and agricultural lessee is required to obtain permission from the Board of Land Commissioners prior to construction in accordance with *Title 36 Public Lands, Chapter 2 Board of Land Commissioners, Article 1 In General* (W.S. 36-2-107). The lessee must complete the OLSI's Application for Construction of Improvements on State Land and submit it to the OSLI for approval. The application includes the location, value, construction date, type of improvement, federal aid received, and applicable water rights for the improvement. Information and applications can be obtained by contacting the OSLI by telephone (307.777.7331) or via the website (*http://lands.wyo.gov/lands/leasing/agricultural*).

5.4.8 Wyoming Department of Fire Protection and Electrical Safety

For any proposed project within the watershed that includes installing electrical equipment, the project sponsor should contact the Wyoming Department of Fire Protection and Electrical Safety to determine if a wiring permit is required before commencing work. A wiring permit is required when electrical equipment is installed in new construction or remodeling of a building, mobile home, or premises. The electrical installation must be performed by licensed electricians in accordance with *Title 35 Public Health and Safety, Chapter 9 Fire Protection, Article 1 Department of Fire Prevention and Electrical Safety* (W.S. 35-9-120 and W.S. 35-9-123). Applicable exemptions to these may exist for work done by an owner or lessee on their own property or on a farm or ranch of 40 acres or more on deeded land pursuant to *Title 35 Public Health and Safety, Chapter 9 Fire Protection, Article 1 Department of Fire Prevention and Electrical Safety, Division 3 Electrical Licensing* (W.S. 35-9-123). More information and the Application for Electrical Wiring Permit can be obtained by contacting the Wyoming Department of Fire Protection and Electrical Safety by telephone (307.777.7119) or via the website (*http://wsfm.wyo.gov/electrical-safety/wiring-permits*).

5.4.9 Albany County

Albany County has adopted regulations for land use zoning, aquifer protection, wastewater, and floodplain development within the project area. The Albany County Planning Department issues permits for activities in the unincorporated areas of the county including but not limited to building structures, wastewater systems, wind energy systems, and aquifer protection. The project sponsor should contact the planning department to determine if any permits are needed to construct a proposed project within the watershed. More information and the permit applications can be obtained by contacting the Albany County Planning Department by telephone (307.721.2568) or via the website (*http://www.co.albany.wy.us/planning.aspx*).

5.4.10 Converse County

Converse County has also adopted regulations for land use zoning and floodplain development within the project area. The Converse County issues permits for activities in the unincorporated areas of the county including but not limited to building structures, energy systems, and floodplain development. The project sponsor should contact the county to determine if any permits are needed to construct a proposed project within the watershed. More information and the permit applications can be obtained by contacting the Converse County by telephone (307.358.2244) or via the website (*http://conversecounty.org/259/Permits-Regulations/*).

5.4.11 Goshen County

Goshen County has adopted regulations for land use zoning and floodplain development within the project area. The county issues permits for activities in the unincorporated areas of the county including but not limited to building structures, energy systems, and floodplain development. The project sponsor should contact the county to determine if any permits are needed to construct a proposed project within the watershed. More information and the permit applications can be obtained by contacting the Goshen County Planner by telephone (307.532.3852) or via the website (*http://www.goshencounty.org/*).

5.4.12 Natrona County

Natrona County has also adopted regulations for land use zoning, stormwater, and floodplain development within the project area. The county issues permits for activities in the unincorporated areas of the county including but not limited to building structures, wind and solar energy systems, and floodplain development. The project sponsor should contact the county to determine if any permits are needed to construct a proposed project within the watershed. More information and the permit applications can be obtained by contacting the Natrona County Planning and Zoning Department by telephone (307.235.9200) or via the website (*http://www.natrona.net*).

5.4.13 Niobrara County

Niobrara County has adopted regulations for land use zoning and floodplain development within the project area. More information and the permit applications can be obtained by contacting the county by telephone (307.334.2211) or via the website (*http://niobraracounty.org/*).

5.4.14 Platte County

Platte County has also adopted regulations for land use zoning and floodplain development within the project area. The county issues permits for activities in the unincorporated areas of the county including but not limited to building structures, energy systems, water wells, septic systems, and floodplain development. The project sponsor should contact the county to determine if any permits are needed to construct a proposed project within the watershed. More information and the permit applications can be obtained by contacting the Platte County Planning and Zoning by telephone (307.322.1341) or via the website (*http://plattecountywyoming.com/*).

5.4.15 Special Districts

There are special districts including water and sewer, sanitary and improvement, flood control, irrigation, road, and improvement/service districts located within the watershed. If a project involves the property and/or facility of a special district, then permission or a permit should be obtained from the special district before commencing construction. The following list provides some of the special districts located within the project area:

- LaPrele Irrigation District
- Sundance Meadows Water and Sewer District
- Monkey Road Improvement and Service District
- Park East Ranchettes Improvement and Service District.

5.5 ENVIRONMENTAL EVALUATION

5.5.1 National Environmental Policy Act Compliance

Compliance with the NEPA typically applies whenever a proposed project that is included in the Watershed Management Plan is located on federal lands, needs passage across federal lands, is funded entirely or partially by federal agencies or programs, or needs to secure a federal permit. The NEPA process is intended to help sponsors and agencies review the potential project effects and involve the public in making informed decisions about the environmental consequences of a project. If any proposed project occurs on BLM and USFS lands or would receive the USDA Farm bill funding, the BLM, USFS, or NRCS would likely be considered the "lead or action agency" in the NEPA process.

The USACE usually has a role in reviewing proposed projects that involve impacting or enhancing a wetland, which would require a Section 404 permit. Typically, federal agencies have a Memorandum of Understanding (MOU) to outline responsibilities and roles of the agencies when a proposed project involves multiple agencies. Specifically, in regards to the NRCS providing technical assistance to conservation districts and landowners on any proposed project that is funded by the WWDC's SWPP, the NRCS' *National Environmental Compliance Handbook, Subpart D – The National Environmental Policy Act, 610.40 Overview of NEPA Requirements,* 610.43 Federal Actions and Major Federal Actions states the following about federal actions:

A. Federal Actions

(1) NEPA compliance is triggered when NRCS proposes a Federal action. A Federal action occurs when NRCS has control or responsibility over the implementation of a proposed activity including technical or financial assistance. Most NRCS Federal actions involve financial assistance through Farm Bill and watershed programs, or approvals, but Federal actions also include activities such as granting compatible uses agreements for easements where NRCS exercises control.

(2) Federal actions do not usually include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance. However, there may be instances where a project can become "federalized" due to a substantial input of Federal resources in the form of technical assistance or when NRCS has some control or responsibility in the result. When NRCS provides technical designs, standards, or specifications, the RFO should evaluate and determine whether NRCS has control or responsibility over the action, thus making it a Federal action subject to NEPA.

(3) Important note: NEPA only applies to Federal actions. It is NRCS policy and required by NRCS regulations to conduct an EE as a part of every planning activity, even if it is not considered a Federal action, (highly erodible land and wetland determinations are technical determinations and not considered planning activities). The results of this process are documented on the NRCS-CPA-52 worksheet, to— (i) Inform the landowner of the plan's impacts.

(ii) Provide a record that the EE was conducted.

5.5.2 Proposed, Threatened, and Endangered Species

The species of concern within the study area including any proposed, threatened, and endangered species are discussed in detail in Section 3.5.1.3. The following threatened and endangered species have the potential to occur within the watershed study area [Wyoming Natural Diversity Database, 2015]:

- **Endangered:** Black-footed ferret (*Mustela nigripes*)

- **Threatened:** Canada lynx (*Lynx canadensis*)
  Grizzly Bear (*Ursus arctos arctos*)
  Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*).

5.5.3 Other Species of Concern

The Wyoming Natural Diversity Database (WYNDD) records and maintains a list of plant species in Wyoming that are thought to be rare or sensitive, as discussed in Section 3.3.4.2. Table 3.7 lists the tracked or watched status of 29 plant species of concern that potentially occur within the study area. Tracked species are those that are vulnerable to extirpation because of rarity, inherent vulnerability, or habitat threats. Watched species are those that appear to be presently secure but have limited distribution. Although some of these plant species could occur on a proposed project area, none of the species are currently protected by state or federal regulation but still deserve appropriate planning and implementation considerations.

Also, the WYNDD records and maintains a list of species for amphibians, birds, crustaceans, fish, insects, mammals, mollusks, and reptiles in Wyoming that are thought to be rare or sensitive, as discussed in Section 3.5.1.3. Table 3.37 lists the tracked or watched status of 4 amphibians, 67 birds, 4 fish, 4 insects, 29 mammals, 12 mollusks, and 8 reptiles [WYNDD, 2015]. Table 3.37 also shows that the greater sage-grouse is classified as a "candidate species; warranted but precluded," which reflects information that is contained in the WYNDD database before the US Department of Interior (USDoI)'s decision in September 2015 to withdraw the greater sage-grouse from the USFWS's candidate species list, which is discussed in Section 3.5.1.3.

On September 22, 2015, the USDOI determined that the greater sage-grouse does not require federal protection under the ESA and withdrew the greater sage-grouse from the USFWS's candidate species list. However, the greater sage-grouse is still recognized as a sensitive species/species of concern by the BLM and a species of concern by WGFD. In June 2008, Executive Order 2008-2 was signed by the governor and stresses additional management consideration to sage-grouse and greater sage-grouse habitats statewide. This original executive order has been extended most recently by Executive Order 2015-4, which was signed by Governor Mead in July 2015. The order includes requirements of state agencies to encourage development outside of the core areas and to focus management to the greatest extent possible on the maintenance and enhancements of habitat within them. The core areas for greater sage-grouse cover approximately 135,680 acres (6.5 percent) of the study area and are shown in Figure 3.77. Additional information about Wyoming's sage-grouse management including mitigation, *de minimus* activities, core area maps and data, and the Density Disturbance Calculation Tool (DDCT) can be found at the website (*https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management*).

Sponsors of a WWDC SWPP project within the watershed should complete the WWDC's *Sage-Grouse Analysis Sheet* to determine if the proposed project is within the sage-grouse core area or is located within 0.6 mile of a sage-grouse lek as well as if the proposed project creates any wetlands or surface-water acres or provides enough water for mesic vegetation after construction. More information and forms about the WWDC's SWPP can be found at the website (*http://wwdc.state.wy.us/small_water_* *projects/small_water_project.html*). For all other proposed projects within the watershed, sponsors should contact the WGFD at least 60 days prior to submitting an application for a permit or project so any sage-grouse-related issues can be identified and any stipulations can be incorporated before commencing project activities.

5.5.4 Fish Distribution, Wildlife Habitat Distribution, Sensitive/Endangered Species

Available information and geospatial data regarding fish distribution, wildlife habitat distribution, and sensitive and threatened/endangered plant and animal species (e.g., greater sage-grouse) were obtained, mapped, and incorporated into the study's ArcGIS geodatabase and digital library. Information about these fish and wildlife species and their habitats are discussed in Section 3.5 of Chapter 3.

5.5.5 Wetland Delineation

Site-specific wetland delineation and inventories were not part of the scope of the watershed study. Geospatial data for the mapped National Wetlands Inventory (NWI) areas are listed in Table 3.15 and shown in Figure 3.12. This mapping was used to prepare conceptual proposed project plans that are listed in Chapter 4.0 for irrigation systems and livestock/wildlife water projects to avoid impacts to wetland resources. The alternatives for rehabilitating reservoirs, dam embankments, and inlet/outlet ditches may also affect wetland resources depending on the specific provisions of the plans, designs, and construction specifications. Entities should consult the USACE about any jurisdictional determinations when proposing any water-development projects with wetlands before implementing any proposed project. Specific mitigation measures would need to be formulated to compensate for wetland losses that are determined by certified wetland delineations.

5.6 PLANNING RESOURCES AND TOOLS

Sources of technical support and assistance for project planning and implementation within the watershed are primarily provided through partnerships between local landowners, conservation districts, the NRCS, BLM, USFS, WGFD, and/or the Nature Conservancy. Additionally, online planning tools and publicly available maps are also available for planning efforts. These web-based mapping applications can help local sponsors assist landowners who are interested in moving forward with a conceptual project proposed in the Watershed Management Plan.

5.6.1 Wyoming Association of Conservation Districts – SuiteWater

The Wyoming Association of Conservation Districts (WACD), in partnership with the Wyoming Geographic Information Science Center (WyGISC), have created SuiteWater which is a web-based mapping application (*http://suitewater.wygisc.org/*) and planning tool developed by and for Wyoming conservation districts. SuiteWater provides users with integrated geospatial data, digital imagery, background information and documents, and user-generated data for developing natural-resource plans. However, access to SuiteWater is limited to the conservation districts and WACD directors, staff, and advisors. Requests for access to SuiteWater must be submitted to the WACD for approval.

5.6.2 Natural Resources Conservation Service – Web Soil Survey

Local sponsors, landowners, managers, and water users can access soils information via the NRCS' Web Soil Survey (WSS) (*http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm*). The WSS provides soil information produced by the National Cooperative Soil Survey in updated soil maps and data. Soil mapping data and interpretations can be used for general or local planning. No online account is necessary unless datasets are downloaded from the website. Site-specific soil maps of an area can be created and customized using the online tools to customize a soil map report, measure distances, explore interpretations and ratings, and download associated geospatial data. Although the WSS is useful in analyzing soils data during project planning, on-site soil investigations are recommended for most implementation activities including but not limited to reservoir, irrigation, and wetland construction or rehabilitation projects.

5.6.3 Wyoming Cultural Resource Information System

The SHPO has created online applications and web services for researching cultural resources within any proposed project area. The SHPO's online resources include the Natural Resource and Energy Explorer (NREX) via the website (*https://nrex.wyo.gov/*) and the Cultural Resource Management Tracker (CRMTracker) at the website (*http://www.gnomon.com/CRMTracker/CRMTracker_AllOrg/CRMTrackerHome.aspx*). NREX has replaced the Cultural Research Information Summary Program (CRISP) and is discussed further in the following section. Additional cultural resource web service information can be obtained by contacting the SHPO by telephone (307.777.7697) or via the website (*http://wyoshpo.state.wy.us/OLResources/Index.aspx*).

5.6.4 Natural Resource and Energy Explorer

The NREX is a web- and GIS-based software tool that supports pre-planning development considerations by enabling discovery and energy analysis of environmental, cultural, socioeconomic, and infrastructural assets for user-defined, project-scale areas of interest in the state. The NREX can be accessed via the website (*https://nrex.wyo.gov*). The tool is designed to support the Energy Atlas concept within Governor Mead's Energy Strategy Initiative by providing public access to credible geographic data and information maintained by state agencies. The NREX can be used by developers, conservationists, consultants, planners, and managers for resource assessment.

5.6.5 Wyoming State Engineer's Office e-Permit System

The SEO's e-Permit system facilitates supervising and protecting surface-water and groundwater for the purpose of appropriation, distribution, and application to beneficial use of water in Wyoming. The SEO's e-Permit system is a web-based, online application that allows registered users to submit applications, petitions, and other requests; search the SEO's database of water rights; track the application process; access water-rights-related documents; and download streamflow and reservoir data. The SEO's e-Permit system can be accessed via the website (*http://seoweb.wyo.gov/e-Permit/*).

5.6.6 Wyoming Interagency Spatial Database and Online Management System

The Wyoming Interagency Spatial Database and Online Management (WISDOM) System (*http://wisdom.wygisc.org/*) is another online planning tool that allows individuals to access data regarding Wyoming's wildlife resources for use in developing project plans. WISDOM was developed as a partnership between the Western Governors' Association, WGFD, WyGISC, WYNDD, WDEQ, OSLI, WYDOT, NRCS, the Nature Conservancy, and USFWS. WISDOM provides users with landscape-level information for initial project planning phases; however, site-specific analysis with applicable agencies is still warranted regarding crucial wildlife habitat requirements and conservation potential. WISDOM preserves the confidentiality of sensitive data by displaying land ownership as federal, state, or private, and the records for certain species are generalized to prevent users from viewing specific location data.

5.6.7 Wyoming Density and Disturbance Calculation Tool for Greater Sage-Grouse

The WyGISC, in partnership with the WGFD, the BLM, and the USFS created the DDCT (*http://ddct.wygisc.org/*), which is a web-based application tool that calculates both the number of disruptive activities averaged per square mile and total surface disturbance within the DDCT assessment area for proposed projects in protected greater sage-grouse core areas. The DDCT web application is used by individuals to prepare required permits for development activities. Users must register before the web application can be used.

5.6.8 US Fish and Wildlife Service Information for Planning and Conservation

The USFWS's IPaC (*https://ecos.fws.gov/ipac/*) is a web-based application that is available to anyone who needs assistance in determining how their activities may impact sensitive natural resources such as migratory birds, species listed under the ESA, or wetlands. Information that users obtain from IPaC is produced by USFWS field offices to help improve project planning, discussions, and recommendations. Additional information can be obtained by contacting the Wyoming Ecological Services Field Office by telephone (307.772.2374) or website (*https://www.fws.gov/wyominges/index.php*).

5.6.9 Wyoming Department of Enterprise Technology Services

The Wyoming Department of ETS's mission is to increase the ability of state agencies to deliver quality, cost-effective services to Wyoming citizens by refining and establishing information services and technology. The ETS' "State Agency Map Portal," which can be accessed via the website (*gis.wyo.gov*), provides links for GIS web applications with publicly accessible maps, as listed in Table 5.2.

Table 5.2. Wyoming State Agency Map Portal GIS Web Applications

Agency	Address	Description
Enterprise Technology Services (ETS)	http://gis.wyo.gov/parcels/	Statewide Parcels
	http://gis.wyo.gov/Wyofires/	Wyoming Fire Map
State Parks and Historic Trails	http://gis.wyo.gov/WYOutsideResourceGuide/	State Parks Events Info
Office of State Lands and Investment (OSLI)	http://www.onanypc.com/statelandaccess/	Public Access to State Lands
	http://www.onanypc.com/osligis/oilandgas/	Oil and Gas Information
Wyoming Pipeline Authority (WPA)	http://www.wyopipeline.com	Pipeline Data
Public Service Commission (PSC)	http://psc.state.wy.us/htdocs/Dwnload/CertMaps/electric.pdf	Electric Utilities Areas
	http://psc.state.wy.us/htdocs/Dwnload/CertMaps/Gas.pdf	Gas Utilities Certificate Area Map
State Engineer's Office (SEO)	http://seo.maps.arcgis.com/home/index.html	Water Data Information
Wyoming Department of Environmental Quality (WDEQ)	http://deq.state.wy.us/lqd_permit_public/	Viewer of Active Mining Permits
Wyoming Game and Fish Department (WGFD)	http://wisdom.wygisc.org/	G&F decision support system
Wyoming State Geological Survey (WSGS)	http://www.wsgs.uwyo.edu/data/maps/published.html	Geologic Maps
	http://www.wsgs.uwyo.edu/Data/GIS/	Digital data by theme
Wyoming Geographic Information Science Center (WyGISC)	http://www.uwyo.edu/wygisc/	Home page for WyGISC
Wyoming Climate Office	http://www.wrds.uwyo.edu/sco/data/PRISM/PRISM.html	PRISM Climate Data Server
	http://ims2.wrds.uwyo.edu/Website/Statewide/	Water/Climate Map Server

6.0 COST ESTIMATES

The estimated costs, which represent 2017 dollars, are explained in the following sections for each of the conceptual proposed projects and alternatives described in Chapter 4.0.

6.1 IRRIGATION SYSTEM COMPONENTS

The costs of irrigation system components of the Watershed Management Plan were estimated by using current unit costs for individual projects. The National Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) cost docket data were used when possible for typical design concepts. The irrigation system costs are estimated in Table 6.1. The estimated costs for the irrigation system components included the following cost assumptions:

- Pipeline costs range from $7 to $37 per linear-foot of piping and trenching, depending on pipe rating and size, appurtenances, excavation depth, terrain, and geology.
- Structure for water-control (diversion and headgate) costs range from $7,000 to $20,000 each, depending on structure design capacity, excavation quantity, and concrete volume. Costs for larger structures for water-control can often exceed more than $100,000 each.
- Irrigation-regulating reservoir costs range from $25,000 to $42,000 each, depending on reservoir design capacity, borrow area proximity, and outlet facility requirements.

6.2 LIVESTOCK/WILDLIFE WATER COMPONENTS

The costs of livestock/wildlife water projects included in the Watershed Management Plan were estimated by using recent unit costs for similar projects, the 2016 NRCS EQIP cost docket data, and manufacturers' and vendors' advertised product prices. The livestock/wildlife water project costs are estimated in Table 6.2. The cost assumptions for a livestock/wildlife water project include the following:

- Water-well costs range from $10,000 to $40,000 each, depending on total depth.
- Stock-water tank costs range from $1,750 to $3,500 each, depending on stock-tank volume.
- Storage-tank costs range from $10,000 to $20,000 each, depending on storage-tank volume.
- Pipeline costs range from $11,500 to $19,000 per mile of piping and trenching, depending on excavation depth, terrain, and geology.
- Spring development costs range from $2,500 to $3,500, depending on spring box and storage-tank volume and infiltration design capacity.
- Solar pump, panels, and control costs range from $8,000 to $12,000, depending on pumping depth and number of panels.
- Stock pond and reservoir costs range from $15,000 to $25,000, depending on rehabilitation design capacity, borrow area proximity, and outlet facility requirements.

Table 6.1. Irrigation System Rehabilitation Project Cost Estimates

Item Number	Project Name	Description	Construction Costs ($)	Engineering Costs (10%) ($)	Construction and Engineering Subtotal ($)	Contingency (15%) ($)	Total Construction Costs ($)	Final Plans and Specifications ($)	Permits, Fees, Access ($)	Total Project Costs ($)
I-01	LaPrele Main Canal Diversion	Diversion and Headgate Project	169,600	16,960	186,560	27,984	214,544	10,727	10,727	235,998
I-02	LaPrele Westside Canal Diversion	Diversion and Headgate Project	84,800	8,480	93,280	13,992	107,272	5,364	5,364	118,000
I-03	LaPrele Lateral No. 1	Diversion, Headgate, and Pipeline Project	244,563	24,456	269,019	40,353	309,372	15,469	15,469	340,310
I-04	LaPrele Lateral No. 9A Sublaterals	Headgate and Pipeline Project	75,811	7,581	83,392	12,509	95,901	4,795	4,795	105,491
I-05	LaPrele Lateral No. 4 Sublateral	Headgate and Pipeline Project	22,387	2,239	24,626	3,694	28,320	1,416	1,416	31,152
I-06	LaPrele Lateral No. 2A Sublateral	Headgate and Pipeline Project	17,638	1,764	19,402	2,910	22,313	1,116	1,116	24,545
I-07	East Side No. 3 Reservoir	Regulating Reservoir	71,232	7,123	78,355	11,753	90,108	4,505	4,505	99,118
I-08	J A Moran Ditch Regulating Reservoir	Regulating Reservoir	89,040	8,904	97,944	14,692	112,636	5,632	5,632	123,900
I-09	Walker No. 3 Ditch	Headgate and Pipeline Project	93,958	9,396	103,354	15,503	118,857	5,943	5,943	130,743
I-10	Hoffman Ditch and Diversion	Diversion, Headgate, and Pipeline Project	83,613	8,361	91,974	13,796	105,770	5,289	5,289	116,348
I-11	Johnson Pump Lift (Cassa Ditch)	Diversion and Channel Stability Project	91,245	9,124	100,369	15,055	115,425	5,771	5,771	126,966
I-12	Wright No. 2 Ditch	Diversion, Headgate, and Pipeline Project	82,426	8,243	90,669	13,600	104,268	5,213	5,213	114,695
I-13	Wright No. 2 Ditch (Enlargement)	Diversion, Headgate, and Pipeline Project	63,600	6,360	69,960	10,494	80,454	4,023	4,023	88,500
I-14	Seepage Saddle Ditch and Diversion	Diversion, Headgate, and Pipeline Project	91,923	9,192	101,115	15,167	116,283	5,814	5,814	127,910
I-15	Carey Ditch No. 2 Ditch	Headgate and Pipeline Project	94,298	9,430	103,728	15,559	119,286	5,964	5,964	131,215
Total			**$1,376,134**							**$1,914,891**

Table 6.2. Livestock/Wildlife Water Project Cost Estimates

Item Number	Project Name	Description	Construction Costs ($)	Engineering Costs (15%) ($)	Construction and Engineering Subtotal ($)	Contingency (15%) ($)	Total Construction Costs ($)	Final Plans and Specifications ($)	Permits, Fees, Access ($)	Total Project Costs ($)
LW-01	East Draw	Stock Ponds Project	90,000	9,000	99,000	14,850	113,850	4,000	3,000	120,850
LW-02	Lone Tree	Spring Development and Tank Project	33,859	3,386	37,245	5,587	42,831	4,000	3,000	49,832
LW-03	Lawrence No. 1	Well, Pipeline, and Tank Project	63,480	6,348	69,828	10,474	80,302	4,000	3,000	87,302
LW-04	Section 11	Well Rehabilitation Project	45,000	4,500	49,500	7,425	56,925	4,000	3,000	63,925
LW-05	Prado 1	Well, Pipeline, and Tank Projects	92,119	9,212	101,331	15,200	116,531	4,000	3,000	123,531
LW-06	Section 7	Well, Pipeline, and Tank Projects	49,313	4,931	54,244	8,137	62,381	4,000	3,000	69,381
LW-07	T-J-T No. 2	Pipeline and Tank Project	17,839	1,784	19,623	2,943	22,566	4,000	3,000	29,566
LW-08	Rock House No. 1	Spring Development and Tank Project	29,438	2,944	32,382	4,857	37,238	4,000	3,000	44,238
LW-09	Buggy Hub	Spring Development and Tank Project	26,813	2,681	29,494	4,424	33,918	4,000	3,000	40,918
LW-10	Upper Draw	Spring Development and Tank Project	26,813	2,681	29,494	4,424	33,918	4,000	3,000	40,918
LW-11	Larime No. 1	Stock Reservoir and Tank Project	57,630	5,763	63,393	9,509	72,902	4,000	3,000	79,902
LW-12	Rodeman Livestock No. 2	Pipeline and Tank Project	4,313	431	4,744	712	5,456	4,000	3,000	12,456
LW-13	CT 2A	Stock Pond/Reservoir Project	30,000	3,000	33,000	4,950	37,950	4,000	3,000	44,950
LW-14	Pullman	Stock Reservoir Project	30,000	3,000	33,000	4,950	37,950	4,000	3,000	44,950
LW-15	Westfork No. 1 (Blue Downey)	Stock Reservoir Project	30,000	3,000	33,000	4,950	37,950	4,000	3,000	44,950
LW-16	Bill Young Spring No. 1	Spring Development and Tank Project	43,230	4,323	47,553	7,133	54,686	4,000	3,000	61,686
LW-17	Bill Young Spring No. 2	Spring Development and Tank Project	29,006	2,901	31,907	4,786	36,693	4,000	3,000	43,693
LW-18	Back 55	Pipeline and Tank Project	76,039	7,604	83,643	12,546	96,189	4,000	3,000	103,189
LW-19	Don Sommers No. 2	Well, Pipeline, and Tank Project	69,188	6,919	76,107	11,416	87,523	4,000	3,000	94,523
Total			**$844,080**							**$1,200,760**

6.3 OTHER MANAGEMENT PRACTICES AND IMPROVEMENTS

The costs of other potential practices and improvements from the Watershed Management Plan, such as stream-channel restoration, rangeland and grazing management, noxious weed control, and wetland enhancement were not estimated because these types of projects and associated components are highly variable and depend on site location and accessibility, available material sources, hauling and mileage, specialized equipment and operator availability, and permitting and design requirements. Staff with local organizations that are listed in Chapter 7.0 should be consulted regarding the estimated costs for these types of practices and improvement projects.

7.0 FUNDING OPPORTUNITIES

7.1 OVERVIEW

Sources of funding and financing for proposed projects within the watershed and the associated technical support are available from various local, private, state, and federal entities. The widespread opportunities described in this Level I Watershed Study, Watershed Management Plan, and the resulting proposed projects and alternatives make identifying and obtaining potential project funding dependent on local coordination and voluntary cooperation.

Local coordination is crucial in developing viable financing approaches that could be developed in implementing proposed projects and realizing beneficial watershed improvements. Voluntary cooperation between landowners, managers, irrigators, residents, organizations, and agencies is essential in addressing the identified land- and water-resource concerns within the Middle North Platte–Glendo Watershed. Land and water users and managers who are interested in voluntarily implementing conservation projects and programs should be aware of the partnership opportunities and program incentives available for successfully achieving their watershed-improvement goals and objectives.

Local, state, and federal agencies, along with private organizations, provide technical assistance for watershed and conservation projects; a smaller number of these entities also provide financial assistance. Private contributions, such as in-kind provisions, are vital in developing and accomplishing a successful watershed or conservation project. Agencies and organizations with technical and financial assistance programs, which could potentially assist with proposed projects and alternatives, are provided in the subsequent sections. Funding and program information for potential conservation and watershed project as well as assistance was obtained primarily from the following sources:

- **Water Management and Conservation Assistance Programs Directory** is an overview of local, state, and federal programs with associated contact information (*http:// wwdc.state.wy.us/ wconsprog/2014WtrMgntConsDirectory.html*).
- **Catalog of Federal Funding Sources for Watershed Protection** is a searchable database of financial assistance sources (grants, loans, and cost-sharing) available to fund a variety of watershed projects (*https://ofmpub.epa.gov/apex/watershedfunding/f?p=fedfund:1*).

Additional information about potential funding sources were reviewed and incorporated from previous watershed studies completed on behalf of the Wyoming Water Development Commission (WWDC) and specifically included excerpts from the *Blacks Fork River Watershed Study Basinwide Watershed Management Plan* [Anderson Consulting Engineers, Inc., 2015], the *Middle North Platte River Watershed Management Plan, Level I Watershed Study* [RESPEC, 2014], and the *Medicine Bow River Watershed Management Plan, Level 1 Watershed Study* [RESPEC, 2016]. These potential sources, which are described in this chapter, are certainly not an all-inclusive listing of the available opportunities for water management and conservation projects. Also, the available funding levels for these programs vary annually because they are subject to budget appropriations, spending authorizations, and (in some instances) donation amounts for organizations. Additionally, the contact information for these sources can and does change occasionally. The following is a partial list of contact information for local conservation organizations:

- Converse County Conservation District (307.358.3050)
- Lingle-Fort Laramie Conservation District (307.532.4880)
- Laramie Rivers Conservation District (307.721.0072)
- Natrona County Conservation District (307.261.5436)
- Niobrara Conservation District (307.334.2953)
- Platte County Resource District (307.322.9060)
- Natural Resources Conservation Service (NRCS) Casper State Office (307.233.6750)
- NRCS Casper Field Office (307.261.5436)
- NRCS Douglas Area Office (307.358.3050)
- NRCS Lusk Field Office (307.334.2953)
- NRCS Medicine Bow Field Office (307.379.2221)
- NRCS Wheatland Field Office (307.322.9060)
- Bureau of Land Management (BLM) Cheyenne State Office (307.775.6256)
- BLM Rawlins Field Office (307.328.4200)
- BLM Casper Field Office (307.261.7600)
- USFS Douglas Ranger District (307.358.4690)
- Wyoming Game and Fish Department (WGFD) Casper Regional Office (307.473.3400)
- WGFD Laramie Regional Office (307.745.4046).

7.2 LOCAL AGENCIES

7.2.1 Conservation Districts

Six conservation districts cover portions of the watershed, including the Converse County Conservation District (CCCD) (62.9 percent), Platte County Resource District (PCRD) (24.7 percent), Niobrara Conservation District (NCD) (4.7 percent), Laramie Rivers Conservation District (LRCD) (4.6 percent), Natrona County Conservation District (NCCD) (2.1 percent), and Lingle-Fort Laramie Conservation District (LFLCD) (0.9 percent).

Conservation districts are locally led, locally elected county government entities. These districts function as representatives of local people with a responsibility to natural-resource issues. Local conservation district boards perform as a liaison between local landowners and resource users and state and federal government agencies. Conservation districts provide information and education at the local level. Districts also provide technical assistance as local resources, capacity, and expertise allow and can also assist in developing and implementing program and project design and funding by assisting in proposal preparation, presentation, and pursuit of grant assistance. Conservation districts can also provide funding assistance, often through in-kind contributions such as staff time and technical aid. Districts can administer programs, projects, and grants on behalf of recipients of state and federal natural-resource programs. Districts can also assist with developing leveraged, partnered programs and projects. Additional information can be found on the website (*http://www.conservewy.com*).

Conservation districts also provide supplemental grants through cost-share programs to fund local residents with conservation projects and enhancements to their homes and community. Cost-share programs will vary from district to district and depend on the size and scope of the project. CCCD currently offers eight different cost-share programs to help "share the cost" with residents who are undertaking projects they could not afford on their own. Programs currently include Solar Pumping Plant Conversion, Septic System Improvement, Tree Planting/Windbreak Program, Community Pride Enhancement Program, Well Water Testing Day, Resource Enhancement Program, Household Hazardous Waste Day, and Community Canopy Program. The district will offer up to 50 percent of the project's cost; although, maximum available funding varies per program. At this time, the LFLCD offers three cost-share programs, including Tree Planting Cost-Share, which offers 50 percent with a maximum up to $750; Solar Cost-Share, which is awarded on a first-come-first-served basis; and a Water Testing Cost-Share program, which is also on a first-come-first-served basis with a cost-share that depends on how many participate. The LRCD offers a Regular Cost-Share program, which is available to all residents for soil and water conservation and landscape projects up to $1,000 on a $2,000 or more project; a Rural Cost-Share program, which is intended for landowners and cooperators who do not qualify for federal or state funding and which maximizes a matching amount of $5,000 on a $10,000 or more project; and an Analysis Cost-Share program, which provides funding for testing natural resources at analytical labs, and matches up to $500. The NCCD provides up to 50 percent of Small Water Project Programs (SWPP), which are discussed further in Section 7.3.3. Residents of each county are encouraged to contact their district for more information on cost-share options.

7.2.2 County Weed and Pest Districts

County Weed and Pest Districts in Albany, Converse, Goshen, Natrona, Niobrara, and Platte Counties also provide technical and financial assistance to landowners within the study area. These special-purpose districts deliver a wide range of support, including weed information, treatment education, field mapping, infestation control and eradication, early detection and response, and cost-share or discounted product incentives. Local contact information for the weed and pest control districts within the study area includes the following:

- Albany County Weed and Pest (307.742.4469)
- Converse County Weed and Pest (307.358.2775)
- Goshen County Weed and Pest (307.532.3713)
- Natrona County Weed and Pest (307.472.5559)
- Niobrara County Weed and Pest (307.334.3373)
- Platte County Weed and Pest (307.322.3210).

7.3 STATE PROGRAMS

7.3.1 Wyoming Water Development Commission

The WWDC is responsible for coordinating, developing, and planning Wyoming's water and related land resources. The commission, which consists of ten members who are appointed by the Governor with approval of the Senate, represents the four-state water divisions and the Wind River Reservation. Appointments are for a term of 4 years, and a political split on the commission is required. The commission serves public entities, including but not limited to irrigation districts, conservancy districts, municipalities, water and sewer districts, joint powers boards, improvement and service districts, and tribal business councils. The WWDC administers and develops financing recommendations for the Wyoming Water Development Program, which was defined as the following by W.S. 41-2-112(a):

> *Established to foster, promote and encourage the optimal development of the state's human, industrial, mineral, agricultural, water and recreational resources. The program shall provide, through the commission, procedures and policies for the planning, selection, financing, construction, acquisition and operation of projects and facilities for the conservation, storage, distribution and use of water, necessary in the public interest to develop and preserve Wyoming's water and related land resources. The program shall encourage development of water facilities for irrigation, for reduction of flood damage, for abatement of pollution, for preservation and development of fish and wildlife resources and for protection and improvement of public lands and shall help make available the waters of this state for all beneficial uses, including but not limited to municipal, domestic, agricultural, industrial, instream flows, hydroelectric power and recreational purposes, conservation of land resources and protection of the health, safety and general welfare of the people of the state of Wyoming.*

7.3.2 Wyoming Water Development Program

The main Wyoming Water Development Program encompasses new development, dams and reservoirs, rehabilitation, water-resource planning and construction. The information described in this section was abstracted from the Operating Criteria of the Wyoming Water Development Program (*http://wwdc.state.wy.us/opcrit/final_opcrit.pdf*). In 2015, the WWDC and Wyoming Water Development Office (WWDO) updated the operating criteria for the Wyoming Water Development Program and the SWPP to establish priorities and procedures and to serve as a tool to coordinate with other state and federal programs, which provide assistance for water projects. These updates were incorporated into this report; however, local sponsors should review the Project Application Information via the WWDC website (*http://wwdc.state.wy.us/project_application_info/project_app_info.html*) and/or contact the appropriate program manager at the WWDO before submitting a project application.

Current information on funding is important to review before submitting an application because WWDC's policies and procedures can and do change over time in response to legislative direction and/or commission action. Reviewing the available information at the listed websites and contacting the WWDC staff is recommended before beginning the application process. The following information in Sections 7.3.2.1 through 7.3.2.5 contains excerpts from Chapter II – Programs of the Operating Criteria of the Wyoming Water Development Program [WWDC, 2015a].

7.3.2.1 *New Development Program*

The New Development Program develops presently unused and/or un-appropriated waters of Wyoming. The program is funded by Water Development Account No. I, which has received general fund appropriations and budget reserve account appropriations on occasion, as approved by the legislature; the interest earnings that have accrued to Water Development Account No. I; and a percentage (12.45 percent) of the revenues that accrue to the state's severance tax distribution account. Legislative approval must be granted prior to allocating funds to a particular purpose or project.

The New Development Program provides an opportunity for sponsors to develop water supplies for existing and anticipated future needs to ensure that lack of water supply will not inhibit economic growth. The program encourages water development through state/local partnerships. The sponsor can complete a water supply project with state funding assistance. If a project is developed to meet the needs of the sponsor alone, the sponsor owns the project and its revenues. However, if there is an opportunity to sell water for other purposes, the sponsor and state share in the revenues from the sale in proportion to the grant/loan mix. This partnership is discussed in further detail in subsection I of Chapter IV of these criteria.

New development projects can proceed as sponsored projects or state projects.

1. Sponsored Projects

The project sponsor shall be a public entity that can legally receive state funds, incur debt, generate revenues to repay a state loan, hold title and grant a minimum of a parity position mortgage on the existing water system and improvements appurtenant to the project or provide other adequate security for the anticipated state construction loan. A project sponsor can be a municipality, irrigation district, joint powers board, or other approved assessment district, which will realize the major direct benefits of the project. The project sponsor must be willing and capable of financially supporting a portion of the project development costs and all operation and maintenance costs. Sponsors request project technical and financial assistance from the WWDC through the application process.

The sponsor may request that a Level I or Level II study be conducted to identify solutions and alternatives for addressing water supply issues or they may request funds for a Level III construction project, if it is determined the project is technically and economically feasible and serves to meet a water supply need or alleviate a water supply problem.

2. State Projects

The typical state project serves to benefit more than one entity and is multipurpose in nature. Another common characteristic of state projects is that each has a difficult permitting or political issue, which must be addressed. These issues may include developing a partnership with the federal government, another state, and/or private industry to encourage project development; resolving endangered species, water quality, or wetland issues; or addressing resistance to the project from downstream states. The WWDC shall consider investments in state projects on a case-by-case basis. However, it *should be recognized that present federal laws and regulations make it difficult to achieve federal clearances for projects in which there is not a clearly defined purpose and need.*

7.3.2.2 *Rehabilitation Program*

The purpose of the Rehabilitation Program is to provide funding assistance for the improvement of water projects completed and in use for at least 15 years. The source of revenue for the program is Water Development Account No. II, which receives a percentage (2.10 percent) of the revenues that accrue to the state's severance tax distribution account and the interest earnings that have accrued to Water Development Account No. II. Legislative approval must be granted prior to allocating funds to a particular purpose or project.

Rehabilitation projects are initiated by an application from a project sponsor. If the application is approved, the project is usually assigned a Level II status and can proceed through construction if it is determined the project is technically and economically feasible. The project sponsor must be willing and capable of financially supporting a portion of the project development costs plus all operation and maintenance costs.

The Rehabilitation Program serves to assist project sponsors in keeping existing water supplies effective and viable, thereby preserving their use for the future. Rehabilitation projects can improve an existing municipal or rural domestic water supply system or an agricultural storage facility or conveyance system. The projects serve to ensure dam safety; decrease operation, maintenance, and replacement costs; and/or provide a more efficient means of using existing water supplies.

7.3.2.3 *Dam and Reservoir Program*

Proposed new dams with storage capacity of 2,000 acre-feet or more and proposed expansions of existing dams of 1,000 acre feet or more qualify for the Dam and Reservoir Program. The source of revenue for the program is Water Development Account No. III, which has received Water Development Account No. I appropriations and budget reserve account appropriations on occasion, as approved by the legislature; the interest earnings that have accrued to the Water Development Account No. III; and a percentage (0.5 percent) of the revenues that accrue to the state's severance tax distribution account. Legislative approval must be granted prior to allocating funds to a particular purpose or project. Dams and reservoirs typically provide opportunities for many potential uses. While water supply and use shall be emphasized in the development of reservoir operating plans, recreation, environmental enhancement, flood control, erosion control and hydropower uses are explored as secondary purposes.

7.3.2.4 *Drinking Water State Revolving Fund*

By enacting W.S. 16-1-302, the Legislature authorized the use of water development account funds to provide 50 percent of the state's matching fund requirements for the federal Drinking Water State Revolving Loan Fund (DWSRF) program. The DWSRF program may be used to fund improvements to water treatment systems and to finance measures that address other Safe Drinking Water Act compliance issues. This program is not included in the annual Omnibus Water Bill considered by the Legislature. Water Development Program funds are appropriated automatically by statute to match 10 percent of the federal capitalization grant.

7.3.2.5 *Water Resource Planning*

The Wyoming Water Development Commission serves as the water-planning agency for the State of Wyoming. The water development planning function is an important aspect of the Water Development Program. Because the issues facing water development in the west are complex, the scope of the WWDC's planning efforts is not as closely defined as the New Development, Rehabilitation, and Dam and Reservoir Programs. The planning aspects of the Wyoming Water Development Program establish the framework for development strategies and serve to identify and resolve water issues. The source of revenue for the planning function of the program is typically Water Development Account No. I.

1. *River Basin Plans*

The program develops basin wide plans for each of the state's major drainage basins. These plans identify water supply problems and development opportunities. The plans serve to promote interest from water users who may become interested in a particular project and become project sponsors. Basin plans shall include the development of a water related database to provide data and information to developers and resource managers.

2. *Watershed Studies*

These studies provide a detailed evaluation of an individual watershed. The studies may identify water development and system rehabilitation projects as well as address erosion control, flood control or other non-water development related environmental issues. Watershed improvement studies are an integral part of the Small Water Project Program, which has its own specific criteria. The studies may identify projects that may be eligible for the New Development, Rehabilitation, or Dam and Reservoir Programs.

3. *Master Plans*

Master plans provide a service to municipalities, districts and other entities to assist in the preparation of planning documents, which serve as a blueprint for future water supply system improvements. Master plans also serve as a framework for the entities to establish project priorities and to perform the financial planning necessary to meet those priorities.

In addition, master plans assist entities in preparing the reports necessary to achieve federal funding assistance for water development, flood control, erosion control, hydropower, rehabilitation, watershed improvements and other water related projects. Sound water planning serves to promote the effective and efficient use of available water resources. Master plans provide information to users as to whether the resource can adequately service the existing and anticipated demands for water within a certain area and provide reconnaissance level information regarding costs and scheduling.

4. *Research*

Water development issues and problems may encompass watersheds, river basins or include the entire state. In order to address these issues, non-project specific research and data collection is necessary. The legislature has assigned the Water Development Program the following research tasks:

Instream Flow

The Wyoming Game and Fish Department (WGFD) select candidate stream segments for instream flows. The WWDC files water right applications with the State Engineer for permits to appropriate water for instream flows in those segments of stream recommended by the WGFD. Further, W.S. 41-3-1004 assigns the WWDC the responsibility to generate feasibility reports for all instream flow permit applications. The reports are hydrological analyses of water availability in the reach of the stream to which the applications apply. The analyses also quantify existing water rights above and within the stream segment. As the water-planning agency, the WWDC also reviews instream flow requests to determine whether they may conflict with future water development opportunities.

(a) Groundwater Grant Program

W.S. 41-2-119 authorizes the Commission to grant funds to cities, towns, and special districts for exploration programs to evaluate the potential use of underground water for municipal and rural domestic purposes. Authorized entities are eligible to receive up to $400,000 in grant funds and are required to provide 25% of the total project costs in local matching funds. The primary purpose of the program is to inventory the available groundwater resources in the state. The program also serves to assist communities in the development of efficient water supplies. Unlike other projects within the Water Development Program, funding for projects that meet the criteria of the Groundwater Grant Program can be allocated directly by the WWDC without project specific legislation.

University of Wyoming's Office of Water Programs

The Wyoming Water Development Program provides funding each year to the UW Office of Water Programs to fund non-project water related research. Annually, topics for potential research projects are solicited from Wyoming stakeholders. A Selection Committee, made up of federal and state agency representatives, prioritizes these topics and issues requests for proposals to address these areas of concern. From these requests, proposals are selected based on peer-reviewed selection criteria.

7.3.2.6 *Key Criteria and Procedures*

An application for funding under the New Development and Rehabilitation Programs must meet the following key criteria that best applies to potential projects as identified in Chapter 4.0:

The project sponsor shall be a public entity that can legally receive state funds, incur debt, generate revenues to repay a state loan, hold title and grant a minimum of a parity position mortgage on the existing water system and improvements or provide other adequate security for the anticipated state construction loan.

The proposed project must serve fifteen (15) or more municipal/domestic water taps of 2,000 or more water righted acres. The WWDC may waive the requirement for water meters if there is no existing water supply system or the sponsor demonstrates that water meters will be installed in the near future.

Important procedures, deadlines, and requirements for applications to the New Development and Rehabilitation Programs include but are not necessarily limited to the following:

- A fee of $1,000 must be submitted with the initial project applications; the fee does not obligate the Water Development Commission or state of Wyoming to fund a study or provide construction funding for any proposed project or purpose.
- A certified resolution that was passed by the governing body of the sponsoring entity must accompany an application.
- The applicant must be a public entity before applying for a Level II study.
- The due date for new project applications is August 15 of each year; the due date for applications to advance to the next study level or construction funding is October 1 of each year.

Important criteria that apply specifically to dam and reservoir projects include the following:

> *The scope specifically…pertains to projects that enlarge existing storage project by 1,000 acre-feet or greater or for proposed new dam and reservoirs with a capacity or 2,000 acre-feet or greater. The WWDC may accept applications related to the construction of dams and reservoirs from applicants that are not public entities. As the evaluations of the feasibility of new dams are complex, this will allow the applicant to know if the proposed reservoir is feasible prior to becoming a public entity. However, the applicant must be a public entity before applying for Level II, Phase III funding. Work included under this phase includes final engineering design, reviews required by the National Environmental Policy Act, consultations required by the Endangered Species Act, and acquisition of state and federal permits.*

7.3.2.7 *Financial Plan*

The current standard terms of the Wyoming Water Development Program financial plan are summarized as follows:

- Maximum grant of 75 percent for proposed Level III projects (*Typical grants for Level III projects are 67 percent from the WWDC and 33 percent Sponsor match*)
- Minimum 4 percent loan interest rate (*current rate is 4 percent, but legislature may increase the rate*)
- Maximum 50-year term of loans; term shall not exceed the economic life of project
- Payment of loan interest and principal may be deferred up to 5 years after substantial completion at the WWDC's discretion under special circumstances.

The commission will evaluate whether or not a project will be funded for Level III construction after reviewing the results of Level II studies. If the commission determines that the project should not advance because of high repayment costs (as determined by an analysis of the sponsor's ability to pay and after other funding sources have been considered), the sponsor has the option of making a formal presentation to the WWDC relative to the sponsor's ability and willingness to pay. This presentation must address the need for the project, the direct and indirect benefits of the project, and any other information that the sponsor believes is relevant to the commission's final decision.

The project sponsor shall be a public entity that can legally receive state funds, incur debt, generate revenues to repay a state loan, hold title, and grant a minimum of a parity position mortgage on the existing water system and improvements appurtenant to the project or provide other adequate security for the anticipated state construction loan. The WWDC may waive the requirement that the project sponsor be a public entity under the following exceptions:

1. The WWDC may accept applications for Level I studies from applicants that are not public entities. Applicant may then know if a viable project exists before becoming a public entity. However, the applicant must be a public entity before applying for a Level II study. Under these circumstances, the Level I process will have a 2-year duration with the study being completed the first year and the sponsor forming the public entity the second year.
2. The WWDC may accept applications related to constructing dams and reservoirs from applicants that are not public entities. Because evaluating the feasibility of new dams is complex, the applicant will know if the proposed reservoir is feasible before becoming a public entity. However, the applicant must be a public entity before applying for Level II, Phase III funding.

7.3.3 Small Water Project Program

The SWPP is intended to be compatible with the conventional WWDC program that was previously described. The following information contains excerpts from Chapter II – Programs of the Operating Criteria of the Wyoming Water Development Program [WWDC, 2015c].

7.3.3.1 *Introduction*

The purpose of the Small Water Project Program (SWPP) is to participate with land management agencies and sponsoring entities in providing incentives for improving watershed condition and function. Projects eligible for SWPP grant funding assistance include the construction or rehabilitation of small reservoirs, wells, pipelines and conveyance facilities, springs, solar platforms, irrigation works, windmills and wetland developments. Projects should improve watershed condition and function and provide benefit for wildlife, livestock and the environment. Projects may provide improved water quality, riparian habitat, habitat for fish and wildlife and address environmental concerns by providing water supplies to support plant and animal species or serve to improve natural resource conditions.

These criteria provide the Wyoming Water Development Commission (WWDC) and the Wyoming Water Development Office (WWDO) with general standards for evaluating and prioritizing applications for funding from the SWPP. In addition, the criteria serve as a tool to coordinate with the public and other state and federal agencies.

7.3.3.2 *Legal and Institutional Constraints*

1. Sponsoring Entity: Pursuant to W.S. 99-3-1903(k)(i)and W.S. 99-3-1904(m)(i)1, funding is available only to eligible public entities.
2. Eligible public entities are defined by state statute and include conservation districts, watershed improvement districts, water conservancy districts, irrigation districts, municipalities, the Joint Business Council of the Eastern Shoshone and Northern Arapaho Indian Tribes, the Business

Council of the Eastern Shoshone Indian tribe, the Business Council of the Northern Arapaho Indian tribe, or other approved assessment districts formed in accordance with Wyoming law.

3. Project Description: Pursuant to W.S. 99-3-1903(k)(iii)and W.S. 99-3-1904(m)(iii), the SWPP may provide for construction or rehabilitation and replacement of small dams, windmills, spring development, pipelines, etc., to impound, develop and convey water for livestock, wildlife, irrigation, environmental and recreational purposes.
4. Project Funding: Pursuant to W.S. 99-3-1903(k)(vii) and 99-3-1904(m)(vii), a small project is a project where estimated construction or rehabilitation costs, permit procurement, construction engineering and project land procurement are one hundred thirty-five thousand dollars ($135,000.00) or less and where the maximum financial contribution from the commission is thirty-five thousand dollars ($35,000.00) or less.

7.3.3.3 *Small Water Project Program Definitions*

1. Small Reservoir: A small reservoir is any water-storage facility up to twenty feet (20') of dam height and twenty acre-feet (20 AF) of capacity.
2. Well: A well may be eligible for funding depending on the depth of the well and scope of the project. Projects that propose to drill into unproved aquifers, as determined by the WWDC, may be eligible for the SWPP at the discretion of the WWDC. Discretion of the WWDC will be exercised in cases including but not limited to cases where the applicant is willing to reimburse the WWDC if the well does not meet the minimum requirements of the project in terms of quality and quantity.
3. Solar Platforms: Construction of solar platforms may be eligible for funding through the SWPP.
4. Pipelines and conveyance facilities: Rehabilitation of existing pipelines or conveyance facilities or construction of new pipelines or conveyance facilities may be eligible for funding through the SWPP.
5. Springs: Improving flows of existing springs and installation of collection facilities associated with springs may be eligible for funding through the SWPP.
6. Wetland Development: Development of wetlands where multiple benefits accrue may be eligible for funding through the SWPP.
7. Environmental: Projects that provide for stream bank stability, water quality improvements, or erosion protection may be eligible for funding through the SWPP.
8. Irrigation: Irrigation projects may be eligible for funding through the SWPP.
9. Windmill: Rehabilitation of existing windmills or construction of new windmills may be eligible for funding through the SWPP.

7.3.3.4 *Application and Evaluation Process*

1. Planning for small water projects will be generated by a WWDC watershed study or equivalent as determined by the WWDC.
2. Applications shall be received by January 1 of each calendar year. Applications meeting criteria requirements will be considered during the regularly scheduled WWDC meeting in March.

Applications shall include a project application, detailed project description, description of public benefit, outline of financial and technical contributions, project location map, project cost estimates and any letters of authorization or commitment of participation that may be available from other funding sources.

3. Projects that improve watershed condition and function, provide multiple benefits, and meet the funding criteria specified in W.S. 99-3-1903(k)(vii) or W.S. 99-3-1904(m)(vii), as described in B.4 herein, are eligible for consideration.
4. The sponsoring entity will be required to address the WWDC and provide testimony and other additional supporting evidence that justifies SWPP funding whenever the public benefit documentation, as required in W.S. 99-3-1903(k)(viii)(c) and W.S. 99-3-1904(m)(viii)(c), submitted with the application is deemed to be insufficient by the WWDO.
5. In order to establish priorities for both New Development and Rehabilitation projects, and to utilize available program funds effectively and efficiently, it is necessary to develop priorities. A project's priority will be assigned based the projects primary purpose, secondary benefits may be considered at the Commission's discretion.

Project priorities in order of preference, are defined as follows.

1. Source Water Development
2. Storage
3. Pipelines, Conveyance Facilities, Solar Platforms, and Windmills
4. Irrigation
5. Environmental

1. Projects that have completed the following requirements prior to application will be classified as "Shovel Ready," and may be considered as a funding priority at the Commission's discretion.
   - Permit procurement
   - State and Federal Agency Notifications
   - Land procurement, Right-of-Way, or Easement Acquisition
   - Have finalized all other financial agreements

   To establish completion of the above listed requirements, the project applicant may be asked to submit additional documentation as determined by the Commission at the time of application.
2. In the case of limited funding for this program the WWDC may only fund a portion of the applications submitted by any one Sponsor.
3. The Commission may take into consideration a Sponsor's existing backlog of previously funded projects that are not completed, when awarding grants for new projects.

7.3.3.5 *Project Development*

1. The sponsoring entity shall adhere to design standards for small water projects that are provided by the NRCS, an appropriate land management agency or the State Engineer.

2. Project water rights shall be in good standing with the State of Wyoming prior to construction of the project.
3. If the sponsoring entity initiates the construction process without prior written notification by the Commission, the sponsoring entity shall bear all costs resulting from said action.

7.3.3.6 *Program Expenditures*

1. Project Description: Projects that develop unused and/or unappropriated water will be considered SWPP New Development Projects and will be funded from SWPP Account I, which is funded by appropriations from Water Development Account I. Projects that improve completed water projects, decrease operation and maintenance costs, and/or improve efficiency of use of existing water supplies will be considered SWPP Rehabilitation Projects and will be funded from SWPP Account II , which is funded by appropriations from Water Development Account II.
2. Project Funding: W.S. 99-3-1903(k)(vii) and W.S. 99-3-1904(m)(vii)as described in 7.3.3.2 herein, establish the funding limitations for the SWPP.
3. Activities eligible for SWPP funding include design, permit procurement, project land procurement, construction engineering (design and construction inspections), project materials and invoiced contractor expenses. In-kind contributions are only eligible for installation of project materials that were purchased specifically for the project as documented by invoices.
4. Required permits and clearances shall be obtained prior to construction of the project. Copies of the final permits and clearances must be submitted to the WWDO before the WWDO will issue the notice to proceed for construction. WWDC funds may be used as necessary to secure the technical assistance required to complete permitting activities before construction commences.
5. The sponsoring entity shall provide the WWDO an operation and maintenance plan for the estimated life of the project.
6. SWPP funds shall not be used to refinance projects that have already been completed. SWPP funds shall not be used to augment the operating budget of a sponsor or any other entity. Maintenance costs, as determined by the WWDO, are not eligible expenditures under the SWPP. SWPP funding is limited to a one-time construction of a new project or a single rehabilitation of an existing project.
7. A Project Agreement between the WWDC and the sponsoring entity, which documents the roles and responsibilities of the project participants, must be finalized prior to expenditure of SWPP funds. Changes, modifications, revisions or amendments to the Project Agreement may be granted by the WWDC.
8. Construction contractors shall be selected using a competitive bid process.
9. Upon project completion, WWDC funds will be disbursed when a certified bill is received from the sponsoring entity including statement of completion, before and after photographs, project longitude/latitude coordinates and the affidavit of publication documenting the required notices of final settlement were published pursuant to W.S. 16-6-116.
10. If the sponsoring entity submits a certified bill, WWDC funds can be disbursed for a component of a project upon receipt of a certification by the project engineer that the component provides a

beneficial use and functions in the manner intended. Retainage on the cost of the component may be held until conditions described in F.9 are met.

11. Upon receipt of WWDC funds, the sponsoring entity shall promptly pay outstanding obligations.
12. Unexpended funds allocated under the Project Agreement will revert to SWPP Account I or SWPP Account II, as appropriate, upon the expiration date of the Project Agreement. Expiration dates may be extended in writing by the WWDC.

7.3.3.7 *Eligibility*

The projects eligible for SWPP funding include but are not limited to the following:

- Small reservoirs and stock-watering ponds (up to 20 feet high and 20 acre-feet capacity)
- Well
- Solar platforms
- Pipeline
- Springs
- Wetland development
- Environmental (streambank stability, water quality improvements, or erosion protection)
- Irrigation
- Windmill.

Irrigation works and projects may be eligible if they are already documented in a conservation district's existing watershed plan, a resource management plan, or an environmental evaluation prepared by a state or federal agency. These types of projects are only eligible if they cannot be addressed by the Water Development Program. Benefits associated with SWPP projects may include, but are not necessarily limited to the following:

- Improved water quality
- Habitat and water for fish and wildlife
- Improved riparian habitat.

These projects may address environmental concerns by providing water supplies to support plant and animal species or serve to improve natural-resource conditions. Funding can only be provided to eligible public entities, including but not necessarily limited to conservation districts, watershed-improvement districts, water conservancy districts, and irrigation districts.

7.3.3.8 *Application, Evaluation, and Administration*

Details of the application and evaluation process and program administrative procedures are provided in the Small Water Project Program Operating Criteria, which is available online as previously noted. Some key aspects of the process and procedures applicable to the potential projects that were identified in Chapter 4.0 include the following:

1. Planning for small water projects will be generated by a WWDC watershed study or equivalent as determined by the WWDO. A watershed study will incorporate, at a minimum, available

technical information that describes conditions and assessments of the watershed including hydrology, geology, geomorphology, geography, soils, vegetation, water conveyance, infrastructure, and stream system data. A plan outlining the site-specific activities that may remediate existing impairments or address opportunities beneficial to the watershed shall also be included. A watershed study may identify one or more projects that may qualify for SWPP funding. A professional engineer and/or geologist (as appropriate) shall certify any analysis submitted unless generated by a federal agency.

2. Applications shall be received by January 1 of each calendar year. Applications that meet criteria requirements will be considered during the regularly scheduled WWDC meeting in March. Applications shall include a project application, sponsor project referral, project location map, project cost estimates, and any letters of authorization or commitment of participation that may be available from other funding sources.
3. Projects that improve watershed condition and function, provide multiple benefits, and meet the funding criteria specified in W.S. 99-3-703(j)(vii) or W.S. 99-3-704(g)(vii), as described in B.4 herein, are eligible for consideration.
4. The sponsoring entity will be required to address the WWDC and provide testimony and other additional supporting evidence that justifies SWPP funding whenever the public benefit documentation, which is submitted with the application, is deemed to be insufficient by the WWDC.

7.3.4 Wyoming Office of State Lands and Investments

The Wyoming Office of State Lands (OSLI) is the administrative arm of the Board of Land Commissioners and the State Loan and Investment Board. The statutory responsibility of the OSLI is to carry out the policy directives and decisions of these two boards. The organizational structure of OSLI consists of the Office of the Director and four divisions: Administrative Services Division, Trust Land Management Division, Field Service Division, and Wyoming State Forestry. Collectively, these divisions serve as the trust beneficiaries to Wyoming's schoolchildren and state institutions; many clients in agriculture, mineral, timber, transportation, communication, public utility, recreation, tourism and other Wyoming industries; local government entities; state and federal agencies; and the resident and nonresident general public.

The Farm Loan Program, was established in 1921, and provides long-term real estate loans to Wyoming's agricultural operators. The use of this program has been expanded over the years to include loans for purchasing livestock and to assist beginning agricultural producers. The Irrigation Loans Program, was established in 1955 and is designed to support small and large agricultural water-development projects. The Legislature has allocated a total of $275 million for loans under the Farm Loan Program and $20 million for the Irrigation Loan Program. Both programs are funded from the Wyoming Permanent Mineral Trust Fund. The Joint Powers Act Loan Program was established in 1974 and the Legislature authorized the Joint Powers Act Loan Program to benefit local communities for infrastructure needs. These loans are approved from funds within the state's Permanent Mineral Trust Fund. These programs aid cities, counties, and special districts in providing needed government services and public facilities. Additional information is also available via the website (*http://lands.wyo.gov/grantsloans/loans/farm).*

7.3.5 Wyoming Department of Environmental Quality

The Wyoming Department of Environmental Quality (WDEQ) Water Quality Division (WQD) administers the Nonpoint Source Program, which solicits funding proposals under Section 319(h) of the Clean Water Act (CWA) that address nonpoint sources of pollution within the state of Wyoming. Funded proposals usually address multiple program objectives such as best management practice (BMP) installation, agriculture and urban, information and education, and BMP effectiveness or water quality monitoring. Available nonpoint-sources program funding depends on federal budget appropriations and the annual fund allocation from the US Environmental Protection Agency (EPA) to the state of Wyoming. Section 319 grant funds are available to local, state, and federal agencies; nongovernmental organizations; and private individuals who implement projects that reduce nonpoint-source pollution and improve the quality of surface water and groundwater. Information regarding program eligibility, priorities, and applications is available at the Wyoming Nonpoint Source Program website (*http://deq.wyoming.gov/wqd/non-point-source*).

7.3.6 Wyoming Game and Fish Department

The Wyoming Game and Fish Department (WGFD) may offer technical and funding assistance to help landowners, conservation groups, institutions, land managers, government agencies, industry, and nonprofit organizations develop or maintain water sources for fish and wildlife. Assistance may also be provided to protect or improve riparian areas/wetlands, restore streams, and upgrade irrigation infrastructure that provides improved fish passage or diversion screening.

Habitat Trust Fund: Funds can be used to acquisition, maintain, or improve wildlife habitat or to promote human understanding and enjoyment of the fish and wildlife resource (habitat or information and education projects). Funds can be used for internal projects or paid as grants to an outside entity. All proposals must have a department sponsor and be entered into a department proposal database by early January or early August annually. Project proposals will be prioritized for funding by department staff during January through March and the Wyoming Game and Fish Commission grants preliminary approval in March and final approval in July for funds available in July. No cost-share is required but is strongly recommended. Projects should occur in priority habitats or watersheds. More information can be obtained by contacting any habitat biologist in a regional office nearest the project (*https://wgfd.wyo.gov/About-Us/Offices-and-Facilities*).

Fish Passage Grants: All proposals must be submitted by December 15 each year, and coordination with the Fish Passage Coordinator or Regional Aquatic Habitat Biologist is encouraged to begin as early as possible. Proposed projects will be prioritized for funding by WGFD staff during February or March. Applicants will be notified at that time, although final approval rests with the WGFD at a meeting typically held in July. A draft grant agreement will be developed by the WGFD and presented to the recipient for review and refinement. Funding usually becomes available in July once the WGFD has given final approval to the fiscal year budget. More information can be obtained by contacting the Fish Passage

Coordinator at 307.332.7723 (ext. 277) or any Aquatic Habitat Biologist in a regional office nearest the project (*https://wgfd.wyo.gov/About-Us/Offices-and-Facilities*).

Additionally, the state of Wyoming provides funding to support the local sage-grouse working groups and fund conservation projects that benefit sage-grouse and their habitat. Implementing projects that are consistent with local sage-grouse conservation plans will reduce the likelihood of sage-grouse being listed under the federal ESA. Project Proposal forms for the Wyoming Sage Grouse Conservation funding can be downloaded by accessing the website (*https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Sage%20Grouse/WSGCF_PROJECTPROPOSAL_FORM.pdf)*.

7.3.7 Wyoming Wildlife and Natural Resource Trust

The Wyoming Wildlife and Natural Resource Trust (WWNRT) was created in 2005 and is an independent state agency governed by a nine-member citizen board appointed by the governor. Funded by interest earned on a permanent account, donations, and legislative appropriation, the purpose of the program is to enhance and conserve wildlife habitat and natural-resource values throughout the state. Any project that is designed to improve wildlife habitat or natural-resource values is eligible for funding. The office is centrally located in Riverton, Wyoming. The goal of the WWNRT is to assist applicants in enhancing wildlife and natural resources in Wyoming.

WWNRT funding is available for a wide variety of projects throughout the state, including natural-resource programs of other agencies. More information is available at the WWNRT website (*https://sites.google.com/a/wyo.gov/wwnrt/how-to-apply*). Some examples include the following:

- Improving or maintaining existing terrestrial habitat that are necessary to maintain optimum wildlife populations
- Preserving open space by purchasing or acquiring development rights
- Improving and maintaining aquatic habitats, which is necessary to maintain optimum fish populations
- Acquiring terrestrial or aquatic habitat when existing habitat is determined crucial/critical or is present in minimal amounts, and acquisition presents the necessary factor in attaining or preserving preferred wildlife or fish population levels
- Conserving, maintaining, protecting, and developing wildlife resources, the environment, and Wyoming’s natural-resource heritage
- Participating in water enhancement projects to benefit aquatic habitat for fish populations and allow for other watershed enhancements that benefit wildlife
- Addressing and mitigating impacts detrimental to wildlife habitat, the environment, and the multiple use of renewable natural resources that are attributable to residential, mineral and industrial development
- Mitigating conflicts and reducing potential for disease transmission between wildlife and domestic livestock.

7.4 FEDERAL AGENCIES

7.4.1 Bureau of Land Management

The BLM's Riparian Habitat Management Program offers the opportunity to coordinate with outside interests on riparian improvement projects. The goal of the BLM's riparian-wetland management is to maintain, restore, improve, protect, and expand these areas so they are in proper functioning condition for their productivity, biological diversity, and sustainability. The overall objective is to achieve an advanced ecological status, except where resource management objectives, including proper functioning condition, would require an earlier successional stage. The goal includes aggressive riparian-wetland information, inventory, and training and research programs, as well as improving the partnerships and cooperative management processes.

Partnerships have been available for riparian improvement projects and for research into riparian issues. Funding is available on an annual basis subject to budget allocations from Congress. Submitted projects compete for the funds available in the program.

The BLM's Range Improvement Planning and Development Program is a cooperative effort not only with the livestock operator but also with other outside interests, including the various environmental/ conservation groups. Water development, whether it be for better livestock distribution or improved wetland habitats for wildlife, is essential to healthy rangelands and biodiversity. Before actual range-improvement development occurs, an approved management plan must be in place. These plans outline a strategy for an area and identify the type of range improvements needed to accommodate that management. Examples include Coordinated Resource Plans, Allotment Management Plans, and Wildlife Habitat Management Plans.

All rangeland improvement projects on lands administered by the BLM require permit execution. Although a couple of methods are available for authorizing range improvements on public lands, Cooperative Agreement for Range Improvements (Form 4120-6) is the method most commonly used. This method applies equally to range-improvement projects that involve water such as reservoirs, pits, springs, and wells, including any associated pipelines for distribution. The major funding source for the BLM's share is from the range-improvement fund, which is generated from the collected grazing fees. A limited amount of funding comes from the general rangeland management appropriations. If the cooperator is a livestock operator, their contributions are generally in the form of labor; at times, livestock operators may also provide some of the material costs. Contributions from the conservation/environmental interest are monetary, are often in the form of grants, and occasionally contribute labor.

The BLM's Watershed and Water Quality Improvement efforts are undertaken in a cooperative approach with the state of Wyoming, conservation districts, livestock operators, and various conservation groups. Wyoming's BLM is collaborating in implementing several Section 319 watershed plans statewide. As the WDEQ continues to inventory state waters and identify impaired and/or threatened waterbodies, the BLM will partner with the WDEQ to improve water quality in waterbodies on public lands. In the course of developing watershed plans or total maximum daily loads (TMDLs) for these watersheds, the BLM will be routinely involved in watershed assessment, planning, implementation, and BMP monitoring.

Now and in the future, the goals of cooperative watershed projects will typically be restoring and maintaining healthy watershed functions. These goals will typically be accomplished through approved BMPs (e.g., prescribed burns, vegetation treatments, instream structures to enhance vegetation cover, controlled accelerated soil erosion, increased water infiltration, and enhanced flows and water quality).

Currently, the BLM is expanding its efforts to address water quality and environmental concerns associated with abandoned mines. This work will also be accomplished in cooperation with the State Abandoned Mine Lands Division, on a priority watershed basis, and employing appropriate BMPs to address identified acid-mine drainage and runoff problems from mine tailings and waste rock piles.

7.4.2 Bureau of Reclamation

The mission of the US Bureau of Reclamation (USBR) mission is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the public. The USBR has a major responsibility, in partnership with states, water users, and other interested parties, to help improve water resources and efficient water use in the western United States. After more than 100 years, the USBR's primary role has evolved from one of water-resource development to one of water-resource management. More efficient water use is a key component of the USBR's water resource management strategy.

The Sustain and Manage America's Resources for Tomorrow (WaterSMART) Program establishes a framework to provide federal leadership and assistance on efficient water use, integrating water and energy policies to support the sustainable use of all natural resources, and coordinating the water conservation activities of various department bureaus and offices. Through the WaterSMART Program, the USBR is working to achieve a sustainable water management strategy to meet the nation's water needs through projects that conserve and use water more efficiently, increase the use of renewable energy and improve energy efficiency, protect endangered and threatened species, facilitate water markets, address climate-related impacts on water, or prevent any water-related crisis or conflict.

A major component of WaterSMART is the Water and Energy Efficiency Grant Program, through which the USBR provides funding in two funding groups. In Funding Group I, up to $300,000 in federal funding is available per project, for smaller on-the-ground projects that can be completed within 2 years. In Funding Group II, up to $1 million in funding is available for larger, phased, on-the-ground projects that may take up to 3 years to complete. Water and Energy Efficiency Grants are awarded through a west-wide competitive process that requires a minimum 50 percent cost-share by the recipient.

In contrast, the Water Conservation Field Services Program (WCFSP) provides smaller amounts of funding ($100,000 per project maximum) through local competitions within a region or area. The projects funded are generally smaller in scope than Water and Energy Efficiency Grant projects and focus on fundamental conservation improvements as identified in water conservation plans developed by water users. Financial assistance provided through the WCFSP also requires a minimum 50 percent cost-share by the recipient. Funding opportunity announcements for WaterSMART grants and the WCFSP can be found on the website (*http://www.grants.gov/)*.

7.4.3 Environmental Protection Agency

The EPA administers several financial assistance programs that provide grants and loans to small, nonprofit organizations to large, state governments for watershed projects. Information about watershed funding can be found by visiting the EPA's website (*http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/watershed-funding*). Additionally, EPA policies for competition of assistance agreements and information on competitive grant opportunities, including a list of open announcements for competitive grant opportunities, and information on past competitions are available by visiting the EPA's website (*http://www.epa.gov/grants/open-announcements-competitive-grant-opportunities*).

7.4.4 Farm Service Agency

The Farm Service Agency (FSA) oversees several voluntary conservation-related programs. The FSA administers four different programs that may be applicable to some of the alternative projects identified in Chapter 4.0. Each of these four programs is briefly discussed below. Programs administered through the FSA are offered through local county committees. Available FSA programs include the Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Emergency Conservation Program (ECP), and the Grassland Reserve Program (GRP). Contacting a local FSA office for program eligibility requirements is recommended.

7.4.4.1 *Conservation Reserve Program*

The CRP pays a yearly rental payment in exchange for farmers who remove environmentally sensitive land from production and who plant species that will improve environmental quality. More information is available via the CRP website (*http://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index*).

7.4.4.2 *Conservation Reserve Enhancement Program*

The CREP, which is an offshoot of CRP, targets high-priority conservation issues identified by government and nongovernmental organizations. Farm land that falls under these conservation issues is removed from production in exchange for annual rental payments. More information is available via the CREP website (*http://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index*).

7.4.4.3 *Emergency Conservation Program*

The ECP provides funding and technical assistance for farmers and ranchers to restore farmland damaged by natural disasters and for emergency water conservation measures in severe droughts. More information is available via the ECP website (*http://www.fsa.usda.gov/programs-and-services/conservation-programs/emergency-conservation/index*).

7.4.4.4 *Grassland Reserve Program*

The GRP works to prevent grazing and pasture land from being converted into cropland or used for urban development. In return for voluntarily limiting the future development of their land, farmers receive a rental payment. More information is available via the GRP website (*http://www.fsa.usda.gov/programs-and-services/conservation-programs/grassland-reserve/index*).

7.4.5 Fish and Wildlife Service

Technical and financial assistance are available to private landowners, for profit or nonprofit entities, public agencies, and public-private partnerships under several programs that address managing, conserving, restoring, or enhancing wildlife and aquatic habitat (including riparian areas, streams, wetlands, and grasslands). Some of these programs are identified in the following text with Information available via the US Fish and Wildlife Service (USFWS) website (*http://www.fws.gov/grants/ programs.html*).

The Partners for Fish and Wildlife Program serves as the primary tool for conservation delivery on privately owned land for the USFWS. The program provides technical and financial assistance to private landowners and tribes on a voluntary basis to help meet the habitat needs of federal trust species and conservation partner-designated species of interest. The program targets habitats that need to be restored or enhanced, such as riparian areas, streams, wetlands, and grassland. Field biologists work one-on-one with landowners and partners to plan and implement a variety of projects, including grazing lands management, sage steppe enhancement, stream habitat improvement and fish passage, invasive species removal, and wetland establishment.

The Wildlife and Sport Fish Restoration (WSFR) Program works with states, insular areas, and the District of Columbia to conserve, protect, and enhance fish, wildlife, and their habitats, as well as hunting, sport fishing, and recreational boating opportunities. The WSFR Program provides oversight and/or administrative support for the following grant programs: Wildlife Restoration Grant Program, Sport Fish Restoration Grant Program, Boating Infrastructure Grant Program, State Wildlife Grant Program, Tribal Wildlife Grant Program, and Tribal Landowner Incentive Grant Program.

The Cooperative Endangered Species Conservation Fund (Section 6 of the ESA) provides grants to states and territories to participate in a wide array of voluntary conservation projects for candidate, proposed, and listed species. The program provides funding to states and territories for species and habitat conservation actions on nonfederal lands. States and territories must contribute a minimum nonfederal match of 25 percent of the estimated program costs of approved projects or 10 percent when two or more states or territories implement a joint project.

The North American Wetlands Conservation Act (NAWCA) Grant Program promotes long-term conservation of wetlands ecosystems and the waterfowl, migratory birds, fish, and wildlife that depend on such habitat. Supported conservation actions include acquisitioning, enhancing, and restoring wetlands and wetlands-associated habitat. This program encourages voluntary, public-private partnerships. Public or private, for profit or nonprofit entities, or individuals who establish public/private sector partnerships are eligible. Partners must at least match grant funds with nonfederal monies.

The **USFWS Challenge Cost-Share Program** started in 1988 as a way to enhance partnerships with state and local governments, individuals, and public and private groups. The program enables the USFWS to manage cooperatively its natural and cultural resources and fulfill stewardship responsibilities to fish and wildlife management. Under this program, projects must occur on a refuge or directly benefit a refuge. The program encourages refuge managers to form partnerships and leverage allocated funds to complete the projects. Appropriated funds may be used to pay for no more than 50 percent of the cost of a project. Nonfederal sources, including state/local governments, private individuals/organizations, business enterprises, and philanthropic and charitable groups provide the matching 50 percent cost-share. The cooperator share may be a nonmonetary contribution. Cooperative agreements are signed with the cost-share partners.

7.4.6 Forest Service

Several federal laws direct or authorize watershed management on US Forest Service (USFS) lands. Some of these laws provide broad authority while others deal more narrowly with specific watershed-management activities. The objectives of the USFS watershed management program are to protect and enhance soil productivity, water quality, water quantity, and timing of water flows and to maintain favorable conditions of streamflow and continuous production of resources from USFS watersheds. The policy of the USFS is to implement watershed-management activities on USFS lands in accordance with general objectives of multiple use and the specific objectives in the forest land management plans for the area involved. Another objective is to design management activities of other resources to minimize short-term impacts on soil and water resources and to maintain or enhance long-term productivity, water quality, and water quantity.

Specific direction for water quality is contained in the Land and Resource Management Plan for each national forest. The forests in Wyoming are in the process of completing the Inland West Water Reconnaissance that will provide a classification of watersheds and stream-reach conditions. USFS water quality programs are coordinated with the WDEQ and other appropriate agencies. The USFS also has a water-rights program that is coordinated with the Wyoming SEO. The USFS, in conjunction with other federal, state, and local agencies, provides watershed management and condition training.

7.4.7 Natural Resources Conservation Service

The NRCS administers several funding and technical assistance programs applicable to many of the proposed projects. The NRCS provides leadership in a partnership effort to help people voluntarily conserve, improve, and sustain natural resources on private lands. The purpose and mission of the agency is to help landowners treat every acre of their private property according to its needs and within its capability. The treatment includes a balance between the land use for economic return and protecting its ability to be productive from generation to generation.

Conservation planning is key to successful land stewardship as NRCS employees and landowners work together to tailor-make voluntary conservation plans that meet the specific needs of individual customers. The NRCS workforce has the technical expertise and field experience to help land users solve their natural-resource challenges and maintain and improve their ability to thrive economically. The workforce is highly skilled in many scientific and technical specialties, including soil science, soil conservation, range conservation, engineering, agronomy, biology, geology, hydrology, forestry, cultural resources, GIS, and economics. The NRCS conducts natural-resource inventories and assessments to indicate status, conditions, and trends of natural resources on private lands. This resource information and technology include science-based technical tools, technical guides, and practice specifications and standards ensuring quality and consistency of conservation planning and application across the nation.

Technical and cost-share assistance are available through the NRCS. This assistance includes designs, specifications, construction, management, and financial help for practice and system installation. Local people (individually and collectively) decide how to use the NRCS capabilities in the natural-resource conservation planning and application process. The NRCS supports and facilitates these individual and local decisions based on good resource information, whether that is a grazing management plan or layout for an irrigation system.

The NRCS provides technical assistance for the following programs in Wyoming:

- **Grazing Lands Conservation Initiative (GLCI):** Accelerated range-management technical assistance is available to producers in every county to support this initiative.
- **Small Watershed Program (PL-566):** The NRCS works through local government sponsors to help solve natural resources and related economic problems on specific watersheds.
- **Snow, Water, and Climate Services:** Snow survey crews collect information on snowpack conditions to provide Wyoming water users with forecasts of seasonal water supplies. This forecasting helps determine available water to meet agricultural, industrial, recreational, and urban area needs.
- **Soil Surveys:** Soil surveys provide a field-based scientific inventory of soil resources and information on the potentials and limitations of each soil. This information assists in determining the best uses of the land based on soil type.
- **Plant Materials:** The Wyoming NRCS is serviced by the Plant Materials Center (PMC) in Bridger, Montana. The Plant Materials Program identifies, selects, and releases superior-performing plant collections for a variety of conservation uses.

The NRCS administers the following Landscape Planning Programs:

- **Emergency Watershed Protection (EWP) Program** assists in implementing emergency measures, including purchasing floodplain easements, for runoff retardation and soil-erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.
- **Watershed Protection and Flood Prevention Operations (WFPO) Program** provides technical and financial assistance to entities of state and local governments and tribes (project sponsors) for planning and installing watershed projects.
- **Watershed Surveys and Planning (WSP)** authorizes the NRCS to cooperate with federal, state, and local agencies and tribal governments to protect watersheds from damage caused by erosion, floodwater, and sediment and to conserve and develop water and land resources.

The NRCS administers the following 2014 Farm Bill programs:

- Through the **Environmental Quality Incentives Program (EQIP)**, technical assistance, cost-share, and incentive payments are available to agricultural producers to implement conservation practices that improve water quality, enhance grazing lands, and/or increase water conservation.
- **The Greater Sage-Grouse Working Lands for Wildlife Initiative** is offered under EQIP to provide assistance to agricultural producers to implement practices that will alleviate or reduce threats to greater sage-grouse habitat.
- The **Conservation Stewardship Program (CSP)** encourages land stewards to improve their conservation performance by installing and adopting additional activities, and by improving, maintaining, and managing existing activities on agricultural land and nonindustrial, private forest land.
- The **Regional Conservation Partnership Program (RCPP)** promotes coordination between the NRCS and its partners to deliver conservation assistance to producers and landowners. The NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. Assistance is delivered in accordance with the rules of EQIP, CSP, Agricultural Conservation Easement Program (ACEP), and Healthy Forest Reserve Program (HFRP), and (in certain areas) the Watershed Operations and Flood Prevention Program.
- The **Agricultural Management Assistance (AMA)** provides financial assistance to agricultural producers to address resource issues such as water management, water quality, invasive species control, and erosion control by incorporating conservation into their farming or ranching operations. The purpose of the AMA is to assist producers in reducing risk to their operation.
- The **Conservation Innovation Grants (CIG) Program** is intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, EQIP funds are awarded to nonfederal governmental or nongovernmental organizations, tribes, or individuals.
- The **Agricultural Conservation Easement Program (ACEP)** provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements (ALE), the NRCS assists tribes, state and local governments, and organizations in protecting working agricultural lands and limiting nonagricultural uses of the land. Under the Wetlands Reserve Easements (WRE) component, the NRCS helps to restore, protect, and enhance enrolled wetlands.

7.4.8 US Army Corps of Engineers

The US Army Corp of Engineers (USACE) has civil responsibilities for flood-damage reduction, hydroelectric power generation, and navigational improvement as well as other water and land-resource problems and needs, including environmental preservation and enhancement, ecosystem management, and comprehensive floodplain management.

The USACE is responsible for a worldwide military construction program, an extensive environmental program, and a broad national civil works program. The USACE is authorized to provide technical assistance to local communities, states, and federally recognized Indian tribes to support their efforts to alleviate flooding impacts, reduce erosion, and otherwise plan for the wise and prudent use of the nation's water and related land resources. The USACE also has authority to construct certain water-related projects and respond to water-resource needs.

- **Planning Assistance to States.** This program provides for assistance in preparing plans for developing, using, and conserving water and related land resources. The USACE provides technical planning assistance in all areas related to water resources development such as bank stabilization, sedimentation, water conservation, ecosystem and watershed planning, and water quality. Assistance is limited to $500,000 per state and studies are cost-shared on a 50-50 basis with a nonfederal sponsor such as a state, public entity, or a tribe.
- **Floodplain Management Services.** This program provides technical services and planning guidance to support and promote effective floodplain management. Flood and floodplain data are developed and interpreted with assistance and guidance provided in the form of "Special Studies" on all aspects of floodplain management planning. All services are free to local, regional, state, or nonfederal public agencies. Federal agencies and private entities have to cover 100 percent of costs.
- **Flood-Damage Reduction Projects.** This program provides structural and nonstructural projects to reduce damages caused by flooding and focuses on solving local flood problems in urban areas, towns, and villages. The USACE works with the project sponsor to define the flood problem, evaluate solutions, select a plan, develop the design, and construct a project. A feasibility study is conducted to identify projects with the first $100,000 of the cost funded by federal sources. Any cost above this amount is cost-shared 50-50 with the sponsor in the form of cash and in-kind services. Construction lands, easements, right-of-way (ROW), relocations, and disposal and 5 percent of the projects costs are the sponsor's responsibility. Operation, maintenance, and a maximum of 50 percent of total project cost are the sponsor's responsibility.
- **Project Modification for Improvement of Environment.** The purpose of this program is to modify structures or operation of previously constructed water resources projects to improve environmental quality, especially fish and wildlife values. A study, at federal expense, is initiated followed by a feasibility plan that is cost-shared 25 percent by the sponsor.
- **Aquatic Ecosystem Restoration.** This effort aims to restore habitat conditions to benefit fish and wildlife resources primarily to provide structural or operational changes to improve the environment, such as channel reconnection, wetland creation, or improving water quality. The conditions are similar to the Project Modification Program with cost-share at 35 percent.
- **Water Resources Projects.** The purpose of this program is to construct larger projects for flood-damage reduction and to provide technical assistance in resolving more complex water-resource problems. The program is used to evaluate projects that cost more than $10 million and include the purposes of flood control, water supplies, water quality, environmental protection and restoration, sedimentation, or recreation. Examples include reservoirs, diversions, levees, channels, or floodplain parks. The USACE works with a nonfederal sponsor to define the flood- or water-resource-related problem or opportunity, evaluate flood control or solutions, select a plan, develop a design, and construct a project. Special authorization and funding from Congress is required with a reconnaissance study being federal cost. A feasibility

study to establish solutions is cost-shared 50 percent by the nonfederal sponsor with 35–50 percent of the construction cost being the responsibility of the sponsor.

- **Support for Others Program.** This program provides for environmental protection and restoration of facilities and infrastructure and includes Environmental Planning and Compliance, Economic and Financial Analyses, Floodplain Management, Cultural Resources, and General Planning. All costs for these programs are provided by the customer agency.
- **Regulatory Authority/Responsibility.** The USACE has regulatory authority under the CWA and the River and Harbor Act. These laws aim to restore and maintain the chemical, physical, and bioslogical integrity of waters of the United States. Section 404 of the CWA authorizes the USACE to regulate discharging dredged or fill material into waters, which would include dams and dikes, levees, riprap, bank stabilization, and development fill. Three kinds of permits are issued by the USACE: individual, nationwide, and regional general.

7.4.9 Rural Utilities Service

The US Department of Agriculture (USDA) Rural Development's Utilities Program is authorized to provide financial assistance for water- and waste-disposal facilities in rural areas in towns of up to 10,000 people. This program is intended for nonprofit corporations and public bodies such as municipalities, counties, and special-purpose districts and authorities.

Funding may be obtained through Rural Development only when the applicant is unable to secure funding from other sources at reasonable rates and terms. The applicant must have legal capacity to borrow and repay loans, pledge security for loans, and operate and maintain the facilities. The applicant must be financially sound and able to manage the facility effectively as well as have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay the costs of operating, debt service, and reserve. Grants are also available and are used to supplement loans to reduce debt service where necessary to achieve reasonable user rates. Assistance is available on how to assemble information regarding engineering, financing, and management of proposed improvements.

Loans and grants may be used to construct, repair, improve, expand, or modify rural water supplies and distribution facilities such as reservoirs, pipelines, wells and pumping stations, waste collection, pumping, treatment, or other disposal facilities. This assistance may also be used to acquire a water supply or water right or to finance facilities in conjunction with funds from other agencies or those provided by the applicant. These funds can be used to pay legal and engineering fees connected with developing a facility or pay other costs related to development, including ROW or easements and relocating roads or utilities. Loan terms are a maximum of 40 years, state statute, or the useful life, whichever is less with interest rates based on current market yields for municipal obligations.

The USDA Rural Development also guarantees loans to eligible commercial lenders to improve, develop, or finance water- or waste-disposal facilities in rural areas. This guarantee is a warrant to protect the lender and may cover up to 90 percent of the principal advanced. The guarantee fee is 1 percent of the loan amount multiplied by the percent of the guarantee. Interest rates will be negotiated between the lender and the borrower.

7.4.10 Wyoming Landscape Conservation Initiative

The Wyoming Landscape Conservation Initiative (WLCI) is a long-term science-based effort to assess and enhance aquatic and terrestrial habitats at a landscape scale in southwest Wyoming, while facilitating responsible development through local collaboration and partnerships. The WLCI is composed of many committees and teams that consist of representatives from the participating agencies. These agencies include: the BLM, US Geological Survey (USGS), USFWS, USFS, WGFD, Wyoming Department of Agriculture (WDA), Southwest Wyoming County Commissions, Southwest Wyoming Conservation Districts, National Park Service (NPS), NRCS, University of Wyoming, and the USBR.

Information gathered through inventory and assessment of species and habitat is combined with local input and knowledge to develop and implement conservation projects. The WLCI conducts regular Local Project Development Team meetings, where public participation is needed and expected. Ideas for projects can be presented at these meetings or sent to the WLCI Coordination Team through the BLM High Desert District Office (307.352.0227 or *blm_wy_wlci_wymail@blm.gov*). The application form and project tracking checklist are available from the website (*http://www.wlci.gov/lpdt-resources*).

7.5 NONPROFIT AND OTHER ORGANIZATIONS

7.5.1 Ducks Unlimited

Ducks Unlimited, Inc. (DU) is a funding source for wetlands and waterfowl restoration. DU conducts program development through a partner agency to provide short-term project funding assistance. Money availability is limited to what is within the organizational system. Generally, $20,000–$30,000 is available annually statewide with additional funding support from project-specific donations.

DU offers a waterfowl habitat-development and protection program called Matching Aid to Restore States Habitat (MARSH). This program is a reimbursement program that provides matching funds for restoring, protecting, or enhancing wetlands. The financial extent of this program depends on DU's income within the state. MARSH projects must significantly benefit waterfowl. Projects that receive funding support must be on lands that can demonstrate at least a minimum 30-year project life. Groups that request assistance must be able to demonstrate capacity to execute long-term habitat agreements, be able to deliver and manage projects, and be willing to assume project liability. DU's goal is to match MARSH funds equally with private, state, or federal sources. Their objective is to obtain the most leverage possible to maximize waterfowl benefits; therefore, leveraged projects have a greater likelihood of being approved. Specifics for proposal submission, budget preparation, project development, and funding can be further explained by the DU local coordinator. The local coordinator can provide additional information that relates to the program and provide partner contact opportunities at a local level.

7.5.2 National Fish and Wildlife Foundation

The National Fish and Wildlife Foundation (NFWF) is a private, nonprofit, tax-exempt organization that was chartered by Congress in 1984 to sustain, restore, and enhance the nation's fish, wildlife, plants, and habitats. The NFWF provides competitive grants through their Keystone Initiative Grants and Special

Grant Program. Information about these and other NFWF grants/programs is available at their website (*http://nfwf.org/*). Some of the grants/programs available include but are not limited to, the following:

- The **Pulling Together Initiative** provides support (on a competitive basis) for forming local weed-management area partnerships that engage federal resource agencies, state and local governments, private landowners, and other interested parties in developing long-term weed-management projects within the scope of an integrated pest management strategy; a minimum 1:1 nonfederal match is required.
- The **Bring Back the Natives/More Fish Grant Program** funds projects that restore damaged or degraded riverine habitats and their native aquatic species provided by the BLM, USBR, USFWS, USFS, and NFWF; a minimum 2:1 nonfederal match required.
- The **Five Star and Urban Waters Restoration Grant Program** provides modest financial assistance on a competitive basis to support community-based wetland, riparian, in-stream and/or coastal habitat restoration projects that build diverse partnerships and foster local natural-resource stewardship through education, outreach, and training activities.

7.5.3 Trout Unlimited

The Wyoming Council of Trout Unlimited conserves, protects, and restores Wyoming's cold-water (trout) fisheries and their watersheds. The Council consists of 16 chapters that are located throughout the state. While a majority of members are enthusiastic anglers, they do not focus on only maintaining fisheries for the purpose of angling. Healthy trout fisheries indicate well-functioning, sound ecosystems, and work toward restoring trout habitat will ultimately benefit the overall environment.

Of special concern are Wyoming's four subspecies of native cutthroat trout that currently inhabit a tiny fraction of their historic range. Working with federal and state agencies, local officials, and landowners, the Council is actively engaged trying to keep these fish from being listed under the Endangered Species Act. The Council provides funding and volunteer labor for a variety of stream and watershed projects such as erosion control and fish habitat structures, willow and other riparian plantings, and stream-protection fencing. Embrace-A-Stream grants are available for up to $10,000 per project. Partnerships are encouraged and can include local conservation districts and state and federal agencies. Those interested should contact the Council office or visit their website (*http://wyomingtu.org/*).

8.0 CONCLUSIONS AND RECOMMENDATIONS

A comprehensive, interdisciplinary study including inventory and description of the Middle North Platte River–Glendo Watershed was completed to identify and evaluate land- and water-resource issues and concerns in the study area. An extensive Geographic Information Sciences (GIS) and digital library were also incorporated as part of this Level I watershed study. The GIS includes information collected and generated during the study from many sources and serves as a valuable reference for potential projects and future efforts within the watershed.

After the information was gathered and inventory efforts of the watershed study were inventoried, several proposed projects and associated components along with identified opportunities, initial recommendations, and potential resource effects were developed as part of the Watershed Management Plan. The plan's projects, opportunities, and recommendations were formulated based upon field inventory findings; GIS mapping and analysis; landowner feedback during scoping meetings and field visits; and planning conceptual projects with participants, partners, and sponsors during the study. Resource issues and concerns within the watershed were identified and evaluated to develop conceptual proposed project opportunities for the following:

- Irrigation system rehabilitation
- Livestock/wildlife water
- Grazing management
- Surface-water storage
- Channel-stability opportunities
- Other management opportunities.

Each of these opportunities is described in the following sections.

8.1 IRRIGATION SYSTEM REHABILITATION OPPORTUNITIES

- A total of 15 proposed projects with 40 associated components were identified during field inventories for irrigation system infrastructure were completed for 16 irrigation systems.
- Most of the systems that were inventoried during the study involved weakened or deteriorated diversion and headgate structures along with laterals and ditches that had seepage and erosion issues.
- Nine systems were inventoried within Converse County and six systems inventoried within Platte County.
- Seven of the inventoried systems and proposed projects that were associated the LaPrele Irrigation District (LID) and another eight systems that were more individual in nature within the watershed.
- Recommended improvements to existing irrigation systems mainly involve replacing and/or rehabilitating existing diversion and headgate structures and replacing earthen ditches with buried pipelines to reduce conveyance losses and decrease erosion and sedimentation.

- The study participants identified rehabilitating their diversion and headgate structures as a priority, while the ditch to pipeline conceptual project components were largely included for consideration of potential water conservation planning opportunities.
- Most of the proposed irrigation system projects would require minor involvement or permitting from regulatory agencies to be completed.
- However, the proposed work that involved the diversion and headgate structures for the LID's Main and Westside Laterals would require permitting and associated consultation with the US Army Corp of Engineers (USACE), the Wyoming State Engineer's Office (SEO), the Wyoming Department of Environmental Quality (WDEQ), and the Wyoming State Historical Preservation Office (SHPO).

8.2 LIVESTOCK/WILDLIFE WATER OPPORTUNITIES

- Livestock grazing and ranching occurs throughout the watershed with other land uses including mining, wind power, oil and gas production, wildlife habitat, and recreation.
- Opportunities to improve range and riparian conditions require installing and operating well-distributed, reliable water sources and watering facilities for livestock and wildlife.
- The study area contains 167 Bureau of Land Management (BLM) grazing allotments that contain 61,132 acres of federal rangeland and 11,933 acres of forestland along with 39 US Forest Service (USFS) allotments that encompass 35,613 rangeland acres and 84,242 acres of forestland.
- When a future project is planned and would occur on federal land, coordinating with the BLM and the USFS is necessary when developing proposed livestock/wildlife water supply projects beyond the conceptual-level projects included within the study report.
- All of the proposed projects and pipeline components were conceptually mapped and located on only on private property or state lands within the watershed.
- A total of 19 proposed livestock/wildlife water projects that were identified for development, which resulted from an effort that evaluated available water sources in coordination with participating landowners and state land lessees.
- The 19 proposed livestock/wildlife water projects included conceptual plans and component descriptions along with associated cost estimates for each of the proposed projects.
- The project components included 6 wells, 10 solar pumps, 6 spring developments, 21,430 feet of buried pipelines, 22 stock tanks, and 8 stock ponds/reservoirs, which would require additional final planning, design, and permitting to be completed before construction commences.
- The proposed projects and components would need to be installed, operated, and maintained by the landowner or manager in accordance with current standards and specifications to realize the expected benefits within the proposed project areas and to the watershed.

8.3 GRAZING MANAGEMENT OPPORTUNITIES

- Reliable water-supply projects need to be developed and constructed in areas with inadequate water sources before grazing management alternatives could be made.

- Developing reliable water sources and associated watering facilities can aid in distribution, timing, and frequency of grazing animals. However, additional measures (e.g., cross fencing, low-stress herding, mineral/salting, and grazing density) should be evaluated as part of the site-specific, grazing management inventory and plan.
- Available tools such as the ecological site description (ESD) and the State and Transition Model (STM) can be used by landowners and managers so that they can be aware of the growth potential of desirable vegetation and predicted responses on a particular range site.

8.4 SURFACE-WATER STORAGE OPPORTUNITIES

- Institutional issues and constraints related to the 2001 Modified Decree and/or the Platte River Recovery and Implementation Program (PRRIP) limit the opportunity to create new reservoirs or increase existing reservoirs through enlargement within the watershed.
- Storage evaluations focused on existing stock pond/reservoir facilities and potential upland water-storage facilities less than 20 acre-feet that were identified by study participants where conditions limited the ability to store water within the study area.
- One existing storage reservoir – East Side No.3 Reservoir – was proposed for rehabilitation. One new storage reservoir – J A Moran Ditch Regulating Reservoir – was proposed for construction within the watershed.
- Two existing stock reservoirs – Larime No.1 and Westfork No. 1 (Blue Downey) were proposed for rehabilitation, and six new stock ponds/reservoirs (Prado 1, CT 2A, Pullman, and East Draw) are proposed for construction within the watershed.

8.5 CHANNEL STABILITY OPPORTUNITIES

- Stream channels on the lower reaches of Cottonwood Creek, Horseshoe Creek, Hunton Creek, and La Prele Creek are affecting diversion, headgate, and ditch structures along with stream stability but would require additional investigation and coordination with multiple landowners.
- Site-specific improvements could be developed to alleviate the channel impairments and restore riparian/wetland function as part of the Watershed Management Plan.

8.6 OTHER MANAGEMENT OPPORTUNITIES

- Coordination with the weed and pest control districts should continue especially regarding beneficial projects such as noxious weed control and planting of desirable vegetation in conjunction with upland water development, and weed infestations on canals or laterals.
- Noxious weed and invasive species control used to assist range and forest management in accordance with range inventories and applicable ESDs and state and transition models.

8.7 RECOMMENDATIONS

Several proposed conceptual projects, identified opportunities, suggested alternatives, and initial conclusions have been presented and discussed within this report. The recommendations listed below are also included for consideration:

- The LID's irrigation water storage and distribution system was too vast to inventory completely within the scope of this study. Although the study effort did initially evaluate the LID's priority components of the system, the facilities and infrastructure are aged and in need of rehabilitation; therefore, the LID is encouraged to submit an application to the Wyoming Water Development Commission (WWDC) for consideration to complete an Irrigation Master Plan to inventory and assess the LID's system, investigate conveyance losses, and prioritize necessary repairs within the LID.
- Several irrigation system rehabilitation projects and livestock/wildlife water projects could be eligible to apply for funding through the WWDC's Small Water Project Program (SWPP).
- Priority projects should be reviewed and selected, and components should be implemented when the necessary technical and financial requirements are determined.
- Landowners or managers who seek to participate in the SWPP should consult and coordinate with the Converse County Conservation District (CCCD), Platte County Resource Districts (PRCD), Niobrara Conservation District (NCD), Laramie Rivers Natural Resource District (LRCD), Natrona County Conservation District (NCCD), and/or the Lingle-Ft. Laramie Conservation District (LFLCD), which are eligible sponsors of SWPP applications and project agreements.
- Proposed project narratives, conceptual plans, and cost estimates could be used by local sponsors in developing SWPP applications. Preliminary project benefits were included to also assist in program application submittal.
- Several of the proposed projects require additional planning that would include site-specific engineering, cultural resource, geologic, groundwater, and wetland investigations and surveys.
- Although the study effort attempted to address all of the participants' requests, more projects from additional landowners will probably be identified after the study is completed. These projects are also eligible for SWPP funding because of their location within the watershed but will need additional planning assistance.
- The study's GIS and digital library should be used as a tool in planning and developing projects and should be updated as necessary from available information sources.
- Innovative strategies for coordinated project funding and financing involving private, local, state, and federal sources such as current partnership efforts between the LID, CCCD, LRCD, PCRD, NCD, NCCD, LFLCD, Natural Resources Conservation Service (NRCS), US Fish and Wildlife Service (USFWS), and the Nature Conservancy should be considered in association with WWDC programs to address resource concerns within the watershed.
- A coordinated approach based on local, collaborative endeavors, which integrates more than one watershed issue that results in achieving multiple benefits, is essential.

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APPENDIX A

SETTLEMENT OF THE NEBRASKA VERSUS WYOMING LAWSUIT

FINAL

SETTLEMENT OF THE <u>NEBRASKA V. WYOMING</u> LAW SUIT

NORTH PLATTE RIVER BASIN PLANNING STUDY

Prepared for:
Wyoming Water Development Program

Prepared by:
Mike Purcell

March 31, 2014

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SETTLEMENT OF THE NEBRASKA V. WYOMING LAW SUIT

Introduction

The purpose of this document is to assist in the development of the North Platte Basin Planning Study being prepared by the Wyoming Water Development Program. The following is a summary of the settlement of the Nebraska v. Wyoming law suit filed in 1986 and resolved in 2001.

The following are the key points in the 1945 North Platte Decree that was amended by 2001 Modified North Platte Decree. These points are offered as a benchmark for the subsequent discussions.

1. Wyoming was enjoined from diverting water for the irrigation of more than 168,000 acres from the mainstem of the North Platte River above Guernsey Reservoir and its tributaries above Pathfinder Dam. *(The tributaries between Pathfinder Dam and Guernsey Reservoir were not included under this limitation.)*
2. Wyoming was enjoined from storing more than 18,000 acre-feet per year for irrigation above Pathfinder Dam.
3. Natural flow in the Guernsey Dam to Tri-State Dam reach was apportioned 75% to Nebraska and 25% to Wyoming during the irrigation season (May 1 through September 30).
4. The priority for filling the federal reservoirs was: 1) Pathfinder Reservoir; 2) Guernsey Reservoir; 3) Seminoe Reservoir; 5) Alcova Reservoir; and 6) Glendo Reservoir. *(The Inland Lakes were not included in this list.)*

It is also important to note what the 1945 Decree did not do:

1. Groundwater, as it pertains to acreage accounting or the apportionment of North Platte water below Guernsey Dam, was not discussed.
2. The 1945 Decree did not address the water of the Laramie River.
3. There were no consumptive use limitations.
4. There was no winter time (October through April) apportionment between the States except the reference to federal reservoir priorities.

Historically, WY administered its water rights in a manner that recognized that each of the North Platte River three segments (above Pathfinder Dam, Pathfinder Dam to Guernsey Dam, and Guernsey Dam to the WY/NE state line) have their respective entitlements under the North Platte Decree. Therefore, during the irrigation season, each section is independently administered under WY water law. For example, a call from a senior water right in Goshen County would not be administered against a junior water right in Carbon County. Such a call would likely be considered futile given the complexity of the system between the appropriators. A call for regulation is considered futile when administering the junior water right would not benefit the calling senior water right. This practice was preserved in the settlement.

Key Dates and Corresponding Important Events Related to the Settlement

This section of the paper is offered to provide a time line of the events that impacted the settlement. The following list does not include all of the events that occurred during the litigation, just those that most affected the settlement.

October 6, 1986-The State of Nebraska (NE) filed its complaint against the State of Wyoming (WY) in the U.S. Supreme Court (Court). The complaint alleged WY is violating or threatening to violate Nebraska's equitable apportionment by:

1. Depleting the flows of the North Platte River by the operations of Grayrocks Reservoir on the Laramie River.
2. Depleting the flows of the North Platte River by the proposed construction of the additional river pumping, diversion and storage facilities at the confluence of the Laramie and North Platte River. *(Corn Creek Project)*
3. Depleting the natural flows of the North Platte River by proposed construction of storage capacity on tributaries entering the North Platte River between Pathfinder and Guernsey Reservoirs. *(Deer Creek Project)*
4. Actions by state officials to prevent the United States Bureau of Reclamation's continued diversions of North Platte water through the Interstate Canal for storage in the Inland Lakes. *(Entitlements of the Inland Lakes in NE.)*

The issues in the original complaint were straight forward. However, the case became more complex as it was expanded based on requests by NE and approvals by the Special Master and Court.

1988-NE moved to amend its pleadings to seek injunctions against Wyoming, Colorado, and the United States prohibiting further depletions in order to protect wildlife habitat along the North Platte and Platte Rivers in NE. The Supreme Court summarily denied NE's motion without opinion. This issue surfaces later in the litigation and negotiations.

1991-NE submitted a motion to amend its pleadings to:

1. Equitably apportion the un-apportioned, non-irrigation season flows of the North Platte River. This request would be denied by the Court in April, 1993. However, this issue was again brought up by NE during both the law suit and settlement negotiations.
2. Allege that WY violated the Decree by allowing irrigation diversions greater than 1 cfs per 70 acres, allowing groundwater that is hydrologically connected to the North Platte River to be used to irrigate lands within the 168,000-acre limitation area, thereby exceeding the 168,000 acre limit, failing to keep accurate records on acres irrigated, depleting return flows and depleting natural flows in the river by allowing additional consumption of tributaries entering the North Platte River below Alcova Reservoir. The Court referred this matter to the Special Master.
3. Request that the US be enjoined from increasing it is depletion of storage water and natural flows in violation of the Decree, alleging that the U.S. had contracted for use of

storage water in Glendo Reservoir in WY that were not authorized by the Decree. The Court referred this matter to the Special Master.

1993-In response to WY's motions for summary judgment, the U.S. Supreme Court issued an opinion on the following issues:

1. The Court established that the Inland Lakes were to be filled on the basis of a priority date of December 6, 1904, the same priority as Pathfinder Reservoir. This issue will be discussed later in this report.
2. Despite arguments from WY that the waters of the Laramie River were completely apportioned between WY and Colorado in the 1922 Laramie River Decree, the Court found, while Laramie River flows were not apportioned in the 1945 North Platte Decree, those flows were considered and counted and, therefore, WY could not freely dewater the Laramie River.

1994-NE filed a motion to:

1. Add allegations that WY's violations of the Decree included "reducing the flows of tributaries entering the North Platte River below Alcova by means of groundwater development, the depletions of return flows, and the construction of reservoirs."
2. Allege that re-regulation reservoirs and canal linings in the Goshen Irrigation District and Horse Creek Conservation District threatened to violate NE's apportionment under the Decree.
3. Again allege the US was violating the Decree by contracting for uses of water from Glendo Reservoir that were not authorized by the Decree.
4. Allege WY was violating the Decree by the proposed Corn Creek Project, the construction and use of new pumping facilities on the Laramie River *(GID pump station)*, refusing to administer the minimum flow released under the Grayrocks Settlement Agreement, and reducing the Laramie River flows through groundwater development.
5. Seek an apportionment of non-irrigation season flows, including flows for wildlife and endangered species uses.

The Court referred these matters to the Special Master, who accepted the first four matters, but denied the motion regarding the apportionment of non-irrigation season flows.

1995-In response to WY's and NE's (1994) motions to amend the law suit, the Supreme Court rendered a decision that:

1. Basically brought groundwater, federal storage administration, and other issues offered by NE into the case.
2. Agreed with the Special Master that he could hear evidence on downstream interests, including evidence of injury to wildlife and wildlife habitat.

July 1, 1997-The Cooperative Agreement was executed in which NE, CO, WY, and DOI agree to develop the Platte River Recovery Implementation Program. *(This date* *becomes important during the development of each states depletions plan, which will be discussed later in this report.)*

September 10, 1997-WY, NE, CO, and the US submitted stipulations pertaining to Glendo Reservoir, storage accounting above Pathfinder, conveyance (river carriage) losses, and Pathfinder Modification Project to the Special Master.

December, 1998-The parties submitted the "allocation stipulation" to the Court. However, NE would not agree to the WY and USBR proposal to resolve the groundwater issues.

May10, 2000-The settlement teams completed the Principles of Settlement, which were approved by the Governors the evening before trial was to begin in Pasadena, CA. The proceeding was suspended by the parties, subject to a Final Settlement Stipulation being submitted to and accepted by the Court.

March, 2001-The attorneys submitted the Final Settlement Stipulation and supporting documents to Special Master Olpin.

October, 2001-Special Master Olpin submitted his final report to the Court recommending approval of the stipulation.

November, 2001-The U.S. Supreme Court approved the settlement.

Final Settlement

The following discussion will attempt to provide additional background information of issues in the settlement in the order provided in the Joint Settlement Agreement, dated October 12, 2001, which we have informally designated as the "Brown Book." It is important to note that this paper is not meant to have sufficient detail to implement the settlement. The reader must read the settlement (Brown Book) to fully understand the implementation of requirements therein.

Article III of the Modified Decree-Inland Lakes

There had been a long standing disagreement between the USBR, Nebraska and Wyoming as to the priority date under which the Inland Lakes should be filled. The historic practice allowed the Inland Lakes to fill under the same priority date as Pathfinder Reservoir. The USBR and NE believed this was appropriate as the Inland Lakes and Pathfinder Reservoir were designated as components of the federal North Platte Project and, therefore, should have the same priority date. Wyoming contended that, unlike Pathfinder Reservoir, the Inland Lakes did not have a Wyoming water right that allowed the diversion of water in Wyoming for the Inland Lakes. Further, the Inland Lakes were not included in the priority for filling federal reservoirs within the 1945 Decree.

In 1993, the Supreme Court established that the Inland Lakes were to be filled on the basis of a priority date of December 6, 1904, the same priority as Pathfinder Reservoir. This ruling gave the USBR the right to divert 46,000 acre feet of water during the months of October, November, and April for storage in the Inland Lakes. While there was some discussion about timing and quantity of deliveries during the negotiations, this 1993 decision basically resolved the matter and maintained the status quo, as outlined in the Natural Flow and Ownership Procedures.

Appendix C-Amendment of the 1953 Order to Provide for Use of Glendo Storage Water

NE alleged that the US was violating the Decree by contracting for uses of water from Glendo Reservoir that were not authorized by the Decree. The 1953 Stipulation to the Decree limited WY's use of our allocation of the Glendo storage water to irrigation purposes in southeastern WY below Guernsey Reservoir. The US, through the USBR, contracted Glendo storage water for short term municipal and industrial use upstream of the reservoir through exchanges and temporary water use agreements. WY approved these transactions through provisions of WY water law. Interestingly, NE was also bending the restrictions within the Decree in the use of its allocation of Glendo storage water. NE's use of Glendo storage water was limited to irrigation purposes in the North Platte River basin in western NE. A portion of NE's storage water allocation was being contracted for, delivered to, and stored in Lake McConaughy for hydropower and irrigation uses downstream of western NE in the Platte River Basin, below the confluence of the North and South Platte Rivers.

It was apparent that the DOI, NE, and WY wanted additional flexibility in the use of Glendo storage water. The settlement, as documented in Appendix C, gives unrestricted use to NE and WY for its respective share of storage in Glendo Reservoir below Guernsey Reservoir and in the Platte River Basin, subject to contracts with the USBR and ESA and NEPA compliance.

Appendix C also provides provisions whereby WY's allocation of Glendo storage water may be used upstream of Glendo Reservoir, subject to certain specified mitigation of lost return flow downstream of Glendo Reservoir. Appendix C also allows that the mitigation for return flow may be used for environmental purposes downstream of Glendo Reservoir to provide mitigation for the upstream use, if mandated by the valid exercise or enforcement of federal law within WY.

In addition, Appendix C allows for the use Glendo storage water for fish and wildlife purposes downstream of Glendo Reservoir subject to the approval of the USBR and the respective state to which the water is allocated. This provision allows for the use of the storage water by the Platte River Recovery Implementation Program.

Appendix D-Procedures for 1945 Decree Paragraph II(b) [now paragraph II(e) of the Modified Decree] Storage Accounting

The 1945 Decree allows WY to annually store a total amount of 18,000 acre feet of water for irrigation purposes from the North Platte River and its tributaries above Pathfinder Reservoir between October 1 and September 30. In order to meet its annual reporting obligations regarding the amount of water stored in the area, State Engineer personnel visited and manually measured the storage in as many of the 85 reservoirs in this area as possible. Admittedly, the accuracy of the measurements could be questioned as access to many of the reservoirs was limited due to their remote locations and snowpack in the spring. However, WY was sure that it was logistically unlikely that the limitation was being exceeded.

NE alleged that the annual storage accounting completed by WY was inadequate and incomplete. While it was probably not admitted, this was an easy matter to resolve as WY officials wanted a less cumbersome and more accurate means to measure the annual storage in the reservoirs. Therefore, WY agreed to install and monitor measuring devices on the eight (8) largest reservoirs in the specified area, which stored over 60% of the allowed 18,000 AF capacity. Appendix D also establishes monitoring requirements for smaller reservoirs and requires the installation of measuring devices on any new reservoirs with a capacity in excess of 600 acre feet. As a matter of policy, WY decided to ultimately invest more into measuring devices for the largest eleven (11) reservoirs to more closely monitor WY's use of storage water.

Appendix E-Stipulation Among the State of Wyoming, The State of Nebraska, and the United States Relating to the Allocation of Water During Periods of Shortage

The federal North Platte Project consists of Pathfinder Reservoir and Guernsey Reservoir in WY and the Inland Lakes in NE. The project provides storage water for irrigators in eastern WY and western NE. The irrigators in NE enjoy approximately 80% of the benefits of the North Platte Project, while the major storage facilities are located in WY and are administered under WY water law and the Decree. NE was concerned that WY would allow its appropriators to operate in a manner that would impact the inflow entitlements of the North Platte Project.

WY alleged that the US was violating the Decree in its allocation of storage water. WY believed that the US operating procedures were inconsistent and haphazard.

In 1988-89, the Area Manager for the USBR made a call for administration of water rights for the benefit of Pathfinder Reservoir and other federal reservoirs. The Wyoming State Engineer honored the call for the non-irrigation season. The water rights administration ended on May 1, the beginning of the irrigation season. WY's logic was that the irrigators upstream of Pathfinder Reservoir were entitled by the Decree to irrigate a specified number of acres during the irrigation season (May 1 through September 30). In addition, the issue of sectionalized administration of the North Platte River was considered which, in part, was to administer the upper basin above Pathfinder Dam independent of the downstream river segments from Pathfinder to the state line.

The purpose of this stipulation was to define criteria that would be used to initiate and administer future calls. It must be emphasized that this stipulation only addresses calls in the months of February, March, and April for the benefit of Pathfinder, Guernsey, and Glendo Reservoirs and in April for the Inland Lakes. The issue of the water rights administration in the irrigation season for the benefit of these reservoirs was discussed but never resolved with the parties agreeing to disagree without impacting there respective positions on the matter.

The parties reviewed historic information provided by the USBR regarding the water usage of the North Platte Project in WY and NE. It was agreed that if the annual forecasted supply (including carryover storage) is less than 1,100,000 acre feet, it would be considered a time of shortage and an allocation would be declared. The USBR generates the forecasts based on the amount of water stored and forecasted inflow through July.

Appendix E introduces and memorializes the concept of “separate storage accounts” during allocation years. Water available to the North Platte Project is allocated first to each state and then the states’ allocation is allocated to each federal North Platte Project storage contractor within that state. Each contractor independently decides the amount of its allocation it wants to use during the irrigation season of the allocation year. If a contractor decides not to use all of its allocation, that contractor may enjoy the benefits of the carryover storage the following year. Section C of Appendix E provides extensive examples regarding the accounting for and use of the carryover storage.

Exhibit 5 (Procedure for Administration Upstream of Guernsey Reservoir During Allocation Years) provides additional information on this issue, which will be discussed later in this report.

Appendix F-Amendment of the 1953 Order to Provide for the Modification of Pathfinder Reservoir

In the late 1970’s, the Wyoming Legislature provided for the funding for the Cheyenne Stage II Trans-basin Diversion Project. As this was the first project funded under the Wyoming Water Development Program, there was considerable debate and discussion related to the funding. In order to secure support for the project, the Laramie County delegation promised that they would support funding for a storage project in the Little Snake River Drainage. This promise was maintained until the High Savery Project was constructed in the early 2000’s. In addition, the funding statutes for the Cheyenne Stage II Project discussed the potential of a Stage III Project. The Stage III was another trans-basin diversion project that would serve municipalities in the North Platte Basin. A joint powers board made up of representatives from Casper, Mills, Evansville, Rawlins, Edgerton, Midwest, Glenrock and others was formed to sponsor the Stage III Project and participate in the feasibility studies being conducted by the Wyoming Water Development Commission (WWDC). Unfortunately, the feasibility studies concluded that the trans-basin project was cost prohibitive and that acquisition of the needed special use permits on the Medicine Bow Forest would be very difficult, if not impossible, to obtain. Therefore, the WWDC turned its attention to storage projects located in the North Platte River Basin in WY.

The best in-basin project was the Deer Creek Dam and Reservoir Project. The project was a 66,000 acre-foot reservoir on Deer Creek, a tributary of the North Platte River between Pathfinder and Guernsey Reservoirs. Obviously, the project would deplete the flows of the North Platte River. The Wyoming State Engineer and Division I Superintendent initially contended that the reservoir would not be administered for water rights on the main stem of the North Platte River, including rights of the federal reservoirs, as the tributaries in this portion of the basin were not expressly addressed in the Decree. The yield of the reservoir would be approximately 22,000 acre feet per year without such regulation, 9,600 acre feet per year with regulation for the downstream federal reservoirs in WY, and 6,400 acre feet per year if, in addition, the reservoir was regulated in April for the Inland Lakes in NE. The WWDC was committed to the project despite the outcome of the water right deliberations and agreed to address yield scenarios in the environmental impact study for the project. In order to resolve the matter of the water rights for the Inland Lakes, in part, to better define the operations of the Deer Creek project, the Wyoming Attorney General's Office filed suit against the USBR in state district court on October 3, 1986. Three days later, NE filed its complaint with the U.S. Supreme Court. Wyoming's law suit against the USBR was stayed and ultimately dismissed.

At the time of the complaint by NE, the design of the Deer Creek Project was 95% complete, land was acquired, water rights were issued, and the federal dredge and fill 404 permit had been secured from the U.S. Army Corps of Engineers. Construction was to begin in the spring of 1987.

As previously noted, the construction of the Deer Creek project was one of the issues cited in NE's complaint. As the negotiations progressed, it became apparent that NE was not necessarily concerned about the development of a new water supply for the WY municipalities. However, NE was concerned about the precedent established by the federal 404 permit for the project. The permit required the acquisition of endangered species habitat in the Central Platte River basin. WY achieved this requirement through the purchase of 470 acres near Kearney, NE. However, there were no conditions within the permit requiring WY to provide water to offset depletions resulting from the operation of the Deer Creek Project. WY convinced the USCOE that any water provided to offset depletions would not arrive at the critical habitat because NE would not or could not protect the water from the state line to the habitat. Therefore, NE was very concerned that WY was permitted to build a storage project by simply buying and retiring NE land without providing mitigation for water depletions. Ultimately, NE filed suit against the USCOE in Nebraska District Court challenging the 404 permit for the Deer Creek Project. The case was designated as Jess v. West. Colonel West was the head on the Omaha District of the USCOE. There was another underlying concern shared by NE and the USBR. NE and the USBR were concerned about WY's administration of the Deer Creek Dam, given the initial position of WY water officials that the project should not be regulated for main stem rights, including the rights of the federal reservoirs.

John Lawson and Ken Randolph of the USBR came up with the concept of the Pathfinder Modification Project (PMP). The concept was derived from the precedent established in the enlargement of the Buffalo Bill Dam near Cody, Wyoming. Storage space lost to sediment was recaptured as a component of the enlargement. Water was allowed to be stored in the recaptured space under the original water right. Lawson and Randolph presented their idea to Mike Purcell, Director of the Wyoming Water Development Program. The WWDC acquired funding for the evaluation of the concept. The USBR and WWDC completed feasibility studies which indicated that the proposal had merit.

The Project was accomplished by raising the elevation of the existing spillway by approximately 2.4 feet with the installation of an ogee crest to recapture the 53,493 acre feet of storage space lost to sediment. Section 1 of Appendix F states, in part: *"The recaptured storage space would store water under the existing 1904 storage right for Pathfinder Reservoir and would enjoy the same entitlements as other uses in the reservoir with the exception that the recaptured storage space could not place regulatory calls on the existing water rights upstream of Pathfinder Reservoir other than the rights pertaining to Seminoe Reservoir."*

During the evaluation of the feasibility of the PMP, hydrologic analyses relating to the potential effects of the project were completed. Based on these analyses, it was apparent that the impacts of the project would be borne primarily by the Kendrick Project (Seminoe Reservoir), as its water right was junior to the reservoirs within the North Platte Project. Moderate impacts were also identified to the North Platte Project (Pathfinder, Guernsey, and Inland Lake Reservoirs). It was understood that these and other impacts would need to be mitigated in order to obtain the change in federal authorization from Congress, the partial change of use for the WY water right for Pathfinder Reservoir from the Wyoming Board of Control, and approval by the Wyoming legislature to export water from the project.

These impacts have been addressed in the following manner:

1. Section 5 of the stipulation states: *"In order to address the effects the Pathfinder Modification Project may have on contractors for water from Glendo, Pathfinder and Seminoe Reservoirs in Wyoming, upon completion of the Pathfinder Modification Project, Wyoming will pay the Wyoming and Nebraska federal storage water contractors' share of the Safety of Dams Modifications to the federal reservoirs to be implemented by the Bureau of Reclamation in the near future."* Funds have been appropriated and deposited in the project's debt service account to pay the federal contractors share of dam safety requirements that have or may be imposed on these dams.
2. Section 6 of the stipulation states: *"In order to address the effects the Pathfinder Modification Project may have on the Kendrick Project, upon completion of the Pathfinder Modification Project, Wyoming will assist the Casper Alcova Irrigation District with the resolution of existing selenium issues that are impacting its existing operation."* The WWDC, through an agreement with Attorney General's Office, has been working with the Casper Alcova Irrigation District to improve the efficiency of its irrigation water delivery system to enhance water conservation and assist in the resolution of selenium issues within the boundaries of the district.
3. The hydrologic analyses completed in the feasibility stage of the Project indicated that the Project could affect the water levels of Seminoe and Pathfinder Reservoirs. In response, the WWDC and Wyoming Game and Fish Department completed a mitigation plan with a $2M budget for reservoir fisheries.
4. Some water users in the Upper North Platte River Basin expressed concern that the project could increase the number of months in which the USBR advises that an allocation is likely resulting in additional water right administration in the basin. Exhibit 5-Procedure for Administration Upstream of Guernsey Reservoir was amended to address these concerns. The amendments will be discussed later in this report.

The Environmental account within the Pathfinder Modification Project is comprised of 33,493 acre feet of the recaptured space. It is operated by the Platte River Recovery Implementation Program (PRRIP) through the USBR, for the benefit of the endangered species and their habitat in Central Nebraska. The Environmental Account is the state's contribution to the PRRIP on behalf of its water users as it will serve as the reasonable and prudent alternative under the ESA for the depletions occurring in WY on or before July 1, 1997. The PRRIP will be discussed later in this report.

The State of Wyoming, through the Wyoming Water Development Program, has contracted with the USBR for the exclusive right to use of 20,000 acre feet of the enlargement capacity in a Wyoming Account. The USBR operates the 20,000 acre feet of storage to provide a firm annual yield of 9,600 acre feet. This is the same yield that was anticipated from the proposed Deer Creek Dam and Reservoir.

The Wyoming Account serves the following purposes, in order of priority:

1. A supplemental water supply for WY's municipalities during times of water rights regulation.
2. A replacement water supply to meet certain obligations agreed to in the Nebraska v. Wyoming settlement agreement, which will be discussed later in this report.
3. A replacement water supply to mitigate water use in excess of WY's existing water related baselines defined in Wyoming's Depletions Plan for the PRRIP.
4. An additional water supply for the PRRIP under temporary annual lease agreements with the WWDC if there is water remaining after the first three purposes have been met.

The Stage III Project and the Deer Creek Dam were proposed as municipal water supply projects. The operation of the Pathfinder Modification Project is similar to that proposed for the Deer Creek Dam. The WWDC realized Deer Creek Dam, now PMP, was probably the last opportunity to develop water for future municipal growth and wanted to make sure the water was used for this purpose. Therefore, municipalities cannot access storage in PMP unless their water rights are being administered. A maximum water use from the PMP for any individual users within the municipalities' service boundaries is 100 acre feet per year to ensure that the water will not be used for future industrial development. These conditions are documented in the stipulation and in the water supply contracts with the municipal customers.

The operating plans for the customers allows for exchanges with the irrigation account in Pathfinder Reservoir, so that municipal customers above and below Pathfinder Reservoir can benefit from the project. The municipalities continue to divert even though their water rights are being administered. Their water in the PMP replaces their depletions (diversions less measurable return flow) that occurred during administration. The depletion information must be submitted by the customers to the Wyoming State Engineer for verification and approval. The approved depletion is deducted from the customer's storage water in the PMP and added to the irrigation account in Pathfinder Reservoir.

Appendix G-North Platte Decree Committee Charter

Before the law suit, communication between the water officials of NE and WY was limited to focusing on the annual "Natural Flow and Ownership" (NFO) meeting which annually discussed the reservoir storage, river operations, and delivery of water. The communications to solve differences of opinions on legal matters and differences between federal and state regulations were contentious.

The North Platte Decree Committee (NPDC) was established by the parties to improve communications among the parties and serve to solve problems before they became contentious. The Charter addresses the organization and powers of the NPDC.

Exhibit 1-NPDC Representatives' Mailing Addresses-No comments needed.

Exhibit 2-North Platte River Ownership and Natural Flow Accounting Procedures for Water Year 2000

These procedures are subject to annual review, revision, and adoption by the parties. One of the powers and authorities of the NPDC is to review and modify the North Platte Ownership and Natural Flow Accounting Procedures. The NPDC will review the procedures and adopt changes, as deemed appropriate, during its spring meeting. The 2000 version of the procedures was incorporated in the "Brown Book" as an example and a place-holder for future NPDC deliberations.

Exhibit 3-Water Administration of the Lower Laramie River System Relating to Basin Electric Power Cooperative's Water Rights

This document, between WY and BEPC, was prepared to clarify and modify the administration of the operation of the Laramie River from the gaging station above Grayrocks Dam to the mouth of the Laramie River at its confluence with the North Platte River. The modifications were necessary to accommodate previous Board of the Control decisions and the Final Settlement Stipulation. The following background information is offered.

The Grayrocks Reservoir is owned by the Basin Electric Power Cooperative (BEPC) and is operated to provide water to the Laramie River Station. The reservoir has a capacity of approximately 104,000 acre feet. In October, 1978, during the construction of the Grayrocks Dam, the State of Nebraska, along with several environmental groups, filed a complaint in Nebraska District Court against BEPC and the U.S. Army Corps of Engineers, contending that the environmental impact statement, which was the basis for the issuance of the federal 404 dredge and fill permit, did not adequately address impacts to the endangered species and their habitat in the Central Platte River in NE. They requested and received an injunction on the construction of the Grayrocks Dam and Laramie River Station. As construction of these facilities was well underway, BEPC was forced to negotiate with NE and the other parties, as the costs of construction were being drastically impacted by the injunction.

A preliminary agreement was reached in 28 days and the injunction was lifted. The final "Agreement of Settlement and Compromise" (ASC) was dated December 4, 1978. BEPC was required to provide $7.5M which was used to establish the Whooping Crane Trust. In addition, BEPC was required to increase the minimum flow releases previously specified in the 404 permit. The purpose of the increased flows downstream from the dam was for fish and wildlife purposes. NE brought its claims in the law suit despite the fact that BEPC had fully complied with all provisions of the 1978 ASC.

The commitment to increase the minimum flow releases put a strain on the yield of Grayrocks Reservoir. Further, a portion of the storage in Grayrocks Reservoir was obligated through a separate arrangement with the Corn Creek Irrigation District for the Corn Creek Project.

The Corn Creek Irrigation District was proposing the construction of river pumping, diversion and storage facilities which would deplete flows at the confluence of the Laramie and North Platte River. NE's 1986 complaint is related to the Corn Creek Project, which was listed among the projects to be considered by the Wyoming Water Development Program (WWDP). The project proposed the installation of large alluvial wells and construction of a pump station and pipeline, which would deliver water to a proposed Teeters Reservoir. The stored water would be used to develop additional irrigated acres in Goshen County. The Corn Creek Irrigation District (CCID) was the project proponent. At the time that NE filed its complaint, the project was on "hold" status within the WWDP as it did not appear to be economically feasible. The CCID had contacted the USBR in Mills, Wyoming and reserved WY's share of the unallocated storage water in Glendo Reservoir, which was approximately 10,600 acre feet. In addition, the CCID was a partner, of sorts, in the Grayrocks Reservoir. The CCID secured state funding for a proportion of the costs of Grayrocks Reservoir through loans provided by the State Farm Loan Board. The CCID made the payments on the loans from funds provided by BEPC. In return, CCID received a markup from BEPC on each payment made. In addition, CCID had an entitlement to 22,500 acre feet of water from Grayrocks Reservoir. If the Corn Creek Project ever became a reality and exercised its entitlements, the ability of the reservoir to meet the demand of the Laramie River Station would be further impacted.

The amount of the minimum flow releases is predicated on reservoir levels in Grayrocks Reservoir.

If the storage in Grayrocks Reservoir is less than 50,000 acre feet, the required releases are reduced. This explains NE desire to protect inflows into Grayrocks Reservoir and the concern that the Corn Creek Project would reduce the storage in the reservoir.

NE's concerns about the protection of the flows below Grayrocks Reservoir were based on the potential implementation of the Corn Creek Project. However, NE was also concerned about water rights held by the Goshen Irrigation District (GID) on the Laramie River. GID held a senior 100 cfs supplemental water right to divert from the Laramie River just upstream of the confluence with the North Platte River, which had been reduced through a prior abandonment action to 25 cfs. GID requested and received funding from the Wyoming Water Development Commission to construct a pump station to allow for a more efficient use of the right. Therefore, the GID pump station and the Corn Creek Project could do real damage to the minimum flow releases with respect to their use by NE as they were considered by the State Engineer to be natural flow available for diversion downstream of Grayrocks Reservoir. However, there were no provisions requested of or granted by WY to protect the minimum flow releases to the mouth of the Laramie River and, certainly, not to the NE/WY state line.

NE's Laramie River claim that WY had consistently refused to administer the releases provided by the BEPC and NE settlement was addressed, in part, by suggestions from the Wyoming State Engineer. In the mid-1990's, BEPC sought and obtained a modification of its water storage rights in Grayrocks Reservoir to include environmental and wildlife uses. BEPC also obtained a secondary permit which allowed for the protection of storage releases to the mouth of the Laramie River for environmental and wildlife purposes. These BEPC and Wyoming Board of Control actions, along with the fact that NE had previously agreed to the

Corn Creek Project in its settlement with BEPC, resulted in the dismissal of NE's claims in the NE v. WY law suit relating to Corn Creek on March 26, 1999.

Nonetheless, as part of the settlement, WY agreed to acquire the rights pertaining to the Corn Creek Project and to cancel all water rights and BEPC obligations to provide water to the project. The logic of this agreement was that WY wanted to secure the remaining 10,600 acre feet of Glendo storage water, which was being reserved by the USBR for the Corn Creek Irrigation District. WY needed this water to provide replacement water for wells and diversions on the tributaries and drains below Whalen Diversion Dam. The transactions related to the demise of the Corn Creek Irrigation Project have been completed by WY and the WWDC has secured a long term contract for the Glendo storage water.

In addition, GID was not utilizing its new pump station. The District was concerned about the pumping costs. Therefore, WY, through the Attorney General's Office, purchased and demolished the pump station and abandoned its water rights. *(See Paragraph VI.B of the Final Settlement Stipulation.)* WY was to change the use and point of diversion of the water right to the confluence of the Laramie and North Platte Rivers. However, there was not sufficient historic use of the water right to support a successful request for such changes by the State Board of Control.

In any event, Exhibit 3 serves as a tool for the administration of Grayrocks Reservoir and documents the changes in that administration resulting from the settlement of the law suit. Exhibit 3 was executed by the Wyoming State Engineer and BEPC. However, the document cannot be modified without the approval of the NPDC and BEPC.

Exhibit 4: Procedure for Administration Upstream of Guernsey Reservoir Acreage Accounting

In 1991, NE alleged that WY violated the Decree by allowing groundwater that is hydrologically connected to the North Platte River to be used to irrigate lands within the 168,000-acre limitation area, thereby exceeding the 168,000 acre limit and failing to keep accurate records on acres irrigated. The Special Master's response to groundwater issues will be discussed later in this report.

Historically, WY had come very close to exceeding the limitation of 168,000 acres in the original Decree. The original limitation addressed the acreage irrigated from the mainstem of the North Platte River above Guernsey Reservoir and its tributaries above Pathfinder Dam. The acreage on the tributaries between Pathfinder and Guernsey Reservoir was not included. NE was interested in extending the acreage limitation to include these tributaries. WY was interested in improving its position under the acreage limitation. The issue was resolved by the agreement that WY may irrigate no more than 226,000 acres between the CO/WY state line and Guernsey Reservoir, exclusive of the Kendrick Project. Basics of the agreement included:

1. WY agreed to provide a base map on the irrigated acres to NE for review. Further, NE officials were allowed to review WY's annual acreage reporting methods.
2. Acres irrigated by hydrologically connected groundwater wells were included under the revised acreage limitation. A hydrologically connected groundwater well was defined as

a well that is so located and constructed that if water is pumped continuously for 40 years, the cumulative stream depletion would be greater than or equal to 28% of the total groundwater withdrawn by that well. "Green Area Maps" were developed, reviewed, and approved by NPDC. Green Area Maps identified those areas in which groundwater wells would not be considered hydrologically connected for the purposes of the Modified Decree. In addition, existing and proposed wells outside the "Green Areas" would not be considered hydrologically connected if the well owners could verify that their wells did not meet the criteria for hydrological connection.

3. Previously, vegetation along ditches and canals, sub-irrigated lands, and other riparian vegetation that was likely the result of irrigation were counted as irrigated acreage. This procedure rectified this situation by defining irrigated lands to be counted against the Modified Decree limitations as lands that in any year are "intentionally irrigated." Intentionally irrigated lands is the acreage irrigated through the efforts of man using a ditch delivery system or pump from surface water, hydrologically connected groundwater, or reservoir storage. This new definition added clarity to the recording, mapping and reporting processes. The term "intentionally irrigated" is now applied to WY's annual acreage inventory.
4. Acres that are irrigated solely from reservoirs are also included under the limitation. This was not a major issue as most of the storage in the existing reservoirs is used as a supplemental supply to acreage already included under the limitation.
5. NE was adamant that the acreage limitation should be divided between the area from the CO/WY state line to Pathfinder Reservoir and from Pathfinder Reservoir to Guernsey Dam, including the tributaries in this lower reach. NE cited that the irrigation efficiency and consumptive use per acre was higher in the lower basin and they feared WY would move acreage from the upper basin to the lower basin, thus potentially increasing the depletions to the North Platte River. As per the original Decree, WY had been measuring all irrigated acreage above Pathfinder and along the main stem of the North Platte River. However, there was no historic, reliable information on the acres being irrigated under the tributaries between Pathfinder Dam and Guernsey Reservoir.

Therefore, WY was concerned about splitting the acreage limitation between the upper and lower basins. The compromise was to agree to a total acreage limitation of 226,000 acres above Guernsey Reservoir, exclusive of the Kendrick Project, with the requirement that the acreage limitation be split by WY between the upper and lower basins after 10-years of experience. This split has been successfully completed.

The following table compares the acreage measured in 2009, the year in which the most acres were irrigated since the settlement, to the split submitted to the NPDC and approved by the Court in 2011.

Above Pathfinder	2009 Actual	2011 Split
Surface Water	148,639	
Sole Source Reservoir	924	
Groundwater	1,177	
Transfers	1,826	
Subtotal	152,566	169,100

Pathfinder to Guernsey	2009 Actual	2011 Split
Surface Water	32,589	
Sole Source Reservoir	2,897	
Groundwater	1,909	
Mainstem	11,969	
Transfers	2,208	
Subtotal	51,572	56,900
Total	204,137	226,000

Exhibit 5: Procedure for Administration Upstream of Guernsey Reservoir During Allocation Years.

Water Rights Administration

At the time of the first delivery of storage, if the forecasted supply for the North Platte Project is less than 1,100,000 acre feet in any one year, that year becomes an "allocation year" (See Appendix E). The forecasted supply, estimated beginning in October, and then again monthly from February through June, is the sum of the existing storage water in Pathfinder and Guernsey Reservoirs and the storable forecasted inflow into both reservoirs. In an allocation year, it is deemed that the USBR has placed a priority call for the federal reservoirs in the months of February, March, and April. This simply means that the USBR does not need to send a letter requesting the call for water rights administration. The call must undergo the same scrutiny as any other calls under WY water law, in that, the Wyoming State Engineer determines whether the call is valid and warrants the regulation of water rights upstream of the calling right. The automatic call is sectionalized. If the call is deemed to be valid, there is water rights administration upstream of Pathfinder Reservoir for the benefit Pathfinder Reservoir during the months of February, March, and April. In addition, there is water rights administration between Pathfinder and Guernsey Reservoirs for the benefit of Glendo Reservoir and Guernsey Reservoir in February, March, and April and the Inland Lakes in April. WY favored this approach for the following reasons:

1. It would equitably resolve and provide consistency on the long standing issue regarding the administration of the federal water rights under state law as influenced by the North Platte Decree.
2. The procedure recognizes and documents WY's position regarding sectionalized administration of the North Platte Basin in WY.
3. The call and any resulting administration ends on May 1, the beginning of the irrigation season.

Water users upstream of Pathfinder Reservoir had long been concerned about water right administration for the benefit of Seminoe and Pathfinder Reservoirs and the resulting impacts on their water supply. Their primary concern was water right administration in the irrigation season. However, some of the water users were concerned that the Pathfinder Modification Project would result in additional allocation years and, therefore, cause additional regulation in the non-irrigation season. The Town of Saratoga filed a partial abandonment action to abandon the

53,493 acre feet of storage space that was to be recaptured by the Pathfinder Modification Project. Ultimately, the Town of Saratoga's request for abandonment was withdrawn. The water users then formally protested the USBR's application to the Wyoming Board of Control for the partial change of use of the storage right for Pathfinder Reservoir needed to implement the Pathfinder Modification Project.

This matter was resolved in a "Stipulation and Settlement Agreement," dated October 16, 2008 between the Upper North Platte Valley Water Users, the Upper North Platte Valley Water Conservation Association, the USBR, and the WWDO. The USBR agreed to stipulate that the operation and use of the 53,493 acre-foot portion of Pathfinder Reservoir would not result in requests for water right administration. On October 15, 2007, the NPDC adopted revisions to Exhibit 5. The revisions established a new methodology for the calculations to insure the Pathfinder Modification Project would not increase the number of allocation years. The Board of Control Order approved the change of use on January 26, 2009. The Order states, in part:

"The recaptured storage space would store water under the existing 1904 storage right for Pathfinder Reservoir and would enjoy the same entitlements as other uses in the reservoir <u>with the exception that the recaptured storage space could not place regulatory calls on existing water rights upstream of Pathfinder Reservoir</u> other than the rights pertaining to Seminoe Reservoir." (Emphasis added.)

Cumulative Irrigation Diversion Procedure

It is not effective for irrigators diverting from the North Platte River between Pathfinder and Guernsey to construct and operate surface water diversions in the river. Therefore, pumps are used. Historically, irrigators along the North Platte River had difficulty delivering their water at the prescribed rate in their water right (1 cfs or 2 cfs/70 acres). It was inefficient to pump at these low rates, plus the fluctuating river levels and flows added difficulties. Often, the SEO hydrographers allowed these irrigators ("the pumpers") to deliver more water for shorter durations. For example, the pumpers were allowed to pump 4 cfs or 8 cfs/70 acres for a period of 6 hours. The impact to the river was the same as though the pumpers delivered 1 cfs or 2 cfs/70 acres for a period of 24 hours.

NE and the USBR questioned this practice. Ultimately, it was agreed that the practice could continue. However, metering of all pumpage was required and a limitation on pumpage was established during allocation years. In an allocation year, the cumulative volume amount of water that can be pumped from this reach for irrigation purposes is 6,600 acre feet per 2 week period.

Exhibit 6: Procedure for Consumptive Use Accounting

NE wanted to add limitations to WY's consumptive use of water throughout the settlement. WY balked because such limitations seemed unwarranted and NE's views of the limitations were too restrictive. It became apparent later in the negotiations that there may not be a settlement unless a concession was made by WY on this matter. Ultimately, a solution was reached which would provide some certainty to NE, while maintaining flexibility for WY. Information from the WY and NE technical experts in the law suit was combined to come up with the final detailed methodology and procedure to calculate the consumptive use of irrigation water. It was recognized by the settlement parties that the methodology was not necessarily technically correct (due to the limited data and information gaps across a large river basin), but it was deemed politically acceptable despite its imperfections. The consumptive use limitation, expressed as a volume of water for the irrigation above Pathfinder Dam, is 1,280,000 acre-feet for a period of ten consecutive years and the consumptive use limitation for the area between Pathfinder Dam and Guernsey Reservoir is 890,000 acre-feet for a period of ten consecutive years. The ten consecutive years include the year of the annual report and the preceding nine years, plus the annual amount of water consumed in each of the same ten years under a water right transferred from irrigation use to another use.

Again, it was understood by the parties that the methodology was certainly not perfect. However, as the methodology was used to both set and to enforce the limitations, it was fair. If the methodology is changed in the future, the consumptive use limitations must also be changed to ensure that WY maintains the flexibility it has under the existing methodology and limitations.

Exhibit 7: Procedure to Eliminate Negative Natural Flow Upon Occurrence

Negative natural flow is the term used to address the situation when storage deliveries from Pathfinder Reservoir are not arriving in sufficient quantity at the Orin gage above Glendo Reservoir. The storage deliveries are assessed conveyance losses and travel times. The river administrators use detailed daily river and storage accounting to determine if the storage water is arriving at the Orin gage. If not, the assumptions are that either there may be problems with the measuring devices or other intervening diverters are intercepting the delivery of storage water. In the past, the State Engineer’s Office had solved the problem without formal water rights administration. The water officials typically know where the problem may be and handle the issue directly with those water users causing the problem. Basically, this procedure simply codified the actions that were being taken by WY before the settlement. Negative natural flow has never been a big issue and the increased conveyance losses (river carriage) in Exhibit 9 will make the problem even less likely. It is interesting to note that there is an unofficial exchange that occurs in this reach of the river. If the intervening tributaries and basin runoff are providing sufficient water at the Orin gage to meet the calculated required storage deliveries from Pathfinder Reservoir, the releases to the river are fair game for upstream natural flow diverters. This unofficial exchange has benefited the municipalities and other users in the Pathfinder to Glendo reach for years.

Exhibit 8: Procedure for Reservoir and Storage Right Evaporation Losses

This procedure provides for an updated method for accounting for evaporation losses in the large federal reservoirs in WY. Previously, this issue was addressed by the Decree. This exhibit replaces the previous language in the Decree, thereby allowing future changes to this technical matter through NPDC rather than a modification to the Decree, which must be approved by the Court.

There had been a long standing practice of storing water in excess of the ownership accounts of the federal reservoirs in Glendo Reservoir and releasing that water to augment natural flow, thereby, delaying the need to call for storage water. The practice serves to reduce "spills" from the reservoir system at times when the water is not needed and benefits the storage inventory in the basin for the water users in WY and NE. In 2000, the Wyoming Board of Control clarified this practice and provided that Glendo Reservoir could be used to reregulate these flows. The Modified Decree embraced the clarification provided by the Wyoming Board of Control and, therefore, codified the practice in the Glendo Reservoir storage water right held by the USBR. This procedure also outlines the conditions under which water in the reregulation space can be used to offset evaporation losses of the federal reservoirs.

Exhibit 9: Procedure for River Carriage (Conveyance) Losses

The parties had realized for quite some time that the conveyance losses being assessed storage water below Pathfinder Dam were too low. A jointly funded study was prepared in 1989 to provide more accurate evaporation and riparian ET rates. No adjustments were made to the conveyance losses specified in the Decree, in part, because the conveyance losses were specified in the Decree and any changes would have to be approved by the Court. Ultimately, it was agreed to remove the losses in the Decree and, instead, include them in this Exhibit 9 procedure, thereby allowing the NPDC to make future changes if deemed appropriate. The conveyance losses to the WY/NE state line were increased to approximate the evaporation losses estimated in the 1989 report. Conveyance losses were added for the river segments to Lake McConaughy in NE, as measured at the Lewellan gage. The increased duty on storage deliveries basically increased the amount of natural flow available for use in WY and NE and reduced the potential for negative natural flow at the Orin gage. (See the discussion on Exhibit 7.) The available natural flow may have increased 5,000 to 20,000 acre feet per year which benefits water users in the Grey Reef to Orin gage reach and the irrigators in WY and NE diverting in the Guernsey to Whalen Dam segment.

Exhibit 10: Procedure for Whalen Diversion Dam to the State Line Reach Administration of Irrigation Groundwater Water Rights

The following is offered to provide a backdrop to the settlement of the Nebraska v. Wyoming lawsuit as it relates to the requirement for replacement water for the operation of certain specified groundwater wells and surface water diversions in Goshen County, Wyoming.

In 1994, groundwater became an issue in the case with NE's submittal of amended pleadings. Count I of NE's amended pleadings alleged WY was violating or threatening to violate the Decree by: *"(i) reducing the flow of tributaries entering the stream below Alcova Reservoir through groundwater development and the depletion of return flows and the construction of reservoirs and (ii) reducing the flow of tributaries and the mainstem as well as canal and lateral flows reaching Nebraska through the same sorts of actions.* "

Wyoming responded by noting that the existing Decree did not address groundwater and that it was not equitable to limit WY's use of groundwater while NE had thousands of groundwater wells. On September 9, 1994, Special Master Olpin issued his "Third Interim Report on Motions to Amend the Pleadings." The Special Master not only agreed with NE, he also derided WY's arguments. This made it clear that groundwater would need to be addressed in the settlement.

While groundwater issues surfaced in the negotiations related to acreage accounting procedures above Guernsey and in the Lower Laramie River basin, the most contentious issue related to WY's groundwater use in the "triangle." The triangle is defined as the area bounded by Whalen Diversion Dam on the west, 300 feet south of the Fort Laramie Canal on the south, one mile north of the Interstate Canal on the north and extending downstream to the WY/NE state line on the east. This area was selected because it was clear that the wells therein were hydrologically connected to the segment of the North Platte River subject to the 75/25 apportionment between NE and WY in May through September.

Ultimately, the parties agreed to an approach that came from data from expert reports. The approach can best be described as follows:

1. The average total pumping of irrigation wells in the triangle from 1946 to 1994 was 48,525 acre feet per year.
2. The average net consumption of the water pumped from the irrigation wells from 1946 to 1994 was 29,783 acre feet per year.
3. There were an estimated 335 irrigation wells in the triangle.
4. Estimates suggested that the irrigation wells depleted an average of 8,158.2 acre feet per year from the flow in the North Platte River at defined times when there was insufficient natural flow to meet irrigation demands in the Whalen to state line reach.
5. Therefore, the parties determined that the average effect on natural flows in the river during shortages is 24.4 acre feet per year per well (8,158.2 acre feet/335 wells).

The above analyses were used to negotiate the provisions of Exhibit 10, which documents:

1. Wells with irrigation ground water right priority dates prior to October 8, 1945 (date of the original North Platte Decree) are not affected by Exhibit 10.
2. WY was required to develop a list of baseline wells, which are irrigation wells with priority dates on or after October 8, 1945 that were active ten years immediately prior to court approval of the settlement i.e. 1992 through 2001. There are 314 baseline wells in the triangle.
3. Each year, WY determines the number of active wells, wells that were pumping for any length of time during the previous irrigation season (May through September). Any well that operates for irrigation purposes during the previous irrigation season whether it pumped for one hour or throughout the entire season is an active well.
4. WY must provide replacement water annually in a quantity equal to 24.4 acre feet per well for every active well in the year following the year in which the wells were active. For example, if 314 irrigation wells are active in 2013, WY would need to provide 7,662 acre feet of water to the segment during the period of natural flow deficiency in the 2014 irrigation season. New wells are assessed 80 acre feet per well per year.

5. Exhibit 10 contains provisions providing for the NPDC to periodically review the above analyses and make changes in the replacement water requirements if warranted.

Exhibit 10 contains the following provisions related to replacement water:

1. Replacement water may be provided from a variety of sources including, but not limited to, WY's allocation of storage water from Glendo Reservoir, the Wyoming Account in the Pathfinder Modification Project (PMP), other storage releases, replacement from other surface and ground water supplies or cancellation or transfer of water rights. Replacement water sources are contingent upon being able to demonstrate to the NPDC that the replacement water will actually become a part of the natural flow in the Whalen Diversion Dam to State Line reach.
2. The replacement water must be available to supplement the natural flow in the Whalen Diversion Dam to State Line reach of the North Platte River and be provided each year during the irrigation season (May 1 and September 30) when natural flow is insufficient to meet the demands of both WY and NE irrigators who divert from the river at or above Tri-State diversion dam. Replacement water, because it is considered natural flow, is split 75% to NE and 25% to WY.

The settlement teams wrestled with the scenario wherein WY would not be able to provide the necessary replacement water. The parties were aware that WY's allocation in Glendo Reservoir certainly did not provide a firm supply. In fact, there were years in the past when very little or no water accrued to the WY or NE storage accounts in Glendo Reservoir. While the parties documented their support for the PMP, they were aware that the PMP would require several federal and state approvals before it could become a reality. Therefore, the settlement teams agreed to the following provision (subsection 3.a) in Exhibit 10 that states in part:

"If Wyoming is unable to assure or provide the required replacement water in any one year, Wyoming will be required to regulate ground water right irrigation wells within the area of administration. In years, when Wyoming does not anticipate having adequate replacement water available for the base line wells, Wyoming will regulate, i.e. prevent from pumping for the entire irrigation season, a sufficient number of baseline line wells to equal the anticipated shortfall in replacement water."

Subsection C.3.a. of the Exhibit also provides an example for determining the number of wells to be regulated: *"For example, as 24.4 acre-feet per well is the replacement water requirement, if Wyoming is unable to provide 1,220 acre-feet of the required replacement amount, Wyoming will regulate, i.e. prevent from pumping 50 of the irrigation wells during the entire irrigation season."*

The above language clearly states that regulation of the wells was only offered as an alternate to providing replacement water if WY "is unable to assure or provide" the replacement water or "does not anticipate having adequate" replacement water. The language indicates that the settlement teams preferred to provide replacement water rather than regulate wells. Clearly, regulation was and is viewed as the option of last resort. But, equally as clear, regulation is allowed to meet the replacement requirements under extraordinary conditions when replacement water cannot be obtained.

An interim replacement water supply strategy was developed until the PMP was completed. The WWDC annually acquired available Glendo storage water. In addition, a storage account was acquired in Glendo Reservoir. Through 2012, water was purchased from the Cheyenne Board of Public Utilities and Pacificorp and transferred into the storage account. There were years when water was obtained from Upper Rock Creek Reservoir and the Torrington and New Grattan Ditch Companies donated water. All of the replacement water was acquired through temporary water use agreements. This strategy was costly, but successful, as WY's replacement obligations were met and the regulation of wells was avoided.

The long term strategy for replacement water is to use storage water from Glendo Reservoir and the Wyoming Account in the PMP. The WWDC has entered into a long term contract for Glendo storage water and has completed the construction of the PMP. These actions should ensure the availability of replacement water for quite some time. However, as municipalities use more water from the PMP, there will be a need to look for other new replacement water alternatives. There are alternatives available. For example, the WWDC completed a successful groundwater exploration program whereby a non-hydrologically connected groundwater well was located at the Split Rock site in the Sweetwater River basin.

Exhibit 11: Procedures for Whalen Diversion Dam to the State Line Reach Administration of Surface Water Rights from Tributaries and Drains

NE contended that WY diversions from the tributaries, such as Rawhide Creek and others small streams, should be counted against WY's 25% share of the natural flow in the reach. Originally, NE concerns also included the Laramie River and Horse Creek below the Gering-Fort Laramie canal. The concerns relating to the Laramie River were addressed by other aspects of the settlement. WY convinced NE that the Horse Creek Drainage upstream of the Gering-Ft. Laramie Canal was over appropriated and did not contribute water to the reach apportioned by the Decree. The issues relating to the Horse Creek Drainage were dropped.

NE argued that WY was unfairly diverting return flow in the drains, such as Katzer Drain and others, to the detriment of flows in the North Platte River, thereby reducing NE's 75% share of the natural flow. WY did not administer these tributaries and drains for shortages on the mainstem.

Ultimately, WY agreed to replace 50% of the diversions or administer the tributaries and drains in times of mainstem regulation. WY has and will continue to provide replacement water for the depletions.

Depletions from diversions on the tributaries and drains are replaced the month after the month the depletions occur. September depletions are replaced the following year. WY is providing the replacement water from the same supplies as discussed under Exhibit 10.

Exhibit 12: Procedure for Lower Laramie River Basin Acreage Accounting

In order to address NE's concerns regarding inflows into Grayrocks Reservoir, WY agreed to limit irrigated acreage in the Lower Laramie River basin, exclusive of the area within the Wheatland Irrigation District (WID), so that the total intentionally irrigated acreage will not exceed 39,000 acres. The measurement, mapping, and reporting procedures, including those related to hydrologically connected groundwater wells, parallel those included in Exhibit 4.

The area of administration is the area downstream of WID's tunnel no. 2 exclusive of the area within the WID. WID was excluded because WY made it clear that lands within the District were irrigated from WY's entitlements under the Laramie River Decree. The settlement acknowledges that the Modified North Platte Decree does not apportion flows of the Lower Laramie River and that the only limitation in this area is the acreage limitation. It is stipulated that the implementation of the procedure depicted in Exhibit 12, or any future amendments thereto, will not affect the Laramie River Decree between CO and WY.

Exhibit 13: Procedure for Reporting Post-2000 Irrigation Wells Within Wheatland Irrigation District
Exhibit 14: Procedure for Reporting New Municipal, Industrial, and Export Permits
Exhibit 15: Procedure for Reporting Permits for New Dams, Enlargements or Groundwater Recharge Projects

These procedures were primarily adopted to improve communications between NE and WY.

Endangered Species

In 1995, the Supreme Court rendered a decision agreeing with the Special Master that he could hear evidence on downstream interests, including evidence of injury to wildlife and wildlife habitat.

In 1999, there was new leadership in the Nebraska Department of Natural Resources (NDNR). The newly appointed Director of the NDNR shared WY's concern about endangered species issues being addressed by the law suit. NE, CO, and WY agreed in the importance of the development of the Platte River Recovery Implementation Program to dissuade the Special Master and Supreme Court from pursuing the matter in the litigation.

There are references in the final settlement regarding the use of Glendo storage water for fish and wildlife purposes and PMP storage water for the Platte River Recovery Implementation Plan. However, the Modified Decree and Final Settlement Stipulation left the resolution of endangered species issues to the Platte River Recovery Implementation Program.

Background

Endangered species issues began affecting water development and management in the North Platte River in WY in the late 1970's. As previously discussed, the construction of Grayrocks Dam and Reservoir by Basin Electric Power Cooperative was delayed due to lawsuits relating to mitigation requirements under ESA for the whooping cranes and their habitat located along the Platte River in Central Nebraska.

Wyoming, Nebraska, and Colorado became interested in a recovery program in the 1990's when it became apparent that the Endangered Species Act (ESA) provided the U.S. Fish and Wildlife Service (USFWS) the authority to require the replacement of existing depletions until it achieved its water supply goal for the critical habitat in the Central Platte River in Nebraska. The USFWS's water supply goal was 417,000 acre feet per year. In addition, the U.S. Fish and Wildlife Service could assess depletion fees in order to acquire 29,000 acres of habitat in the Central Platte.

After 13 years, the negotiations between the Department of Interior and the states were completed and the Platte River Recovery Implementation Program (PRRIP) was implemented. The Wyoming Legislature approved the state's financial contribution of $6M and Governor Freudenthal executed the necessary agreements. The Program commenced on January 1, 2007.

The term of first increment of the PRRIP is 13 years. However, there can be extensions to this term if approved by the parties. Provisions call for additional increments if needed and if approved by the states and the Department of Interior. However, it is important to note that the Governor can pull WY out of the PRRIP at any time if it is determined that the program is progressing counter to the best interests of our state.

The water supply goal in the first increment is to provide 130,000-150,000 acre feet of water per year to reduce shortages to the U.S. Fish and Wildlife target flows in the Central Platte. The three states are contributing 80,000 acre feet of water per year. WY's water contribution on behalf of its water users is the Environmental Account in the PMP. NE contributed water from Lake McConaughy and CO is providing their water contribution through a groundwater recharge project. The remaining supplies are being developed by the PRRIP. The PRRIP is looking at potential supplies in the area of the habitat in the Central Platte in Nebraska. The PRRIP is presently leasing water from the Wyoming Account in the PMP that is not needed to meet WY's demands. This is likely the only PRRIP water that will come from WY.

The land goal is to acquire, protect, and maintain 10,000 acres of habitat in the Central Platte. WY's share is approximately 460 acres of habitat in the Central Platte acquired originally for mitigation for the Deer Creek project. Upon completion of the PMP, these lands were contributed to the PRRIP, through the USFWS. This contribution serves as credit to WY under the PRRIP and provides mitigation for the PMP.

An adaptive management scientific approach is being implemented to determine the water and habitat needs of the endangered birds (whooping crane, least tern, and piping plover) in the Central Platte River Basin in Nebraska and the pallid sturgeon in the Lower Platte River Basin in Nebraska. WY has a seat at the table during the development of this information, which will become the best scientific information available for ESA purposes and will become the basis of future consultations.

The PRRIP is being implemented by a Governance Committee in which the State of Wyoming and WY water users (including Nebraska water users that use federal storage water from WY reservoirs) have individual members. The Committee operates on a consensus basis, which provides WY protection that its views must be addressed. The Director of the Wyoming Water Development Program serves as the Governor's representative on the Governance Committee.

The monetary budget is approximately $187M for the first increment. The federal government is providing approximately $157M and the states are providing $30M. WY's share is $6M. In addition, the states received credit of approximately $130M for their water and land contributions. The Program will be funded approximately 49.5% ($157M) by the Department of Interior and approximately 50.5% ($160M) by the states. The states' contributions include the $30M in cash and the $130M credit for water and land. Therefore, the total budget for the first increment is $317M.

Why did the states stay the course during 14 years of negotiations relating to the PRRIP? The state representatives had several meetings and discussions relating to future life for water supplies for all WY users without a Program and came to the following conclusions:

A. The U.S. Fish and Wildlife Service (USFWS) would be obligated under ESA to undertake separate ESA consultations on the federal reservoirs and other major reservoirs in each state. The likely outcome would be that the operations of those reservoirs that are presently serving our water users would be reconfigured to provide water for the endangered species and their habitat. This would result in the loss of 417,000 acre feet of water in the three states rather than the 130,000-150,000 acre feet of water to be provided by the Program. The loss of this water would "ripple" through each state's water right system impacting not only the users of the federal storage water but also all water users in each of the three states.

B. Prolonged and costly lawsuits would likely be initiated by each state or by the states collectively, challenging the ESA and the U.S. Fish and Wildlife Service's interpretation of the ESA. Recent case history indicates that unless there is meaningful reform to ESA, investments in such litigation would likely be lost. The states decided that cooperation served us better than litigation in this particular situation.

C. Issues in the NE vs. WY lawsuit extended to the critical habitat for endangered species (whooping crane, least tern, and piping plover) in Central Nebraska. All of the principle parties to the final settlement felt that endangered species issues were best addressed in the separate negotiations that ultimately led to the PRRIP.

<u>Wyoming's Depletion Plan</u>

In addition to providing money and water, the states of WY, NE, and CO agreed to curtail their water related activities to the depletions that occurred prior to July 1, 1997, the date the states agreed to develop the PRRIP. As previously noted, the PRRIP is the reasonable and prudent alternative under the ESA for existing water related activities that occurred prior to July 1, 1997. These existing water related activities include:

1. The federal reservoirs in Wyoming, including Wyoming's full allocation of Glendo storage water.
2. The Pathfinder Modification Project.
3. Transfers of water rights approved by the Wyoming Board of Control or temporary water use agreements approved by the Wyoming State Engineer.
4. Existing water uses covered by the existing water related baselines defined in Wyoming's Depletion Plan.

The plan includes two existing water related baselines:

The first baseline addresses irrigation water use in the North Platte River basin above Guernsey Reservoir. Compliance with the NE v. WY settlement will provide confirmation that WY is not exceeding this baseline for purposes of the PRRIP.

The second baseline addresses irrigation water use below Guernsey Reservoir and in the Laramie River and Horse Creek Drainages. It also addresses municipal, industrial, and other water uses in the North Platte, Laramie, and Horse Creek Drainages. A benchmark was established for each use and each municipal and industrial water user. The benchmarks were based on the maximum annual water depletions of the users during the period of 1992 through 1996. Annual shortages under a benchmark can offset annual overruns in other benchmarks. This allows for checks and balances. The total depletions under this baseline, based on the depletions under the various benchmarks, should not exceed the limitation during the term of the first increment of the PRRIP, which ends on December 31, 2019. Likely, the parties to the PRRIP will agree to a second increment of the PRRIP. Wyoming's Depletion Plan will likely be revisited at that time.

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APPENDIX B

SUMMARY DESCRIPTIONS OF VEGETATIVE COMMUNITIES

APPENDIX B SUMMARY OF VEGETATIVE COMMUNITIES

Vegetative communities within the study area vary throughout the watershed because of the differing ecoregions, topography, geology, soils, climate, fire history, and surface managment. The east, northeast portion of the watershed, within the Norwestern Great Plains and High Plains Ecoregion, include mostly grass, forb, shrub, and sagebrush communities. In the southwestern portion of the watershed, Sourthern Rockies Ecoregion, plant communities include pine forests and woodlands, and deciduous forests with an understory consisting of grasses, sedges, and shrubs. In general, the desirable grass species in the watershed include western wheatgrass, needle-and-thread, prairie Junegrass, Indian ricegrass, blue grama, Sandberg bluegrass, sand dropseed, threeawn, little bluestem, and threadleaf sedge.

The following plant community overviews are excerpts and adapted from the general vegeation zones described for the Proposed Resource Management Plan and Final Environmental Impact Statement for the Casper Field Office Planning Area [BLM, 2007]. These general overviews are included to summarize the diverse plant communities within the study area.

Grasslands

Mixed-grass prairie grasslands occur primarily at lower elevations and on rolling plains and foothills in the eastern two-thirds of the planning area...this area occupies most of Converse, Platte, and Goshen counties, north and east of the Laramie Range, and a small part of eastern Natrona County. This vegetative type primarily includes grasses and forbs, but does contain some shrub species. Grass and grass-like plants that are common to this type include western wheatgrass, needle-and-thread, prairie Junegrass, Indian ricegrass, blue grama, Sandberg bluegrass, sand dropseed, threeawn, little bluestem, and threadleaf sedge. The most common shrubs are Wyoming big sagebrush, silver sagebrush, sand sagebrush, snowberry, and Douglas rabbitbrush. Common forbs include fringed sagewort, scurfpea, prairie clover, milkvetch, American vetch, yarrow, buckwheat, and prickly pear cactus. The mixed-grass prairie vegetation type predominantly is used for livestock and wildlife grazing. Other grassland communities present within the planning area inhabit shallow soil sites that are too dry to support many shrubs or trees. These grasslands comprise short- to mid-size grass species and numerous mat-forming forbs. These communities are found primarily in Natrona County in the southern foothills of the South Bighorns.

Shrublands

Shrubland communities occur throughout the planning area and dominate the majority of the public land surface administered by the BLM. These communities are diverse and primarily include three vegetative types: desert shrub and saltbush-greasewood flats, mountain shrub, and sagebrush.

Greasewood

Greasewood-dominated shrublands occur primarily on lowland positions adjacent to streams, playas, lakes, and ponds. They usually occur in areas that receive lower amounts of precipitation and on soils that contain at least moderate amounts of salinity or alkalinity.

Greasewood is a halophyte that does well in very saline soils; however, it needs more soil moisture to survive than does saltbush.

Where greasewood is the dominant shrub, subdominant shrubs include Gardner saltbush, shadscale, rubber rabbitbrush, Wyoming big sagebrush, and basin big sagebrush. The understory is limited to salttolerant herbaceous vegetation, such as inland saltgrass, western wheatgrass, alkali sacaton, bottlebrush squirreltail, Sandberg bluegrass, biscuit root, Hood's phlox, pepperweed, and sea blight. In places, cheatgrass is a substantial component of the understory vegetation.

Although greasewood is not considered very palatable to livestock or big game wildlife, pronghorn and sheep will eat the spiny stems and leaves in the spring and early summer. Cattle use greasewood in the summer and fall as a source of salt. Greasewood contains soluble oxalates that can be poisonous to both sheep and cattle. Greasewood communities are important for providing cover to wildlife and livestock and important spring habitat for mule deer.

Saltbush

Salt desert shrubland is perhaps the most arid vegetation type in the Intermountain West (Knight 1994). Gardner saltbush dominates this community type in the planning area and, in some instances, makes up 90 percent of the vegetative cover. These areas are characterized by accumulations of salt in soils developed primarily from sodic shale. Soils of these areas usually have a potential of hydrogen (pH) of 7.8 to 9, which restricts the uptake of soil minerals and nutrients. The soils in these areas restrict the uptake of water and soil nutrients by all but the most tolerant of plants, usually halophytes. Gardner saltbush normally grows no higher than 12 inches, and may grow along the ground forming a mat. Subdominant shrubs in areas dominated by Gardner saltbush include birdfoot sage, bud sage, spiny hopsage, broom snakeweed, shadscale, and Douglas rabbitbrush. Some greasewood also may be found in this community. Grasses associated with these sites include Indian ricegrass, bottlebrush squirreltail, Sandberg bluegrass, and western wheatgrass. Forbs found in these areas include wild onion, biscuitroot, woody aster, winterfat, Hood's phlox, globemallow, and prickly pear cactus. Saltbush communities within the planning area occur on relatively flat to steep, highly eroded hills at lower elevations, usually in areas of low precipitation …. Gardner saltbush is a valuable forage species on winter and spring ranges for wildlife and livestock. In the spring, when Gardner saltbush is green, its protein content can be higher than late-season alfalfa, and is a preferred livestock forage for lambing sheep and calving cattle.

Mesic Upland Shrub Steppe (Mountain Shrublands)

Chokecherry is the primary shrub in this community, often growing in conjunction with snowberry, currant, Wood's rose, serviceberry, and Rocky Mountain maple. Mesic Upland Shrub Steppe is usually found at low to mid elevations in areas that receive greater moisture due to snow accumulation, runoff, or subsurface flow. These areas include drainage bottoms, north slopes, and the leeward side of hills. This community usually exists as dense but scattered stands of shrubs and is often adjacent to aspen and willow communities. Chokecherry, serviceberry and maple in these areas may grow to be 15-feet high. Herbaceous understory *vegetation includes basin wildrye, green needlegrass, Columbia needlegrass, bluebell, columbine, aster, yarrow, and violet. Although the Mesic Upland Shrub Steppe is found across the planning area, individual stands are seldom more than ½ acre in size. This community provides hiding and thermal cover for deer, elk, and other wildlife species. The dominant shrubs provide excellent forage for browsing animals when their softer leaves and shoots are within reach. These shrubs reestablish following fire, often in less dense patches, making them more accessible to wildlife and livestock. The new growth is highly palatable and is sought out by browsing animals.*

Xeric Upland Shrub Steppe

True and curl-leaf mountain mahogany dominate this plant community. True mountain mahogany is found in the southern portions of the planning area along the foothills of the Laramie Range. Curl-leaf mountain mahogany is found in the northwestern part of the planning area on the southern slopes of the South Bighorns. Both species grow on dry sites, usually rocky slopes and ridges with shallow soils. Mountain mahogany usually occurs as the dominant shrub but sometimes grows in conjunction with juniper, antelope bitterbrush, currant, snowberry, Douglas rabbitbrush, and Wyoming and mountain big sagebrush. Grass species found in the understory include bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, mutton bluegrass, and western wheatgrass. Forb species found in the understory include phlox, buckwheat, locoweed, Hooker sandwort, goldenweed, and milkvetch. Cheatgrass is a dominant component of the understory vegetation within some true mountain mahogany communities. Mountain mahogany may grow to a height of 5 to 7 feet, depending on the extent of browsing and depth of soil. Many of these communities consist of mature and often decadent plants with little recruitment of young plants. Fire generally lessens the density of the shrub stands, allowing grasses and other herbaceous plants to increase, while still providing wildlife browse. Mountain mahogany is an important fall and winter forage species for deer and elk and is utilized by livestock. Mountain mahogany communities within the planning area usually provide crucial winter range for mule deer.

Sagebrush

Sagebrush-dominated communities are the most common vegetative type in the planning area. These communities are found on approximately 630,183 acres (46%) of public land surface within the planning area and include Wyoming big sagebrush and grassland, mountain big sagebrush and grassland, silver sagebrush and grassland, basin big sagebrush shrubland, and the low sages—birdfoot and Wyoming threetip sagebrush and grassland. Fire is an important component of all sagebrush-dominated plant communities. It can create a mosaic of seral stages across the landscape that benefits numerous species of wildlife. Depending on the nature of the site, the fire-return interval can be between 25 and 100 years (Knight 1994). Following a stand replacement fire, it can take more than 20 years for sagebrush to return to pre-burn densities. The return interval for sagebrush is based on several factors, including fire intensity, species of sagebrush, soil, precipitation, percent slope, aspect, and availability of seed source. Sagebrush communities are important sources of food and cover for numerous wildlife species found in Wyoming. Sagebrush obligate species include the sage sparrow, Brewer's sparrow, sage thrasher, greater sage-grouse, sagebrush vole, sagebrush lizard, and pronghorn.

Wyoming Big Sagebrush and Grassland

Wyoming big sagebrush and grassland is the most common community in south-central Wyoming. It occurs primarily in the western half of the planning area on shallow to deep soils at elevations below 7,000 feet. Between 6,000 and 7,000 feet, Wyoming big sagebrush grows in conjunction with mountain big sagebrush. In these areas, Wyoming big sagebrush usually is found on drier sites, while mountain big sagebrush is found on deeper soils and in areas receiving greater moisture, such as drainage bottoms. Shrub height varies from as little as 8-inches tall on shallow soils to around 30-inches tall on deeper soils. The canopy cover for Wyoming big sagebrush communities usually does not exceed 30 percent. Wyoming big sagebrush often appears as the dominant plant in mosaic communities intermixed with other shrubs and open grasslands. On shallow or rocky to gravelly soils, Wyoming big sagebrush may be co-dominant with black sagebrush and Douglas rabbitbrush. On lighter textured soils, such as sandy loams, Wyoming big sagebrush may be co-dominant with silver sagebrush, Douglas rabbitbrush, and winterfat. Grass and forb species vary depending on soil texture, aspect, and slope. Common grass and grass-like species include bluebunch wheatgrass, western wheatgrass, Sandberg bluegrass, mutton bluegrass, Indian ricegrass, needle-and-thread, green needlegrass, prairie June grass, threadleaf sedge, and bottlebrush squirreltail. Common forbs include phlox, sandwort, buckwheat, penstemon, Indian paintbrush, globemallow, astragalus, and prickly pear cactus. Wyoming big sagebrush is the most frequently consumed sagebrush by wildlife and is a staple for pronghorn, mule deer, and the greater sage-grouse. In the planning area, Wyoming big sagebrush is generally the dominant species found on pronghorn and mule deer crucial winter ranges. Many of the Wyoming big sagebrush communities in the planning area have even-aged stands of mature and often decadent plants, which presents a problem on crucial mule deer and pronghorn winter ranges due to the poor forage quality of older plants and lack of new young plants.

Mountain Big Sagebrush and Grassland

Mountain big sagebrush is located on shallow to deep soils at elevations above 7,000 feet. In areas where mountain big sagebrush grows in conjunction with Wyoming big sagebrush, mountain big sagebrush generally grows on the deeper soils and in areas receiving good moisture, either through runoff or snow accumulation. At higher elevations, mountain big sagebrush occurs as smaller plant communities in mountain areas and is often intermixed with aspen and conifer woodlands. Shrub height varies from 10 to 30 inches, with canopy cover reaching 50 to 60 percent. Other shrubs found in mountain big sagebrush communities are antelope bitterbrush, serviceberry, threetip sagebrush, and snowberry. Associated grasses include Idaho fescue, king spike fescue, green needlegrass, Colombia needlegrass, mutton bluegrass, big bluegrass, western wheatgrass, basin wildrye, and elk sedge. Common forbs found in these areas include Indian paintbrush, lupine, larkspur, penstemon, violet, and Oregon grape. Mountain big sagebrush is palatable to wildlife, although browsing is sometimes limited when the higher elevation habitats become unavailable due to snow accumulation. Mountain big sagebrush provides hiding and nesting cover for various wildlife species. Following fire, mountain big sagebrush reestablishes as the dominant species more quickly than other *sagebrush types, often resuming dense canopy cover after 20 to 30 years. The natural fire-return interval in this sagebrush type is 20 to 75 years.*

Silver Sagebrush and Grassland

Silver sagebrush and grasslands have two subtypes occupying distinctly different habitats in the planning area. The more common subtype is found on deep sandy-textured soils where silver sagebrush is the dominant shrub, but other shrubs (including Wyoming big sagebrush, Douglas rabbitbrush, and rubber rabbitbrush) are usually present. In sand dune areas, silver sagebrush may be the only shrub present. Associated herbaceous species include needle-and-thread, Indian ricegrass, threadleaf sedge, blue grama, prairie sandreed, sand dropseed, scurfpea, buckwheat, and prickly pear cactus. The second subtype of silver sagebrush and grassland is not abundant and is located in drainage bottoms and riparian areas above the wet sedge and rush zone found along the streambank. Other vegetation found in this subtype include basin wildrye, Kentucky bluegrass, redtop, streambank wheatgrass, Baltic rush, clover, dandelion, aster, and, occasionally, cottonwood and willow. Silver sagebrush is desirable forage for both livestock and big game species because it provides important habitats for various wildlife species. Silver sagebrush responds well to fire, as it has the capability to send up new stems from root crowns after burning.

Basin Big Sagebrush Shrubland

Basin big sagebrush shrubland is found in moderately deep to deep soils of all soil textures in zones of 10 to 16 inches of annual precipitation (Beetle 1960). It occurs as pockets within Wyoming big sagebrush, Gardner saltbush, and greasewood communities as the dominant shrub type along valley bottoms, canyons, and isolated ephemeral washes. This subspecies of big sagebrush may reach 12 feet in height, with canopy cover reaching 70 percent. Basin big sagebrush shrubland is not abundant within the planning area on BLM-administered land. In addition, basin big sagebrush shrubland is not very palatable forage, usually serving as little to no use as a food source, even in extreme winters when use levels of other plants are severe. It is important, however, as cover for mule deer and elk, and as habitats for other wildlife species. Basin big sagebrush shrubland also may be important to greater sage-grouse in severe winters. Basin big sagebrush shrubland can increase in density and cover with poor livestock management and interruptions in the fire cycle.

Low Sages – Birdfoot and Wyoming Threetip Sagebrush and Grassland

Birdfoot sagebrush is found at elevations below 7,000 feet on clay to dense-clay alkaline soils where pH ranges from 8.5 to 11. At lower pH levels, Gardner saltbush is often found growing in birdfoot sagebrush communities along with a variety of grasses and forbs. Grasses that are present include western wheatgrass, Indian ricegrass, Sandberg bluegrass, and bottlebrush squirreltail. Forbs that are present include woody aster, Hood's phlox, biscuitroot, and wild onion. At higher pH levels, birdfoot sagebrush occurs as a monoculture. Most of the birdfoot sagebrush communities are found in the western part of the planning area in Natrona County. Wyoming threetip sagebrush occurs at elevations above 7,000 feet in the foothills of the various mountain ranges on shallow to moderately deep, well-drained soils. It normally grows to between 4- and 15-inchestall and is found intermixed with mountain big sagebrush and *black sagebrush. Grasses and forbs found in this community include Idaho fescue, king spike fescue, Colombia needlegrass, mutton bluegrass, elk sedge, Indian paintbrush, mountain pea, larkspur, balsamroot, phlox, Hooker sandwort, and buckwheat. Wyoming threetip sagebrush does not appear very palatable to either livestock or wildlife in the summer or winter. Its location on windswept ridges and knolls may cause it to be used as emergency winter forage, especially for big game (Beetle and Johnson 1982). This community-type responds well to lowintensity fires, but may be set back by high-intensity fires. Large fires rarely occur in this type due to the lack of fuel needed to carry the fire through it. The ability of Wyoming threetip sagebrush to stump sprout and layer makes its control difficult.*

APPENDIX C

HYDROGEOMORPHIC CLASSIFICATIONS OF WETLANDS

APPENDIX C HYDROGEOMORPHIC CLASSIFICATIONS OF WETLANDS

The US Army Corp of Engineers (USACE) has developed an approach for classifying wetlands that is based on the watershed-level scale. This classification involves considerations founded on hydrogeomorphic characteristics of the differing wetland types. The USACE Wetlands Research Program Technical Report WRP-DE-9 provides the following regarding hydrogeomorphic wetland classifications [Smith et al., 1995]:

> *The hydrogeomorphic classification is based on three fundamental factors that influence how wetlands function, including geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landform of a wetland, its geologic evolution, and its topographic position in the landscape. For example, a wetland may occur in a depressional landform or a valley landform and may occur at the top, middle, or bottom of a watershed. Water source refers to the location of water just prior to entry into the wetland. All water on the land originates as precipitation, but in many cases the water will follow a circuitous path prior to entry into a wetland (Fetter 1988, pg 38).*
>
> *For example, water may enter the wetland directly as precipitation, follow a less direct path over the surface of the ground as overland flow or overbank flow, follow a subsurface path as interflow, throughflow, or baseflow, or any combination of these. Hydrodynamics refers to the energy level of moving water, and the direction that surface and near-surface water moves in the wetland. For example, the level of energy of an isolated wetland is generally lower than a wetland on a river floodplain, and the movement of water in a riverine wetland is generally unidirectional and downstream.*

This classification schema identifies seven wetland types: depressional, lacustrine fringe, tidal fringe, slope, riverine, mineral flat, and organic flat. Within the study area, depressional, lacustrine fringe, slope, and riverine wetlands are likely to be present and the following excerpt from the USACE report describes these four wetland types [Smith et al., 1995]:

> ***Depressional Wetlands***
>
> *Depressional wetlands occur in topographic depressions with a closed elevation contour that allows accumulation of surface water. Dominant sources of water are precipitation, groundwater discharge, and interflow from adjacent uplands. The direction of water movement is normally from the surrounding uplands toward the center of the depression. Depressional wetlands may have any combination of inlets and outlets or lack them completely. Depressional wetlands may lose water through intermittent or perennial drainage from an outlet, by evapotranspiration, and, if they are not receiving groundwater discharge, may slowly contribute to groundwater. Dominant hydrodynamics are vertical fluctuations, primarily seasonal. Peat deposits may develop in depressional wetlands. Prairie potholes are a common example of depressional wetlands.*

Lacustrine Fringe Wetlands

Lacustrine fringe wetlands are adjacent to lakes where the water elevation of the lake maintains the water table in the wetland. In some cases, they consist of a floating mat attached to land. Additional sources of water are precipitation and groundwater discharge, the latter dominating where lacustrine fringe wetlands intergrade with uplands or slope wetlands. Surface water flow is bidirectional, usually controlled by water level fluctuations such as seiches in the adjoining lake. Lacustrine fringe wetlands are indistinguishable from depressional wetlands where the size of the lake becomes so small relative to fringe wetlands that the lake is incapable of stabilizing water tables. Lacustrine wetlands lose water by flow returning to the lake after flooding, by saturation surface flow, and by evapotranspiration. Organic matter normally accumulates in areas sufficiently protected from shoreline wave erosion. Un-impounded marshes bordering the Great Lakes are a common example of lacustrine fringe wetlands.

Slope Wetlands

Slope wetlands normally are found where there is a discharge of groundwater to the land surface. They normally occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Slope wetlands are usually incapable of depressional storage because they lack the necessary closed contours. Principal water sources are usually groundwater return flow and interflow from surrounding uplands as well as precipitation. Hydrodynamics are dominated by downslope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Slope wetlands lose water primarily by saturation subsurface and surface flows and by evapotranspiration. Slope wetlands may develop channels, but the channels serve only to convey water away. Fens are a common example of slope wetlands.

Riverine Wetlands

Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Additional water sources may be interflow and return flow from adjacent uplands, occasional overland flow from adjacent uplands, tributary inflow, and precipitation. When overbank flow occurs, surface flows down the floodplain may dominate hydrodynamics. At their headwater most extension, riverine wetlands often intergrade with slope or depressional wetlands as the channel (bed) and bank disappear, or they may intergrade with poorly drained flats or uplands. Perennial flow is not required.

Riverine wetlands lose surface water via the return of floodwater to the channel after flooding and through saturation surface flow to the channel during rainfall. They lose subsurface water by discharge to the channel, movement to deeper groundwater (for losing streams), and evapotranspiration. Peat may accumulate in off-channel depressions (oxbows) that have become isolated from riverine processes and subjected to long periods of saturation from groundwater sources. Bottomland hardwood floodplains are a common example of riverine wetlands.

APPENDIX D

SUMMARY TABLE OF PEAK FLOW CHARACTERISTICS [MILLER, 2003] FOR SUBWATERSHEDS (HUC 12)

Table D.1. Peak Flow Characteristics for Subwatersheds (HUC 12) Within the Study Area [Miller, 2003] (Page 1 of 4)

Region Number	Subwatershed (HUC12) Name	Area (miles²)	Discharge by Recurrence Interval (years)									
			Q1.5	Q2	Q2.33	Q5	Q10	Q25	Q50	Q100	Q200	Q500
1	East Box Elder Creek	18.6	1.7	3.9	5.6	21.3	50.3	121.9	215.6	360.3	579.5	1,038.2
1	Headwaters Box Elder Creek	36.3	3	7	10	37.1	86.3	206.4	361.8	599.8	957.1	1,698.6
1	Headwaters Horseshoe Creek	50.1	4	9.3	13.2	48.5	112.1	266.4	464.8	767.7	1,220.1	2,155.6
1	Little Deer Creek	24.9	2.2	5.1	7.2	27.1	63.6	153.3	270.1	449.8	720.9	1,286.1
1	Lower Wagon Hound Creek	48	3.9	8.9	12.7	46.8	108.4	257.7	449.9	743.4	1,182.2	2,089.8
1	Middle Box Elder Creek	54.9	4.4	10	14.2	52.3	120.7	286.3	498.8	822.9	1,306.4	2,305.2
1	Middle Deer Creek	49.6	4	9.2	13.1	48.1	111.3	264.5	461.6	762.4	1,211.8	2,141.3
1	Middle La Bonte Creek	52.6	4.2	9.7	13.7	50.5	116.7	276.9	482.8	796.8	1,265.7	2,234.6
1	Middle La Prele Creek	62	4.9	11.2	15.8	57.9	133.4	315.5	548.8	904	1,433.1	2,524.3
1	Middle Wagon Hound Creek	29.6	2.5	5.9	8.4	31.3	73.2	175.7	308.8	513.1	820.8	1,460.8
1	Owl Creek	25.9	2.2	5.2	7.5	28	65.7	158.2	278.5	463.6	742.7	1,324.4
1	Roaring Fork	29.6	2.5	5.9	8.4	31.3	73.2	175.8	308.9	513.4	821.2	1,461.6
1	Upper Box Elder Creek	47.9	3.9	8.9	12.7	46.8	108.3	257.4	449.4	742.5	1,180.7	2,087.4
1	Upper Cottonwood Creek	53.8	4.3	9.9	14	51.4	118.9	281.9	491.4	810.9	1,287.7	2,272.8
1	Upper Deer Creek	55.8	4.4	10.2	14.4	53	122.4	290.1	505.4	833.6	1,323.1	2,334.1
1	Upper Horseshoe Creek	44.4	3.6	8.4	11.9	43.9	101.8	242.4	423.6	700.6	1,115.1	1,973.4
1	Upper La Bonte Creek	60.2	4.7	10.9	15.4	56.4	130.1	308	535.9	883.1	1,400.5	2468
1	Upper La Prele Creek	60.2	4.7	10.9	15.4	56.5	130.2	308.1	536.1	883.5	1,401.1	2469
1	Upper Wagon Hound Creek	34.5	2.9	6.7	9.6	35.6	83.0	198.6	348.3	577.9	922.6	1,638.4
1	West Fork Deer Creek	43.5	3.5	8.2	11.6	43.1	100.0	238.2	416.3	688.8	1,096.6	1,941.2
1	West Fork La Bonte Creek	69.3	5.4	12.3	17.4	63.4	145.8	344.2	597.8	983.5	1,557.1	2,738.5

Table D.1. Peak Flow Characteristics for Subwatersheds (HUC 12) Within the Study Area [Miller, 2003] (Page 2 of 4)

Region Number	Subwatershed (HUC12) Name	Area (miles²)	Discharge by Recurrence Interval (years)									
			Q1.5	Q2	Q2.33	Q5	Q10	Q25	Q50	Q100	Q200	Q500
3	Middle Wagon Hound Creek	28.1	4.3	8.7	11.9	39.3	86.0	195.6	332.0	537.0	841.0	1,469.8
3	Antelope Creek	43.1	5.1	10.4	14.1	46.7	102.5	233.6	397.7	645.8	1,015.2	1,784.2
3	Bed Tick Creek	22.0	3.9	7.9	10.8	35.5	77.8	176.6	299.2	482.9	754.6	1,314.6
3	Bobcat Hill-Shawnee Creek	35.1	4.7	9.5	13.0	43.0	94.2	214.4	364.4	590.6	926.7	1,624.4
3	Cottonwood Creek	32.8	4.5	9.3	12.7	41.8	91.6	208.4	354.0	573.5	899.3	1,574.9
3	Dry Creek-North Platte River	42.9	5.1	10.3	14.1	46.6	102.3	233.1	396.8	644.3	1,012.9	1,780.0
3	East Fork Shawnee Creek	22.3	3.9	7.9	10.8	35.7	78.2	177.5	300.8	485.6	758.8	1,322.2
3	Elkhorn Creek	60.5	5.8	11.9	16.2	53.6	117.7	268.9	458.8	747.3	1,178.3	2,080.0
3	Fetterman Creek-North Platte River	31.4	4.5	9.1	12.4	41.1	90.0	204.8	347.7	563.1	882.7	1,544.9
3	Fivemile Creek-North Platte River	60.4	5.8	11.9	16.2	53.6	117.7	268.8	458.6	747.0	1,177.9	2,079.2
3	Guernsey Fish Pond-North Platte River	59.0	5.7	11.7	16.0	53.1	116.6	266.2	454.1	739.5	1,165.9	2,057.4
3	Guernsey Reservoir-North Platte River	29.6	4.4	8.9	12.1	40.1	87.8	199.6	338.9	548.5	859.3	1,502.9
3	Indian Creek-North Platte River	65.8	6.0	12.3	16.7	55.5	121.8	278.4	475.3	774.7	1,222.6	2,160.5
3	Little Cottonwood Creek-North Platte River	47.1	5.2	10.7	14.6	48.4	106.2	242.2	412.6	670.5	1,054.9	1,856.1
3	Little Sand Creek-North Platte River	35.1	4.7	9.5	13.0	43.0	94.2	214.3	364.3	590.5	926.6	1,624.1
3	Lower Box Elder Creek	44.4	5.1	10.5	14.3	47.3	103.7	236.4	402.5	653.8	1,028.1	1,807.6
3	Lower Broom Creek	20.9	3.8	7.7	10.6	34.8	76.1	172.8	292.6	472.0	737.2	1,283.5
3	Lower Cole Creek	63.2	5.9	12.1	16.5	54.6	119.9	273.9	467.4	761.7	1,201.6	2,122.3
3	Lower Cottonwood Creek	65.8	6.0	12.3	16.7	55.5	121.8	278.4	475.3	774.7	1,222.5	2,160.4
3	Lower Deer Creek	39.3	4.9	10.0	13.6	45.0	98.6	224.6	382.1	620.0	973.8	1,709.4
3	Lower Horseshoe Creek	43.4	5.1	10.4	14.2	46.9	102.8	234.3	398.7	647.5	1,018.0	1,789.4

Table D.1. Peak Flow Characteristics for Subwatersheds (HUC 12) Within the Study Area [Miller, 2003] (Page 3 of 4)

Region Number	Subwatershed (HUC12) Name	Area (miles²)	Discharge by Recurrence Interval (years)									
			Q1.5	Q2	Q2.33	Q5	Q10	Q25	Q50	Q100	Q200	Q500
3	Lower La Bonte Creek	62.4	5.9	12.0	16.4	54.3	119.3	272.4	464.9	757.5	1,194.7	2,109.8
3	Lower La Prele Creek	53.9	5.5	11.3	15.5	51.2	112.3	256.3	437.0	711.1	1,120.1	1,974.3
3	Lower Lost Creek	41.4	5.0	10.2	13.9	46.0	100.8	229.7	390.9	634.5	997.1	1,751.5
3	Lower Muddy Creek	46.3	5.2	10.7	14.5	48.1	105.5	240.6	409.7	665.8	1,047.3	1,842.4
3	Lower Sage Creek	36.4	4.7	9.7	13.2	43.6	95.6	217.7	370.1	600.1	941.9	1,651.7
3	Lower Sand Creek	35.1	4.7	9.5	13.0	43.0	94.2	214.5	364.6	591.0	927.4	1,625.6
3	Lower Willow Creek	35.1	4.7	9.5	13.0	43.0	94.2	214.4	364.5	590.8	927.0	1,624.8
3	Middle Bear Creek	36.5	4.7	9.7	13.2	43.6	95.7	217.8	370.3	600.4	942.5	1,652.8
3	Middle Broom Creek	51.7	5.4	11.1	15.2	50.3	110.4	251.9	429.3	698.2	1,099.4	1,936.8
3	Middle Cole Creek	24.8	4.1	8.3	11.3	37.3	81.7	185.5	314.5	508.2	794.9	1,387.0
3	Middle Cottonwood Creek	46.2	5.2	10.6	14.5	48.1	105.4	240.4	409.4	665.3	1,046.5	1,840.9
3	Middle Horseshoe Creek	43.6	5.1	10.4	14.2	47.0	103.0	234.7	399.5	648.8	1,020.1	1,793.0
3	Middle Lost Creek	46.3	5.2	10.7	14.5	48.1	105.5	240.6	409.8	665.9	1,047.5	1,842.7
3	Middle Muddy Creek	51.7	5.4	11.1	15.2	50.3	110.4	251.8	429.2	698.1	1,099.2	1,936.3
3	Middle Sage Creek	53.1	5.5	11.3	15.4	50.9	111.6	254.6	434.0	706.2	1,112.2	1,960.0
3	Mill Creek	21.0	3.8	7.7	10.6	34.8	76.2	173.0	293.0	472.8	738.4	1,285.7
3	Miller Draw-North Platte River	46.9	5.2	10.7	14.6	48.3	106.0	241.8	411.8	669.3	1,052.9	1,852.6
3	Mountain Home Number 1 Reservoir-North Platte River	50.2	5.4	11.0	15.0	49.7	109.1	248.8	423.9	689.3	1,085.1	1,910.8
3	North Bear Creek-North Platte River	42.4	5.0	10.3	14.0	46.4	101.7	231.9	394.6	640.7	1,007.0	1,769.4
3	Porter Rock	28.3	4.3	8.7	11.9	39.4	86.3	196.2	332.9	538.5	843.4	1,474.3
3	Sand Creek	29.6	4.4	8.9	12.1	40.1	87.8	199.8	339.1	548.8	859.9	1,503.9
3	Sand Creek-North Platte River	53.8	5.5	11.3	15.5	51.2	112.3	256.2	436.7	710.7	1,119.4	1,973.1
3	Spring Canyon Creek-North Platte River	51.4	5.4	11.1	15.2	50.2	110.2	251.4	428.4	696.8	1,097.1	1,932.6
3	Upper Broom Creek	41.5	5.0	10.2	13.9	46.0	100.8	229.8	391.0	634.7	997.5	1,752.1

Table D.1. Peak Flow Characteristics for Subwatersheds (HUC 12) Within the Study Area [Miller, 2003] (Page 4 of 4)

Region Number	Subwatershed (HUC12) Name	Area (miles^2)	Discharge by Recurrence Interval (years)									
			Q1.5	Q2	Q2.33	Q5	Q10	Q25	Q50	Q100	Q200	Q500
3	Upper Cole Creek	28.9	4.3	8.8	12.0	39.7	86.9	197.7	335.5	542.9	850.3	1,486.7
3	Upper Lost Creek	26.5	4.2	8.5	11.6	38.3	83.9	190.6	323.4	522.8	818.3	1,429.1
3	Upper Muddy Creek	45.4	5.2	10.6	14.4	47.7	104.6	238.6	406.2	659.9	1,037.9	1,825.3
3	Upper Sage Creek	59.3	5.8	11.8	16.1	53.2	116.8	266.7	454.9	740.9	1,168.0	2,061.3
3	Upper Sand Creek	45.8	5.2	10.6	14.5	47.9	105.0	239.5	407.8	662.6	1,042.3	1,833.2
3	Upper Willow Creek	44.0	5.1	10.4	14.2	47.1	103.3	235.5	400.9	651.2	1,023.8	1,799.9
3	West Fork Shawnee Creek	63.5	5.9	12.1	16.5	54.7	120.1	274.3	468.2	762.9	1,203.5	2,125.9
3	Whalen Canyon	27.6	4.2	8.7	11.8	39.0	85.4	194.0	329.2	532.4	833.7	1,456.7
3	Whiskey Gulch-North Platte River	60.6	5.8	11.9	16.2	53.7	117.8	269.1	459.1	747.8	1,179.2	2,081.6
3	Upper Cole Creek	28.9	4.3	8.8	12.0	39.7	86.9	197.7	335.5	542.9	850.3	1,486.7
3	Upper Lost Creek	26.5	4.2	8.5	11.6	38.3	83.9	190.6	323.4	522.8	818.3	1,429.1
3	Upper Muddy Creek	45.4	5.2	10.6	14.4	47.7	104.6	238.6	406.2	659.9	1,037.9	1,825.3
3	Upper Sage Creek	59.3	5.8	11.8	16.1	53.2	116.8	266.7	454.9	740.9	1,168.0	2,061.3
3	Upper Sand Creek	45.8	5.2	10.6	14.5	47.9	105.0	239.5	407.8	662.6	1,042.3	1,833.2
3	Upper Willow Creek	44.0	5.1	10.4	14.2	47.1	103.3	235.5	400.9	651.2	1,023.8	1,799.9
3	West Fork Shawnee Creek	63.5	5.9	12.1	16.5	54.7	120.1	274.3	468.2	762.9	1,203.5	2,125.9
3	Whalen Canyon	27.6	4.2	8.7	11.8	39.0	85.4	194.0	329.2	532.4	833.7	1,456.7
3	Whiskey Gulch-North Platte River	60.6	5.8	11.9	16.2	53.7	117.8	269.1	459.1	747.8	1,179.2	2,081.6
3	Upper Cole Creek	28.9	4.3	8.8	12.0	39.7	86.9	197.7	335.5	542.9	850.3	1,486.7
3	Upper Lost Creek	26.5	4.2	8.5	11.6	38.3	83.9	190.6	323.4	522.8	818.3	1,429.1
3	Upper Muddy Creek	45.4	5.2	10.6	14.4	47.7	104.6	238.6	406.2	659.9	1,037.9	1,825.3

APPENDIX E

SUMMARY TABLE OF THE HYDROLOGIC UNIT CODE SYSTEM

Table E.1. Hydrologic Unit Codes Within the Middle North Platte–Glendo Watershed (Page 1 of 3)

HUC 2	HUC 4	HUC 6	HUC 8	HUC 10 Number	HUC 10 Name	HUC 12 Number	HUC 12 Name	Area (sq. mi.)
Region 10: Missouri	Subregion 1018: North Platte	Accounting Unit 101800: North Platte	Cataloging Unit 10180007: Middle North Platte-Casper	1018000709	Sand Creek-North Platte River	101800070901	Mountain Home Number 1 Reservoir-North Platte River	50.2
						101800070902	Upper Cole Creek	28.9
						101800070903	Middle Cole Creek	24.8
						101800070904	Lower Cole Creek	63.2
						101800070905	Dry Creek-North Platte River	42.9
						101800070906	Upper Sand Creek	45.8
						101800070907	Lower Sand Creek	35.1
						101800070908	Little Sand Creek-North Platte River	35.1
						101800070909	Spring Canyon Creek-North Platte River	51.4
						101800070910	Fetterman Creek-North Platte River	31.4
				1018000710	Deer Creek	101800071001	Upper Deer Creek	55.8
						101800071002	Middle Deer Creek	49.6
						101800071003	West Fork Deer Creek	43.5
						101800071004	Lower Deer Creek	39.3
						101800071005	Little Deer Creek	24.9
				1018000711	Box Elder Creek	101800071101	Headwaters Box Elder Creek	36.3
						101800071102	East Box Elder Creek	18.6
						101800071103	Upper Box Elder Creek	47.9
						101800071104	Middle Box Elder Creek	54.9
						101800071105	Lower Box Elder Creek	44.4
				1018000712	Sage Creek	101800071201	Upper Sage Creek	59.3
						101800071202	Middle Sage Creek	53.1
						101800071203	Lower Sage Creek	36.4
				1018000713	La Prele Creek	101800071301	Upper La Prele Creek	60.2
						101800071302	Middle La Prele Creek	62.0
						101800071303	Lower La Prele Creek	53.9

Table E.2. Hydrologic Unit Codes Within the Middle North Platte–Glendo Watershed (Page 2 of 3)

HUC 2	HUC 4	HUC 6	HUC 8	HUC 10		HUC 12		Area (sq. mi.)
				Number	Name	Number	Name	
Region 10: Missouri	Subregion 1018: North Platte	Accounting Unit 101800: North Platte	Cataloging Unit 10180008: Glendo Reservoir	1018000801	Antelope Creek-North Platte River	101800080101	Fivemile Creek-North Platte River	60.43
						101800080102	Middle Wagon Hound Creek	28.15
						101800080103	Antelope Creek	43.14
						101800080104	Miller Draw-North Platte River	46.87
						101800080105	Bed Tick Creek	22.02
				1018000802	Wagon Hound Creek	101800080201	Upper Wagon Hound Creek	34.54
						101800080202	Middle Wagon Hound Creek	29.56
						101800080203	Lower Wagon Hound Creek	48.03
				1018000803	La Bonte Creek	101800080301	Upper La Bonte Creek	60.17
						101800080302	Middle La Bonte Creek	52.59
						101800080303	Owl Creek	25.89
						101800080304	Lower La Bonte Creek	62.41
						101800080305	Mill Creek	20.96
						101800080306	West Fork La Bonte Creek	69.27
				1018000804	Glendo Reservoir-North Platte River	101800080401	Sand Creek-North Platte River	53.85
						101800080402	Sand Creek	29.61
						101800080403	Indian Creek-North Platte River	65.76
						101800080404	Elkhorn Creek	60.48
						101800080405	Whiskey Gulch-North Platte River	60.58
						101800080406	Cottonwood Creek	32.77
				1018000805	Shawnee Creek	101800080501	West Fork Shawnee Creek	63.46
						101800080502	East Fork Shawnee Creek	22.30
						101800080503	Bobcat Hill-Shawnee Creek	35.08
				1018000806	Lost Creek	101800080601	Upper Lost Creek	26.46
						101800080602	Middle Lost Creek	46.32
						101800080603	Lower Lost Creek	41.42
				1018000807	Muddy Creek	101800080701	Upper Muddy Creek	45.36
						101800080702	Middle Muddy Creek	51.66
						101800080703	Lower Muddy Creek	46.30
						101800080704	Upper Willow Creek	43.98
						101800080705	Lower Willow Creek	35.11

Table E.2. Hydrologic Unit Codes Within the Middle North Platte–Glendo Watershed (Page 3 of 3)

HUC 2	HUC 4	HUC 6	HUC 8	HUC 10		HUC 12		Area (sq. mi.)
				Number	Name	Number	Name	
Region 10: Missouri	Subregion 1018: North Platte	Accounting Unit 101800: North Platte	Cataloging Unit 10180008: Glendo Reservoir	1018000808	Middle Bear Creek-North Platte River	101800080801	North Bear Creek-North Platte River	42.4
						101800080802	Middle Bear Creek	36.5
						101800080803	Little Cottonwood Creek-North Platte River	47.1
						101800080804	Guernsey Reservoir-North Platte River	29.6
						101800080805	Guernsey Fish Pond-North Platte River	59.0
						101800080806	Whalen Canyon	27.6
				1018000809	Horseshoe Creek	101800080901	Headwaters Horseshoe Creek	50.1
						101800080902	Roaring Fork	29.6
						101800080903	Upper Horseshoe Creek	44.4
						101800080904	Middle Horseshoe Creek	43.6
						101800080905	Lower Horseshoe Creek	43.4
				1018000810	Cottonwood Creek	101800081001	Upper Cottonwood Creek	53.8
						101800081002	Middle Cottonwood Creek	46.2
						101800081003	Lower Cottonwood Creek	65.8
						101800081004	Porter Rock	28.3
				1018000811	Broom Creek	101800081101	Upper Broom Creek	41.5
						101800081102	Middle Broom Creek	51.7
						101800081103	Lower Broom Creek	20.9

APPENDIX F

SUMMARY DESCRIPTION OF THE US ARMY CORPS OF ENGINEERS NATIONWIDE PERMIT 27

Nationwide Permit 27 – Aquatic Habitat Restoration, Establishment and Enhancement Activities

Activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.

To the extent that a Corps permit is required, activities authorized by this NWP include, but are not limited to: the removal of accumulated sediments; the installation, removal, and maintenance of small water control structures, dikes, and berms, as well as discharges of dredged or fill material to restore appropriate stream channel configurations after small water control structures, dikes, and berms, are removed; the installation of current deflectors; the enhancement, restoration, or establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to restore or establish stream meanders; the backfilling of artificial channels; the removal of existing drainage structures, such as drain tiles, and the filling, blocking, or reshaping of drainage ditches to restore wetland hydrology; the installation of structures or fills necessary to establish or re-establish wetland or stream hydrology; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or discing for seed bed preparation and the planting of appropriate wetland species; re-establishment of submerged aquatic vegetation in areas where those plant communities previously existed; re-establishment of tidal wetlands in tidal waters where those wetlands previously existed; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities. Only native plant species should be planted at the site.

This NWP authorizes the relocation of non-tidal waters, including non-tidal wetlands and streams, on the project site provided there are net increases in aquatic resource functions and services.

Except for the relocation of non-tidal waters on the project site, this NWP does not authorize the conversion of a stream or natural wetlands to another aquatic habitat type (e.g., stream to wetland or vice versa) or uplands. Changes in wetland plant communities that occur when wetland hydrology is more fully restored during wetland rehabilitation activities are not considered a conversion to another aquatic habitat type. This NWP does not authorize stream channelization. This NWP does not authorize the relocation of tidal waters or the conversion of tidal waters, including tidal wetlands, to other aquatic uses, such as the conversion of tidal wetlands into open water impoundments.

Compensatory mitigation is not required for activities authorized by this NWP since these activities must result in net increases in aquatic resource functions and services.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing any activity in the State of Wyoming (see general conditions 28(f) and 31)

Reversion. For enhancement, restoration, and establishment activities conducted: (1) In accordance with the terms and conditions of a binding stream or wetland enhancement or restoration agreement, or a wetland establishment agreement, between the landowner and the U.S. Fish and Wildlife Service (FWS), the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), U.S. Forest Service (USFS), or their designated state cooperating agencies; (2) as voluntary wetland restoration, enhancement, and establishment actions documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or (3) on reclaimed surface coal mine lands, in accordance with a Surface Mining Control and Reclamation Act permit issued by the Office of Surface Mining Reclamation and Enforcement (OSMRE) or the applicable state agency, this NWP also authorizes any future discharge of dredged or fill material associated with the reversion of the area to its documented prior condition and use (i.e., prior to the restoration, enhancement, or establishment activities). The reversion must occur within five years after expiration of a limited term wetland restoration or establishment agreement or permit, and is authorized in these circumstances even if the discharge occurs after this NWP expires. The five-year reversion limit does not apply to agreements without time limits reached between the landowner and the FWS, NRCS, FSA, NMFS, NOS, USFS, or an appropriate state cooperating agency. This NWP also authorizes discharges of dredged or fill material in waters of the United States for the reversion of wetlands that were restored, enhanced, or established on prior-converted cropland or on uplands, in accordance with a binding agreement between the landowner and NRCS, FSA, FWS, or their designated state cooperating agencies (even though the restoration, enhancement, or establishment activity did not require a section 404 permit). The prior condition will be documented in the original agreement or permit, and the determination of return to prior conditions will be made by the Federal agency or appropriate state agency executing the agreement or permit. Before conducting any reversion activity the permittee or the appropriate Federal or state agency must notify the district engineer and include the documentation of the prior condition. Once an area has reverted to its prior physical condition, it will be subject to whatever the Corps Regulatory requirements are applicable to that type of land at the time. The requirement that the activity results in a net increase in aquatic resource functions and services does not apply to reversion activities meeting the above conditions. Except for the activities described above, this NWP does not authorize any future discharge of dredged or fill material associated with the reversion of the area to its prior condition. In such cases a separate permit would be required for any reversion.

Reporting. For those activities that do not require pre-construction notification, the permittee must submit to the district engineer a copy of: (1) The binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement, or a project description, including project plans and location map; (2) the NRCS or USDA Technical Service Provider documentation for the voluntary stream enhancement or restoration action or wetland restoration, enhancement, or establishment action; or (3) the SMCRA permit issued by OSMRE or the applicable state agency. The report must also include information on baseline ecological conditions on the project site, such as a delineation of wetlands, streams, and/or other aquatic habitats. These documents must be submitted to the district engineer at least 30 days prior to commencing activities in waters of the United States authorized by this NWP.

Note: This NWP can be used to authorize compensatory mitigation projects, including mitigation banks and in-lieu fee projects. However, this NWP does not authorize the reversion of an area used for a compensatory mitigation project to its prior condition, since compensatory mitigation is generally intended to be permanent.

(Sections 10 and 404)

Nationwide Permit General Conditions

To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer.

1. **Navigation.**
   (a) No activity may cause more than a minimal adverse effect on navigation.
   (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. **Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. **Spawning Areas**. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. **Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. **Shellfish Beds.** No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. **Suitable Material.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. **Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. **Adverse Effects from Impoundments.** If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. **Management of Water Flows.** To the maximum extent practicable, the pre-construction course, condition, capacity and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity and

location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. **Fills Within 100-Year Floodplains.** The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. **Equipment.** Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. **Soil Erosion and Sediment Controls**. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. **Removal of Temporary Fills.** Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. **Proper Maintenance.** Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. **Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. **Wild and Scenic Rivers.** No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. **Tribal Rights.** No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. **Endangered Species.**
    (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.
    (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.
    (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the

designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.
(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their websites at www.fws.gov/ or www.fws.gov/ipac and www.noaa.gov/fisheries.html respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

20. Historic Properties.
(a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the NHPA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.
(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the NHPA. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation,

and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that work cannot begin until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. **Discovery of Previously Unknown Remains and Artifacts.** If any previously unknown historic, cultural or archeological remains and artifacts are discovered while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. **Designated Critical Resource Waters.** Critical resource waters include NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

    (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

    (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. **Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).
(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.
(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity result results in minimal adverse effects on the aquatic environment.
(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.
(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).
(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.
(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.
(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.
(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns.

Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

The following regional conditions are applicable to all nationwide permit authorizations in the State of Wyoming to ensure projects result in less than minimal adverse impacts to the aquatic environment and to address local resources concerns.

(a) Wetlands Classified as Peatland. Permittees must notify the Wyoming Regulatory Office (WRO) in accordance with General Condition 31 (Pre-Construction Notification) prior to undertaking any authorized activities in wetlands classified as peatland. Peatlands are saturated and inundated wetlands where conditions inhibit organic matter decomposition and allow for the accumulation of peat. Under cool, anaerobic, and acidic conditions, the rate of organic matter accumulation exceeds organic decay. Peatlands can be primarily classified into ombrotrophic bogs and minerotrophic fens;

Contents adapted from the Federal Register (Volume 77, Number 34) published on Feb. 21, 2012.

the latter subdivided into poor, moderate-rich, and extreme-rich fens, each with distinctive indicator species, community physiognomy, acidity, alkalinity, and base cation content.

(**b) Waters Adjacent to Natural Springs.** Permittees must notify the WRO in accordance with General Condition 31 (Pre-Construction Notification) prior to undertaking any authorized activities within 100 feet of the water source in natural spring areas. For purposes of this condition, a spring source is defined as any location where there is artesian flow emanating from a distinct point source at any time during the growing season. Springs do not include seeps and other groundwater discharge areas where there is no distinct point source.

(c) Class 1 Waters. Permittees must notify the WRO in accordance with General Condition 31 (Pre-Construction Notification) prior to undertaking any authorized activities in Class 1 waters.

Class 1 Waters in Wyoming are defined as:
1. All surface waters located within the boundaries of national parks and congressionally designated wilderness areas as of January 1, 1999;
2. The main stem of the Snake River through its entire length above the U.S. Highway 22 Bridge (Wilson Bridge);
3. The main stem of the Green River, including the Green River Lakes, from the mouth of the New Fork River upstream to the wilderness boundary;
4. The main stem of the Wind River from the Wedding of the Waters upstream to Boysen Dam;
5. The main stem of the North Platte River from the Mouth of Sage Creek (approximately 15 miles downstream of Saratoga, Wyoming) upstream to the Colorado state line;
6. The main stem of the North Platte River from the headwaters of Pathfinder Reservoir upstream to Kortes Dam (Miracle Mile segment);
7. The main stem of the North Platte River from the Natrona County Road 309 bridge (Goose Egg Bridge) upstream to Alcova Reservoir;
8. The main stem of Sand Creek above the U.S. Highway 14 bridge;
9. The main stem of the Middle Fork of the Powder River through its entire length above the mouth of Buffalo Creek;
10. The main stem of the Tongue River, the main stem of the North Fork of the Tongue River, and the main stem of the South Fork of the Tongue River above the U.S. Forest Service boundary;
11. The main stem of the Sweetwater River above the mouth of Alkali Creek;
12. The main stem of the Encampment River from the northern U.S. Forest Service boundary upstream to the Colorado state line;
13. The main stem of the Clarks Fork River from the U.S. Forest Service boundary upstream to the Montana state line;
14. All waters within the Fish Creek (near Wilson, Wyoming) drainage;
15. The main stem of Granite Creek (tributary of the Hoback River) through its entire length;
16. Fremont Lake; and
17. Wetlands adjacent to the above listed Class 1 waters.

(d) Teton County. Permittees must notify the WRO in accordance with General Condition 31 (Pre-Construction Notification) prior to undertaking any authorized activities in Teton County.

(e) Borrow Site Identification. The permittee is responsible for ensuring that the Corps is notified of the location of any borrow site that will be used in conjunction with the construction of the authorized activity so that the Corps may evaluate the site for potential impacts to aquatic resources, historic properties, and endangered species. For projects where there is another lead Federal agency, the permittee shall provide the Corps documentation indicating that the lead Federal agency has complied with the National Historic Preservation Act and Endangered Species Act for the borrow site. The permittee shall not initiate work at the borrow site in conjunction with the authorized activity until approval is received from the Corps.

(f) Regional Conditions Applicable to Specific Nationwide Permits.

Nationwide Permit 23. Permittees must notify the WRO in accordance with General Condition 31 (Pre-Construction Notification) prior to undertaking any activities authorized by NWP 23.

Nationwide Permit 27. Permittees must notify the WRO in accordance with General Condition 31 (Pre-Construction Notification) prior to undertaking any activities authorized by NWP 27.

(g) Regional Conditions to supplement other General Conditions.

General Condition 3. The following is additional information on requirements of General Condition (GC) 3 regarding trout species. However, this information does not diminish the scope of GC 3, which is applicable to all fish species.

Spawning seasons for common trout species are:

Rainbow and Cutthroat Trout -March 15 through July 31

Brown and Brook Trout - September 15 through November 30

Site specific information on spawning seasons and spawning areas for all fish species may be obtained from Fisheries Supervisors in Wyoming Game and Fish Department Regional Offices.

Blue and Red Ribbon Trout Streams and Native Species Status 1, 2, and 3 Streams

The Wyoming Game and Fish Department (WGFD) can provide information on Blue Ribbon and Red Ribbon trout streams or waters that contain State Wildlife Action Plan Native Species Status 1, 2, and 3 fish species. Potential effects on these important resources should be considered when formulating a project plan with the intent of minimizing adverse affects. Early coordination with Fisheries Supervisors in WGFD Regional Offices should be conducted prior to submitting a Pre-Construction Notification (PCN) for activities located in these waters. Otherwise, the WRO may require project modifications to minimize adverse affects after receiving a PCN.

Additional information available at: http://wisdom.wygisc.org/

General Condition 6. Permittees are reminded of General Condition 6 which prohibits use of unsuitable material. A list of materials prohibited or restricted as fill material in waters of the United States within Wyoming can be found at:
http://www.nwo.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/2034/Article/12320/prohibited-restricted-materials.aspx

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_______________________________ _______________________

(Transferee) (Date)

Contents adapted from the Federal Register (Volume 77, Number 34) published on Feb. 21, 2012.

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

31. Pre-Construction Notification.

(a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all the requested information, the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: (Available as a separate document)

Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term "discharge" means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Contents adapted from the Federal Register (Volume 77, Number 34) published on Feb. 21, 2012.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of “open waters” include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of "independent utility"). Single and complete non-linear projects may not be "piecemealed" to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States. If a jurisdictional wetland is adjacent – meaning bordering, contiguous, or neighboring – to a waterbody determined to be a water of the United States under 33 CFR 328.3(a)(1)-(6), that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

APPENDIX G

PREDOMINANT ECOLOGICAL SITE DESCRIPTIONS

ESD1_ Loamy (Ly) 10–14-inch Precipitation Zone, Northern Plains (R058BY122WY)

ESD2_ Sandy (Sy) 10–14-inch Precipitation Zone, Northern Plains (R058BY150WY)

ESD3_ Shallow Loamy (SwLy) 10–14-inch Precipitation Zone, Northern Plains (R058BY162WY)

APPENDIX G

PREDOMINANT ECOLOGICAL SITE DESCRIPTIONS

ESD1_ Loamy (Ly) 10–14-inch Precipitation Zone, Northern Plains (R058BY122WY)

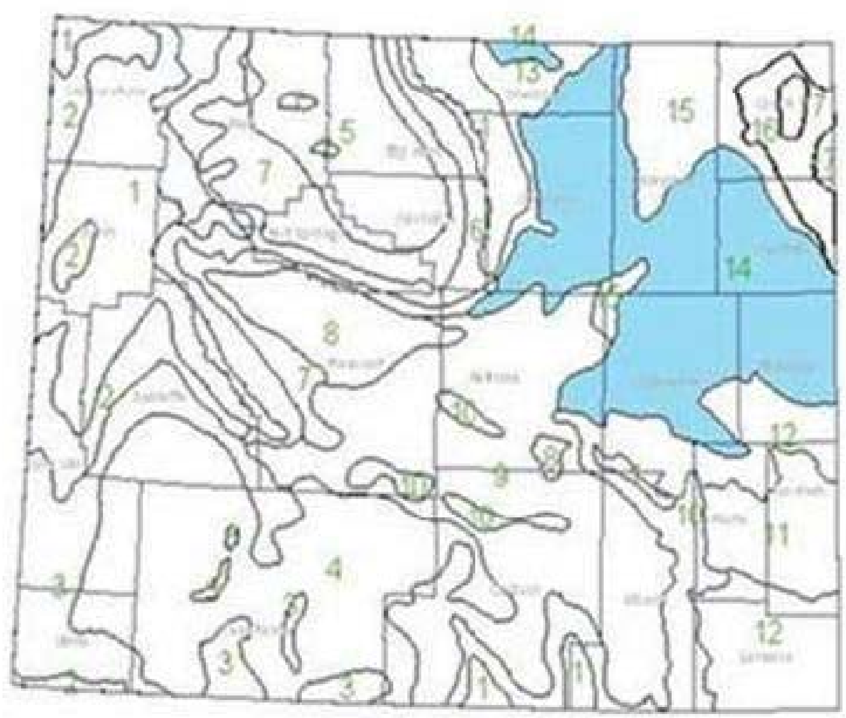
United States Department of Agriculture
Natural Resources Conservation Service
Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site name: Loamy (Ly) 10-14" Northern Plains Precipitation Zone
Site type: Rangeland
Site ID: R058BY122WY
Major land resource area (MLRA): 058B-Northern Rolling High Plains, Southern Part

Precipitation Zones for Rangeland Ecological Site Descriptions



Physiographic Features

This site occurs on gently undulating rolling land.

Landform: (1) Hill
(2) Alluvial fan
(3) Ridge

	Minimum	Maximum
Elevation (feet):	3600	5100

Slope (percent):	0	30
Flooding		
Frequency:	None	None
Ponding		
Depth (inches):	0	0
Frequency:	None	None
Runoff class:	Negligible	High
Aspect:	No Influence on this site	

Climatic Features

Annual precipitation ranges from 10-14 inches per year. Wide fluctuations may occur in yearly precipitation and result in more drought years than those with more than normal precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring.

Wind speed averages about 8 mph, ranging from 10 mph during the spring to 7 mph during late summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 75 mph.

Growth of native cool season plants begins about April 1 and continues to about July 1. Native warm season plants begin growth about May 15 and continue to about August 15. Green up of cool season plants may occur in September and October of most years.

The following information is from the "Clearmont 5 SW" climate station:
Frost-free period (32 F): 76 - 132 days; (5 yrs. out of 10, these days will occur between May 30 – September 11)
Freeze-free period 28 F): 110 - 145 days; (5 yrs. out of 10, these days will occur between May 16 – September 21)
Mean annual precipitation: 12.4 inches
Mean annual air temperature: 43.2 F (28.4 F Avg. Min. – 57.9 F Avg. Max.)
For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/ website. Other climate station(s) representative of this precipitation zone include: "Dull Center"

	Minimum	Maximum
Frost-free period (days):	76	132
Freeze-free period (days):	110	145
Mean annual precipitation (inches):	10.00	14.00

Influencing Water Features

Stream Type: None

Representative Soil Features

The soils of this site are deep to moderately deep (greater than 20" to bedrock), well drained & moderately permeable. Layers of the soil most influential to the plant community varies from 3 to 6 inches thick. These layers consist of the A horizon with very fine sandy loam, loam, or silt loam texture and may also include the upper few inches of the B horizon with sandy clay loam, silty clay loam or clay loam texture.
Major Soil Series correlated to this site includes: Bidman, Cambria, Cushman, Forkwood, Kishona, Parmleed, Theedle

and Zigweid.

Other Soil Series correlated to this site in MLRA 58B include: Absted, Arvada, Ascalon, Big Horn, Bowbac, Briggsdale, Cambria Variant, Cedak Dry, Clarkelen, Connerton, Docpar, El Rancho, Emigha, Emigrant, Forkwood Variant, Fort Collins, Garrett, Glendo, Harlan, Harlan Dry, Haverdad, Hiland, Jonpol, Kadoka, Keota, Keyner, Kim, Kirtley, Larim, Larimer, Lawver, Lohsman, Maysdorf, Neville, Noden, Nuncho, Platmak, Platmak Dry, Pugsley, Recluse, Recluse Dry, Redbow, Reddale, Renohill, Roughlock, Senlar, Spearman, Stoneham, Teckla, Thirtynine, Ulm, Ulm Dry, Wages, Wolf, Wolf Variant, Wolf Dry, and Wyotite.

Surface texture: (1) Loam
(2)Gravelly Sandy loam
(3)Cobbly Very fine sandy loam

Subsurface texture group: Loamy

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	0
Surface fragments >3" (% cover):	0	10
Subsurface fragments <=3" (% volume):	0	15
Subsurface fragments >3" (% volume):	0	10

Drainage class: Moderately well drained to well drained
Permeability class: Moderately slow to moderate

	Minimum	Maximum
Depth (inches):	20	60
Available water capacity (inches):	3.00	6.30
Electrical conductivity (mmhos/cm):	0	4
Sodium adsorption ratio:	0	5
Calcium carbonate equivalent (percent):	0	10
Soil reaction (1:1 water):	6.6	8.4

Plant Communities

Ecological Dynamics of the Site

As this site deteriorates because of a combination of frequent and severe grazing, species such as blue grama and big sagebrush will increase. Cool-season grasses such as green needlegrass, needleandthread, and rhizomatous wheatgrasses will decrease in frequency and production.

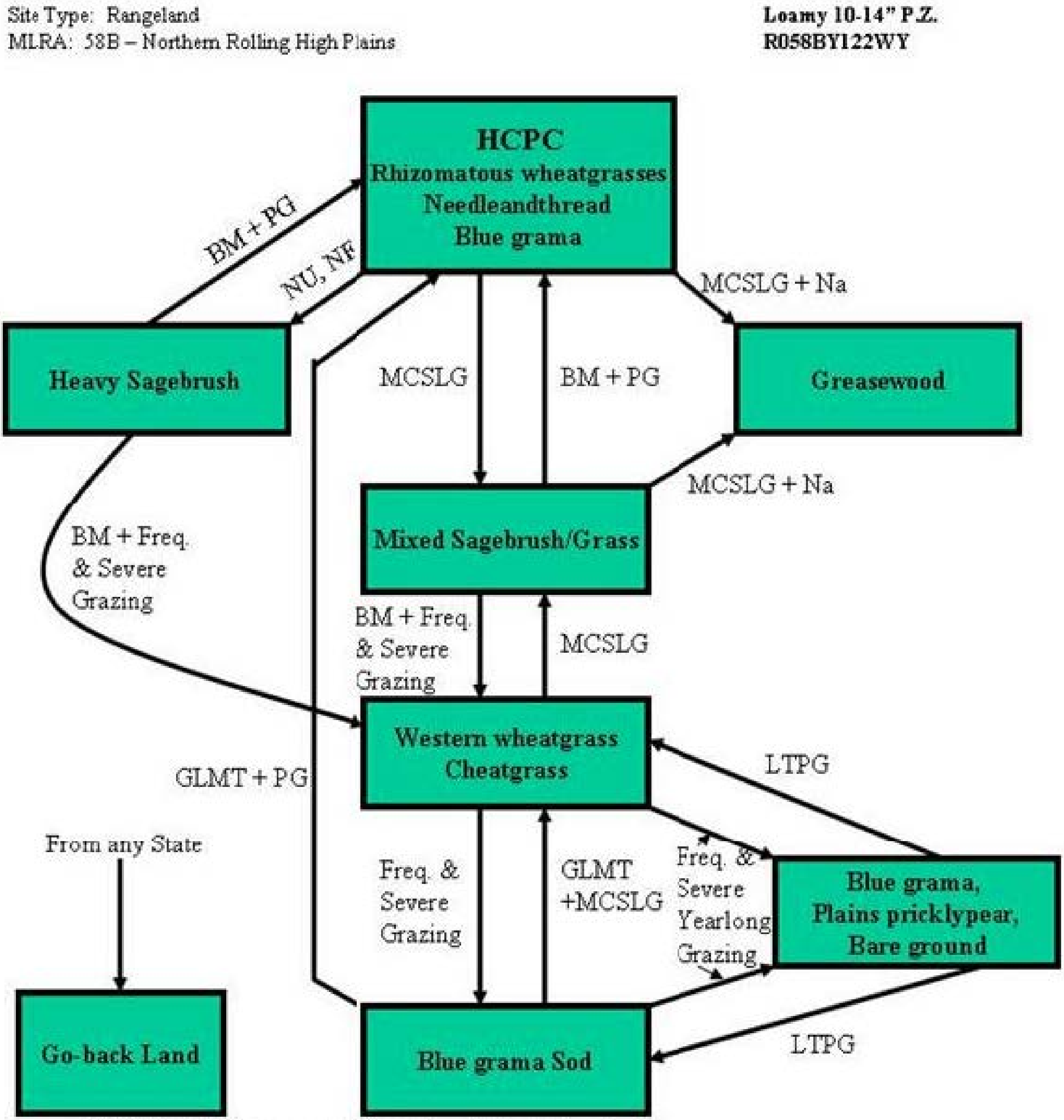
Big sagebrush may become dominant on some areas with an absence of fire. Wildfires are actively controlled in recent times so chemical control using herbicides has replaced the historic role of fire on this site. Recently, prescribed burning has regained some popularity.

Due to the amount and pattern of the precipitation, the big sagebrush component typically is not resilient once it has been removed if a healthy and vigorous stand of grass exists and is maintained. The exception to this is where the herbaceous component is severely degraded at the time of treatment, growing conditions are unfavorable after treatment, and/or recovery periods are inadequate.

The Historic Climax Plant Community (description follows the plant community diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model Diagram that illustrates the common plant communities (states) that can occur on the site and the transitions between these communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

State-and-Transition Diagram



BM - Brush Management (fire, chemical, mechanical)
Freq. & Severe Grazing - Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season
GLMT - Grazing Land Mechanical Treatment
LTPG - Long-tem Prescribed Grazing
MCSLG - Moderate, Continuous Season-long Grazing
NU, NF - No Use and No Fire
PG - Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)
VLTPG - Very Long-term Prescribed Grazing (could possibly take generations)
Na - found adjacent to a saline site

Na - found adjacent to a saline site

Rhizomatous wheatgrasses/Needleandthread/Blue Grama Plant Community

This plant community is the interpretive plant community for this site and is considered to be the Historic Climax Plant Community (HCPC). This plant community evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. This plant community can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. The potential vegetation is about 75% grasses or grass-like plants, 15% forbs, and 10% woody plants. This state is dominated by cool season mid-grasses.

The major grasses include western wheatgrass, needleandthread, and green needlegrass. Other grasses occurring in this state include Cusick's and Sandberg's bluegrass, bluebunch wheatgrass, and blue grama. A variety of forbs and half-shrubs also occur, as shown in the preceding table. Big sagebrush is a conspicuous element of this state, occurs in a mosaic pattern, and makes up 5 to 10% of the annual production. Plant diversity is high.

The total annual production (air-dry weight) of this state is about 1,200 lbs./acre, but it can range from about 700 lbs./acre in unfavorable years to about 1,500 lbs./acre in above average years.

This plant community is extremely stable and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Transitions or pathways leading to other plant communities are as follows:

• No use and no fire for 20 years or more will convert this plant community to the Heavy Sagebrush Plant Community.

• Moderate, continuous season-long grazing will convert the plant community to the Mixed Sagebrush/Grass Plant Community.

• Moderate continuous season-long grazing, where greasewood occurs adjacent to the site, will convert the plant community to the Greasewood Plant Community.

• When cropped annually and then abandoned without reseeding, the site is converted to the Go-back Land Plant Community.

Rhizomatous wheatgrasses/Needleandthread/Blue Grama Plant Community Plant Species Composition

	Grass/Grasslike				Annual Production (pounds per acre)	
Group	Group name	Common name	Symbol	Scientific name	Low	High
1					175	375
		streambank wheatgrass, thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	175	375
		western wheatgrass	PASM	*Pascopyrum smithii*	175	375
2					105	225
		green needlegrass	NAVI4	*Nassella viridula*	105	225
3					175	375
		needle and thread,	HECO26	*Hesperostipa comata*	175	375

		needleandthread				
4					70	150
		Cusick's bluegrass, Cusick bluegrass	POCU3	Poa cusickii	70	150
5					105	225
		blue grama	BOGR2	Bouteloua gracilis	105	225
6					175	375
		Indian ricegrass	ACHY	Achnatherum hymenoides	35	75
		hairy grama	BOHI2	Bouteloua hirsuta	35	75
		needleleaf sedge	CADU6	Carex duriuscula	35	75
		threadleaf sedge	CAFI	Carex filifolia	35	75
		plains reedgrass	CAMO	Calamagrostis montanensis	35	75
		prairie Junegrass	KOMA	Koeleria macrantha	35	75
		Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda	35	75
		bluebunch wheatgrass	PSSP6	Pseudoroegneria spicata	35	75

Forb

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	High
7					105	225
		yarrow	ACHIL	Achillea	35	75
		textile onion	ALTE	Allium textile	35	75
		rosy pussytoes, rose pussytoes	ANRO2	Antennaria rosea	35	75
		aster	ASTER	Aster	35	75
		milkvetch	ASTRA	Astragalus	35	75
		tapertip hawksbeard	CRAC2	Crepis acuminata	35	75
		white prairie clover	DACA7	Dalea candida	35	75
		violet prairie clover, purple prairie clover	DAPU5	Dalea purpurea	35	75
		sulphur-flower buckwheat	ERUM	Eriogonum umbellatum	35	75
		scarlet beeblossom, scarlet gaura	GACO5	Gaura coccinea	35	75
		stemless mock goldenweed	HAAC	Haplopappus acaulis(syn)	35	75
		desertparsley, biscuitroot	LOMAT	Lomatium	35	75
		bluebells	MERTE	Mertensia	35	75
		large Indian breadroot, breadroot scurfpea	PEES	Pediomelum esculentum	35	75
		upright prairie coneflower, prairie coneflower	RACO3	Ratibida columnifera	35	75
		American vetch	VIAM	Vicia americana	35	75

Shrub/Vine					Annual Production (pounds per acre)	
Group	Group name	Common name	Symbol	Scientific name	Low	High
8					70	150
		big sagebrush	ARTR2	Artemisia tridentata	70	150
9					35	75
		winterfat	KRLA2	Krascheninnikovia lanata	35	75

Plant Growth Curve

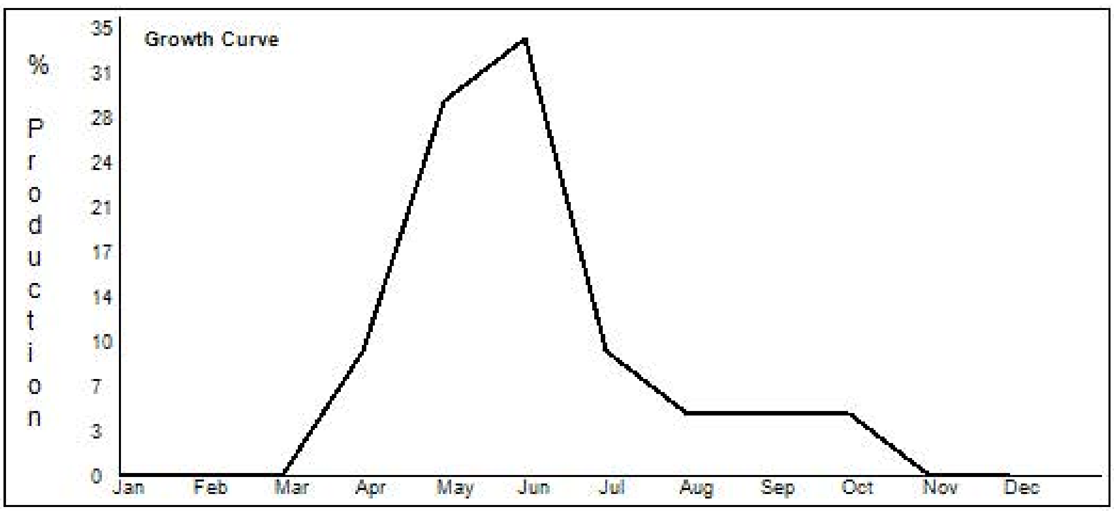
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Mixed Sagebrush/Grass Plant Community

Historically, this plant community evolved under grazing by bison and a low fire frequency. Currently, it is found under moderate, season-long grazing by livestock in the absence of fire or brush management. Wyoming big sagebrush is a significant component of this plant community. Cool-season grasses make up the majority of the understory with the balance made up of short warm-season grasses, annual cool-season grasses, and miscellaneous forbs.

Dominant grasses include needleandthread, western wheatgrass, and green needlegrass. Grasses of secondary importance include blue grama, prairie junegrass, and Sandberg bluegrass. Forbs commonly found in this plant community include plains wallflower, hairy goldaster, slimflower scurfpea, and scarlet globemallow. Sagebrush canopy ranges from 20% to 30%. Fringed sagewort is commonly found. Plains pricklypear can also occur.

When compared to the Historic Climax Plant Community, sagebrush and blue grama have increased. Production of cool-season grasses, particularly green needlegrass, has been reduced. The sagebrush canopy protects the cool-season mid-grasses, but this protection makes them unavailable for grazing. Cheatgrass (downy brome) has invaded the site. The overstory of sagebrush and understory of grass and forbs provide a diverse plant community that will support domestic livestock and wildlife such as mule deer and antelope.

The total annual production (air-dry weight) of this state is about 900 pounds per acre, but it can range from about 700 lbs./acre in unfavorable years to about 1,200 lbs./acre in above average years.

This plant community is resistant to change. A significant reduction of big sagebrush can only be accomplished through fire or brush management. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

Transitions or pathways leading to other plant communities are as follows:

• Brush management (chemical, fire, or mechanical), followed by prescribed grazing, will convert this plant community to the Rhizomatous wheatgrasses, Needleandthread, Blue grama Plant Community. The probability of this occurring is high. When prescribed fire is used, sufficient fine fuels will need to be present. This may require deferment from grazing prior to treatment. Post management is critical to ensure success. This can range from two or more years of rest to partial growing season deferment, depending on the condition of the understory at the time of treatment and the growing conditions following treatment. In the case of an intense wildfire that occurs when desirable plants are not completely dormant, the length of time required to reach the Rhizomatous wheatgrasses, Needleandthread, Blue grama Plant Community may be increased.

• Brush management, followed by frequent and severe grazing, will convert the plant community to the Western Wheatgrass/Cheatgrass Plant Community. The probability of this occurring is high. If bare areas exist after treatment, along with no recovery periods from grazing, cheatgrass will invade and plants not as resistant to grazing as western wheatgrass will be reduced.

• Moderate continuous season-long grazing, where greasewood occurs adjacent to this state, will convert the plant community to the Greasewood Plant Community.

Plant Growth Curve

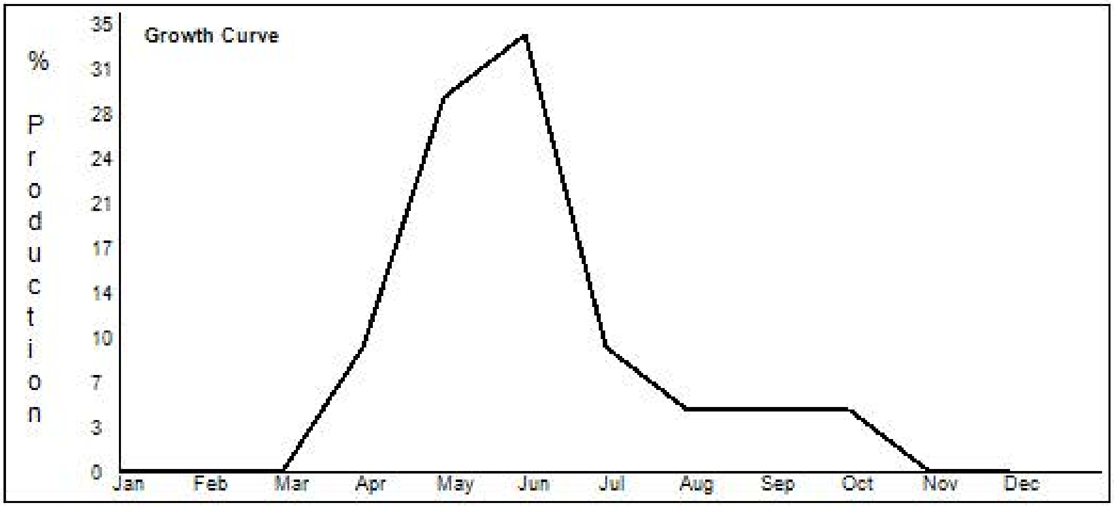
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Heavy Sagebrush Plant Community

This plant community is the result of long-term protection from grazing and fire. Sagebrush eventually dominates this plant community with canopy cover often exceeding 60%. At first, excessive litter builds up, shading out some of the grasses and forbs. Other plants become decadent with low vigor. Bunch grasses often develop dead centers. Eventually, the interspaces between plants increase in size leaving more soil surface exposed. Organic matter oxidizes in the air rather than being incorporated into the soil.

The dominant plants tend to be somewhat similar to those found in the Historic Climax Plant Community. Weedy species, cool-season grasses, and sedges have increased. Blue grama has decreased. Rodent activity has resulted in an increase in soil disturbance. Cactus and sageworts often increase. Noxious weeds such as Dalmatian toadflax, leafy spurge, or Canada thistle may invade the site if a seed source is present. Plant diversity is moderate to high.

The total annual production (air-dry weight) of this state is about 800 pounds per acre, but it can range from about 600 lbs./acre in unfavorable years to about 1,000 lbs./acre in above average years.

This plant community is not resistant to change and is more vulnerable to severe disturbance than the HCPC. The introduction of grazing or fire quickly changes the plant community.

Soil erosion is accelerated because of increased bare ground. Water flow patterns and pedestaling are obvious. Infiltration is reduced and runoff is increased.

Transitions or pathways leading to other plant communities are as follows:

• Brush management, followed by prescribed grazing, will return this plant community to at or near the Rhizomatous Wheatgrasses, Needleandthread, Blue Grama Plant Community.

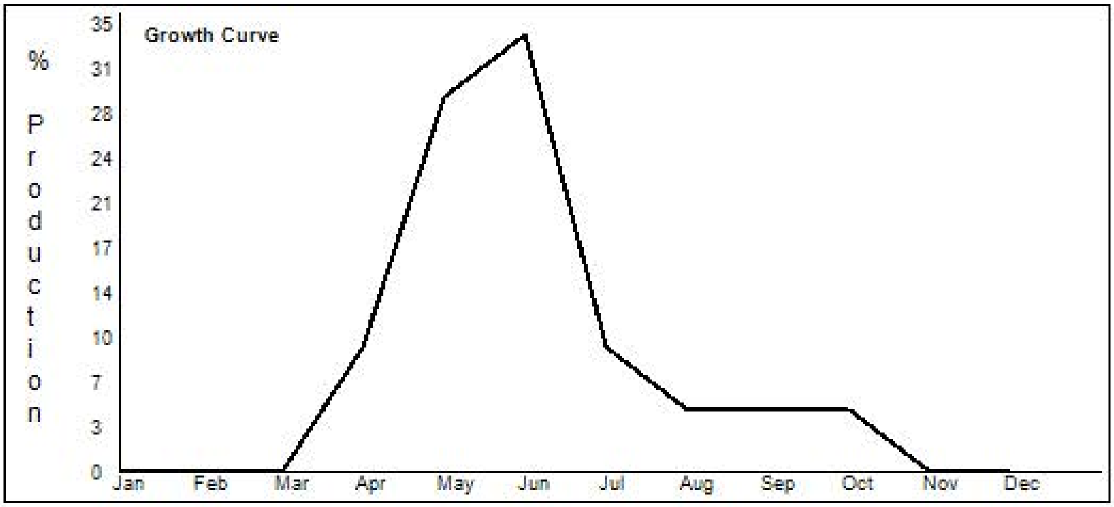
• Brush management, followed by frequent and severe grazing, will convert the plant community to the Western Wheatgrass/Cheatgrass Plant Community. The probability of this occurring is high because of the amount of bare ground exposed to cheatgrass invasion.

Plant Growth Curve

Growth curve number:	WY1401
Growth curve name:	10-14NP upland sites
Growth curve description:	

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Western Wheatgrass/Cheatgrass Plant Community

This plant community is created when the Mixed Sagebrush/Grass Plant Community or the Heavy Sagebrush Plant Community is subjected to fire or brush management not followed by prescribed grazing. Rhizomatous wheatgrasses and annuals will eventually dominate the site.

Compared to the HCPC, cheatgrass has invaded with western wheatgrass and thickspike wheatgrass maintaining at a similar or slightly higher level. Virtually all other cool-season mid-grasses are severely decreased. Blue grama is the same or slightly less than found in the HCPC. Plant diversity is low.

The total annual production (air-dry weight) of this state is about 600 pounds per acre, but it can range from about 450 lbs./acre in unfavorable years to about 750 lbs./acre in above average years.

This plant community is relatively stable with the rhizomatous wheatgrasses being somewhat resistant to overgrazing and the cheatgrass effectively competing against the establishment of perennial cool-season grasses.

An increase in bare ground reduces water infiltration and increases soil erosion. The watershed is usually functioning. The biotic integrity is reduced by the lack of diversity in the plant community.

Transitions or pathways leading to other plant communities are as follows:
• Moderate continuous season-long grazing will eventually return this plant community to the Mixed Sagebrush/Grass Plant Community.

• Frequent and severe grazing will convert this plant community to Blue Grama Sod Plant Community.

• Frequent and severe yearlong grazing will convert this plant community to Blue grama, Plains Pricklypear, Bare Ground Plant Community.

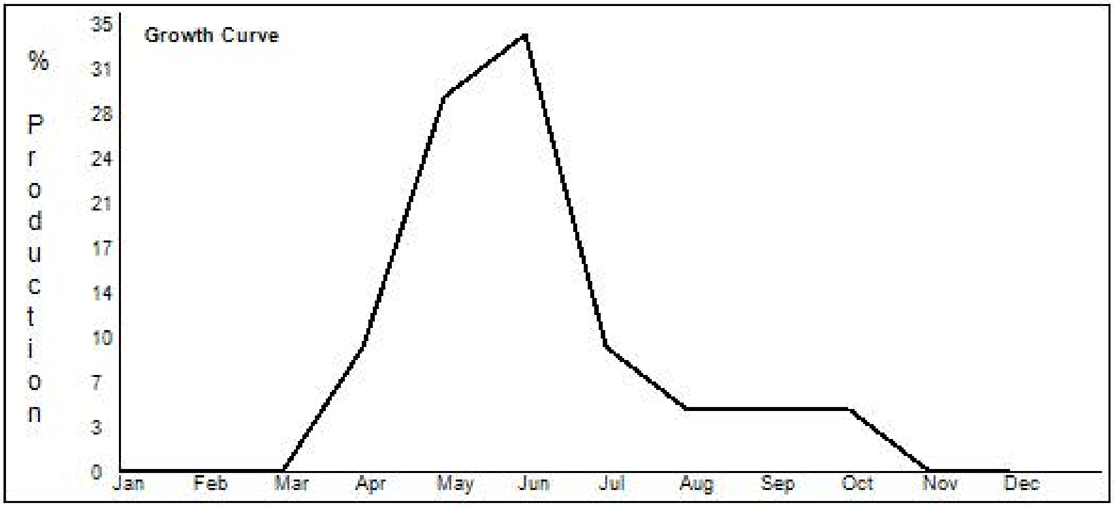
• Long-term, prescribed grazing will eventually return this plant community to at or near the Rhizomatous Wheatgrasses, Needleandthread, Blue Grama Plant Community.

Plant Growth Curve

Growth curve number: WY1401
Growth curve name: 10-14NP upland sites
Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Blue Grama Sod Plant Community

This plant community is the result of frequent and severe grazing during the growing season of the cool-season mid-grasses. A dense sod of blue grama dominates it. Pricklypear cactus can become dense enough so that livestock cannot graze forage growing within the cactus clumps.

When compared to the Historic Climax Plant Community, blue grama and threadleaf sedge have increased. All cool-season mid-grasses and forbs have been greatly reduced. Plant diversity is extremely low.

The total annual production (air-dry weight) of this state is about 600 pounds per acre, but it can range from about 450 lbs./acre in unfavorable years to about 750 lbs./acre in above average years.

This sod bound plant community is very resistant to water infiltration. While this sod protects the site itself, off-site areas are affected by excessive runoff that can cause gully erosion. This sod is very resistant to change and may require a grazing land mechanical treatment, such as chiseling, to return the cool-season grass component.

Transitions or pathways leading to other plant communities are as follows:

• Grazing land mechanical treatment (chiseling, etc.) and pricklypear cactus control (if needed), followed by prescribed grazing, will return this plant community to near Historic Climax Plant Community condition.

• Grazing land mechanical treatment, followed by moderate continuous season-long grazing, will convert this plant community to the Western Wheatgrass/Cheatgrass Plant Community.

• Frequent and severe yearlong grazing will eventually convert this state to the Blue Grama, Plains Pricklypear, Bare Ground Plant Community.

Plant Growth Curve

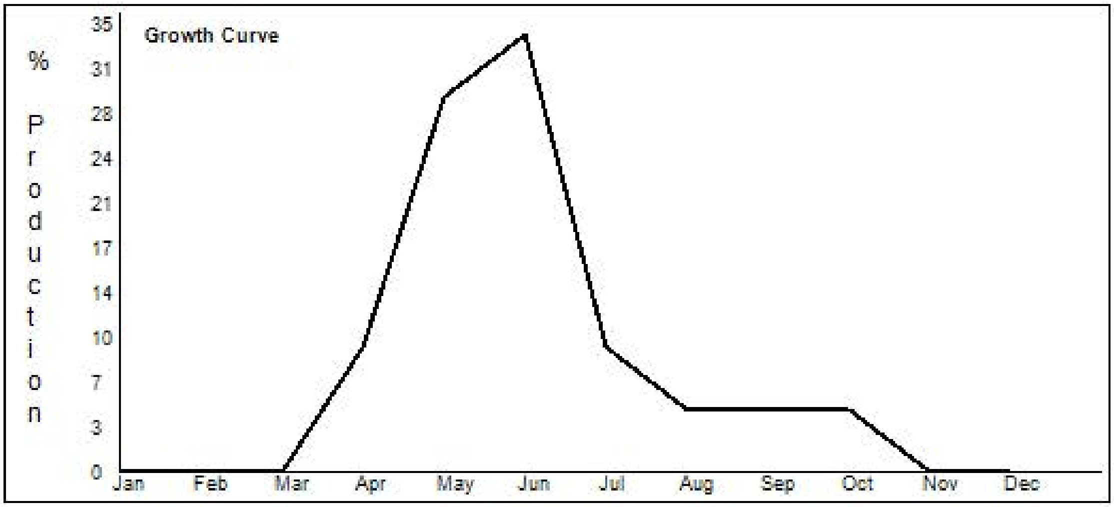
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Greasewood Plant Community

This plant community can occur where states are subjected to continuous season-long grazing at moderate stocking rates and where greasewood occurs adjacent to the site. It is dominated by an overstory of greasewood and possibly big sagebrush. Rhizomatous wheatgrasses, cheatgrass, and inland saltgrass make up the understory. Salts in the surface will increase due to the shedding of the salt-filled leaves of the greasewood. Plant diversity is high.

The total annual production (air-dry weight) of this state is about 700 pounds per acre, but it can range from about 525 lbs./acre in unfavorable years to about 875 lbs./acre in above average years.

This plant community is resistant to change. A significant reduction of greasewood can only be accomplished through repeated brush control treatments. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

The site is protected from erosion as long as ground cover is maintained. The biotic integrity of this state is somewhat intact because of the woody overstory and perennial grass understory. The watershed is functioning as long as a grass cover is maintained.

• Recovery to near Historic Climax Plant Community condition is difficult due to the resistance of greasewood to herbicides and accumulated effects of salts on the soil.

Plant Growth Curve

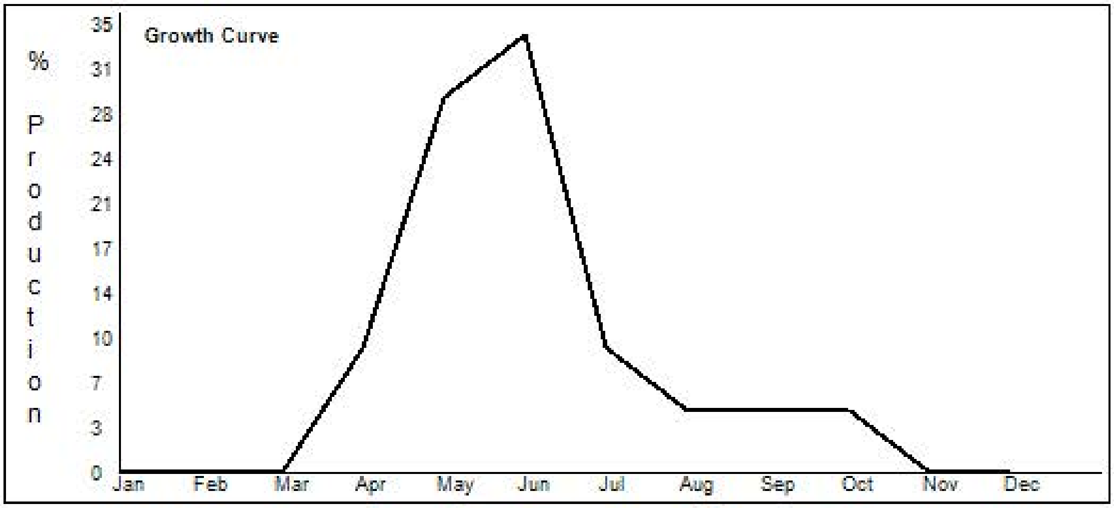
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Blue Grama Sod/Plains Pricklypear/Bare Ground Plant Community

This plant community is the result of frequent and severe yearlong grazing over the long-term. Perennial plants are decreased. Cheatgrass, annual weeds, and bare ground are increased. Plains pricklypear may have increased, rendering much of the forage unusable by livestock.

This plant community is highly variable depending on the severity, frequency, and duration of the grazing and also the condition of the plant community when this level of grazing began. Virtually all plants not resistant to overgrazing may have been eliminated. Dominant plants may include blue grama, threeawns, annuals, and, to a lesser degree, rhizomatous wheatgrasses. Perennial plant diversity is low.

The total annual production (air-dry weight) of this state is about 500 pounds per acre, but it can range from about 375 lbs./acre in unfavorable years to about 625 lbs./acre in above average years.

This state is unhealthy and subject to increased erosion. Runoff is high on this state due to the sod nature of blue grama and bare ground.

Transitions or pathways leading to other plant communities are as follows:

• Long-term prescribed grazing will convert this plant community initially to the Blue Grama Sod Plant Community, when this state is dominated by blue grama sod at the time of treatment.

• Long-term prescribed grazing will convert this plant community to the Western Wheatgrass /Cheatgrass Plant Community, when this state has large amounts of cheatgrass, annual weeds, and bare ground at the time of treatment. Control of plains pricklypear cactus may be necessary.

Reseeding areas with native plant species and proper grazing management may be necessary to accelerate recovery where few desirable plants remain.

Plant Growth Curve

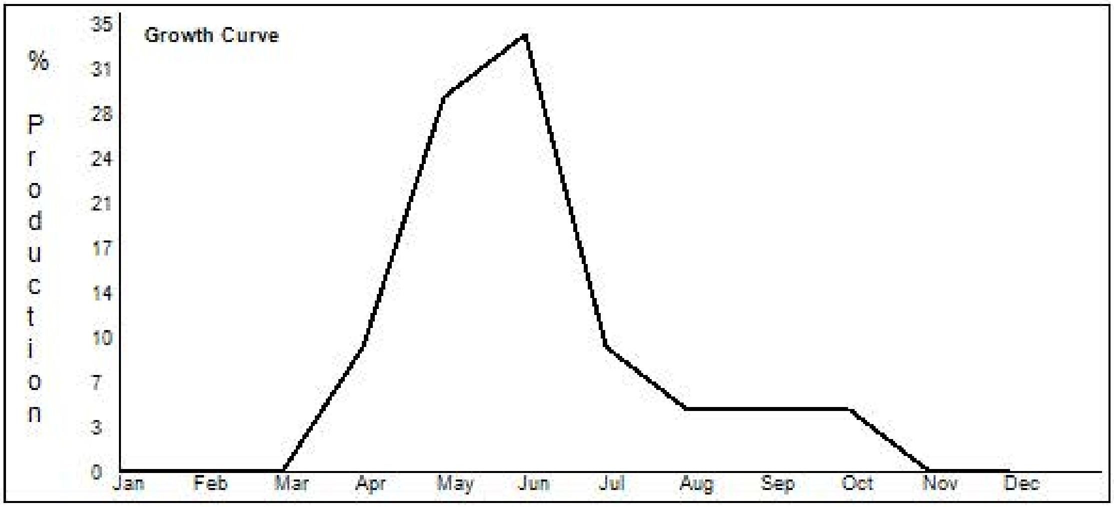
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Go-back Land

This plant community occurs on land that has been cropped annually in the past and then abandoned without reseeding. Natural succession has resulted in a plant community dominated by varying combinations of red threeawn, cheatgrass, blue grama, Sandberg bluegrass, and some rhizomatous wheatgrasses. Forage production is low and grasses such as red threeawn and cheatgrass are not used efficiently by livestock.

The total annual production (air-dry weight) of this state is about 600 pounds per acre, but it can range from about 500 lbs./acre in unfavorable years to about 900 lbs./acre in above average years.

The potential for accelerated erosion can be highly variable depending on amount of bare ground present. Biological diversity is low.

Transitions or pathways leading to other plant communities are as follows:

• Prescribed grazing may be used to increase desirable native cool-season grass production. It is usually difficult to return to near Historic Climax Plant Community condition in a timely manner because of past soil loss.

• Grazing land mechanical treatment (i.e., chiseling) may improve forage production where significant rhizomatous wheatgrass is present to respond.

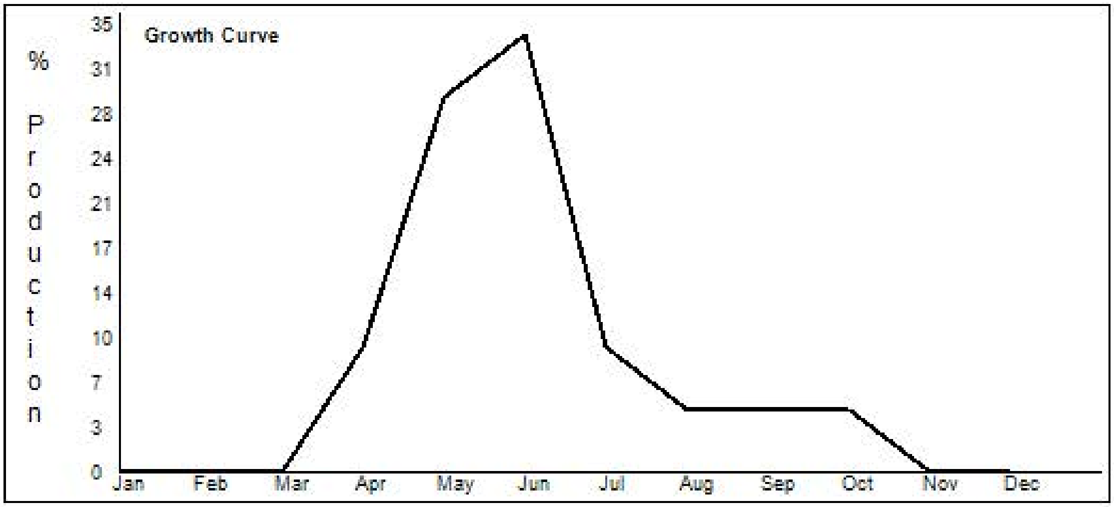
Where there is a lack of perennial grasses, reseeding to tame or native species may be necessary to return these lands to production in the form of pastureland. These pastures are normally seeded to crested wheatgrass, pubescent wheatgrass, or Russian wildrye. They require considerable investment to establish and have a variable life expectancy. They do produce up to 50% more than native range, but their value as forage is somewhat limited due to the single species usually seeded. In some cases, the single species or certain groups of species (e.g., wheatgrasses) may be more vulnerable to infestation by associated insects and/or diseases (e.g., black grass bugs).

Plant Growth Curve

Growth curve number:	WY1401
Growth curve name:	10-14NP upland sites
Growth curve description:	

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Section II: Ecological Site Interpretations

Animal Community

Animal Community – Wildlife Interpretations

Rhizomatous Wheatgrasses, Needleandthread, Blue Grama Plant Community (HCPC): The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants. However, topographical variations could provide some escape cover. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here.

Mixed Sagebrush/Grass Plant Community: The combination of an overstory of sagebrush and an understory of grasses and forbs provide a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer and antelope may use this state for foraging and cover year-round, as would cottontail and jack rabbits. It provides important winter, nesting, brood-rearing, and foraging habitat for sage grouse. Brewer's sparrows' nest in big sagebrush plants, and hosts of other nesting birds utilize stands in the 20-30% cover range.

Heavy Sagebrush Plant Community: This plant community can provide important winter foraging for elk, mule deer and antelope, as sagebrush can approach 15% protein and 40-60% digestibility during that time. This community provides excellent escape and thermal cover for large ungulates, as well as nesting and brood rearing habitat for sage grouse.

Western Wheatgrass/Cheatgrass Plant Community: This plant community may be useful for the same large grazers that would use the Historic Climax Plant Community. However, the plant community composition is less diverse, and thus, less apt to meet the seasonal needs of these animals. It may provide some foraging opportunities for sage grouse when it occurs proximal to woody cover. Good grasshopper habitat equals good foraging for birds.

Blue Grama Sod and Go-back Land Plant Communities: These communities provide limited foraging for antelope and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover and if the Historic Climax Plant Community or the Western Wheatgrass/Cheatgrass Plant Community is limiting. Generally, these are not target plant communities for wildlife habitat management.

Greasewood Plant Community: This plant community exhibits a low level of plant species diversity due to the accumulation of salts in the soil. It may provide some thermal and escape cover for deer and antelope if no other woody community is nearby, but in most cases it is not a desirable plant community to select as a wildlife habitat management objective.

Blue Grama, Plains Pricklypear, Bare Ground Plant Community: Benefits to other wildlife are largely due to the subterranean structure created by the prairie dogs, not the sparse vegetation found on this plant community.

Introduced Pasture: These communities are highly variable depending on the species planted. Refer to Forage Suitability Groups for more information.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
(lb./ac) (AUM/ac)
Rhizomatous WG, Needleandthread, Blue Grama 700-1500 .4
Heavy Sagebrush 800-1400 .3
Blue Grama Sod 400-1000 .2
Mixed Sagebrush/Grass 700-1200 .33
Western Wheatgrass/Cheatgrass 600-1200 .2
Blue grama, Plains Pricklypear, Bare ground 300-800 .1
Greasewood 525-875 .3
Go-back Land 500-900 .2

* - Continuous, season-long grazing by cattle under average growing conditions.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Plant Preference by Animal Kind

Animal kind: All antelope

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	*Achillea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	*Achnatherum hymenoides*	Leaves	N	N	N	P	P	P	N	N	N	D	D	D
textile onion	*Allium textile*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	*Andropogon gerardii*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand bluestem	*Andropogon hallii*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rosy pussytoes, rose pussytoes	*Antennaria rosea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	*Artemisia cana*	Leaves	P	P	P	P	P	P	P	P	P	P	P	P

tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	P	P	P	P	P	P	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue grama	Bouteloua gracilis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Leaves	P	P	P	P	P	P	P	P	P	P	P	P
inland sedge	Carex interior	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sandreed	Calamovilfa longifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
plains reedgrass	Calamagrostis montanensis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Nebraska sedge	Carex nebrascensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

slender wheatgrass	Elymus trachycaulus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand dropseed	Sporobolus cryptandrus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
alkali cordgrass	Spartina gracilis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint														

reedgrass	Calamagrostis canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
alkali sacaton	Sporobolus airoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
alkali cordgrass	Spartina gracilis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broadleaf cattail	Typha latifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Fruits/Seeds	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All deer

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand bluestem	Andropogon hallii	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Wyoming big sagebrush	Artemisia tridentata ssp. wyomingensis	Entire plant	P	P	P	P	P	P	D	D	D	D	D	D
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

prairie sandreed	Calamovilfa longifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Nebraska sedge	Carex nebrascensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
silverberry	Elaeagnus commutata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly,														

stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
prairie coneflower	Ratibida	Entire plant	D	D	D	P	P	P	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand dropseed	Sporobolus cryptandrus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
alkali cordgrass	Spartina gracilis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	Artemisia cana ssp. cana	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	U	U	U	N	N	N	N	N	N	U	U	U
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	D	D	D	U	U	U	U	U	U	D	D	D
sideoats grama	Bouteloua curtipendula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank														

wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
bluebunch														

wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
willow	Salix	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
greasewood	Sarcobatus vermiculatus	Leaves	U	U	U	U	U	U	U	U	U	U	U	U

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
alkali cordgrass	Spartina gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broadleaf cattail	Typha latifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All sheep

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	Artemisia cana	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Wyoming big sagebrush	Artemisia tridentata ssp. wyomingensis	Entire plant	P	P	P	D	D	D	D	D	D	P	P	P
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	N	N	N	T	T	T	T	T	T	T	T	T
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broom snakeweed	Gutierrezia sarothrae	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	D	D	D	D	D	D	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie														

coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue-eyed grass	Sisyrinchium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Legend: P=Preferred; D=Desirable; U=Undesirable; N=Not consumed; E=Emergency; T=Toxic; X=Used, but degree of utilization unknown

Hydrology Functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B and C, with localized areas in hydrologic group D. Infiltration ranges from moderately slow to moderate. Runoff potential for this site varies from low to moderate depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational Uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an esthetic value that appeals to visitors.

Wood Products

No appreciable wood products are present on the site.

Other Products

None noted.

Supporting Information

Associated Sites

Site name	Site ID	Site narrative
Clayey (Cy) 10-14" Northern Plains Precipitation Zone	R058BY104WY	Clayey
Lowland (LL) 10-14" Northern Plains Precipitation Zone	R058BY128WY	Lowland
Overflow (Ov) 10-14" Northern Plains Precipitation Zone	R058BY130WY	Overflow
Sandy (Sy) 10-14" Northern Plains Precipitation Zone	R058BY150WY	Sandy
Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone	R058BY162WY	Shallow Loamy

Similar Sites

Site name	Site ID	Site narrative
Loamy (Ly) 15-17" Northern Plains Precipitation Zone	R058BY222WY	Loamy 15-17" Northern Plains P.Z. has higher production.

State Correlation

This site has been correlated with the following states: **MT**

Inventory Data References

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel was also used. Those involved in developing this site include: Glen Mitchell, Range Management Specialist, NRCS; Chuck Ring, Range Management Specialist, NRCS; and Everet Bainter, Range Management Specialist. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, and USDA NRCS Soil Surveys from various counties.

Inventory Data References
Data Source Number of Records Sample Period State County
SCS-RANGE-417 12 1971-1994 WY Campbell & others
Ocular estimates 5 1990-1999 WY Campbell & others

Other References

Field Offices
Buffalo, Douglas, Gillette, Lusk, Newcastle, Sheridan

Original Site Description Approval

Author	Date	Approval	Date
G. Mitchell	4/25/2000	E. Bainter	3/7/2008

Reference Sheet

Author(s)/participant(s):

Contact for lead author:

Date: 4/1/2005 **MLRA:** 058B **Ecological Site:** Loamy (Ly) 10-14" Northern Plains Precipitation ZoneR058BY122WY This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: XAnnual Production, Foliar Cover, Biomass

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Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural disturbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

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1. **Number and extent of rills:** Rills should not be present.

2. **Presence of water flow patterns:** Barely observable.

3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** Bare ground is 20-30% occurring in small areas throughout site.

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None

7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement. Plant litter
remains in place and is not moved by erosional forces.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and litter is at 70% or greater of soil surface and maintains soil surface integrity. Soil Stability class is anticipated to be 5 or greater.

9. **Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness):** Use Soil Series description for depth and color of A-horizon.

10. **Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Grass canopy and basal cover should reduce raindrop impact and slow overland flow providing increased time for infiltration to occur. Healthy deep rooted native grasses enhance infiltration and reduce runoff. Infiltration is Moderate.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer or soil surface crusting should be present.

12. **Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    Dominant: Cool Season Bunch grasses > Cool Season Rhizomatous grasses > Short stature grasses/grasslikes > Forbs = Shrubs
    Sub-dominant:
    Other:
    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very Low.

14. **Average percent litter cover (%) and depth (inches):** Average litter cover is 25-35% with depths of 0.25 to 1.0 inches.

15. **Expected annual production (this is TOTAL above-ground production, not just forage production):** 1200 lbs/ac

16. **Potential invasive (including noxious) species (native and non-native). List Species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicator, we are describing what is NOT expected in the reference state for the ecological site:** Blue grama, Threadleaf sedge, Fringed sagewort, Prickly Pear, Big sagebrush, Broom Snakeweed,
and Species found on Noxious Weed List

17. **Perennial plant reproductive capability:** All species are capable of reproducing.

Reference Sheet Approval:

Approval	Date
E. Bainter	3/7/2008

APPENDIX G

PREDOMINANT ECOLOGICAL SITE DESCRIPTIONS

ESD2_ Sandy (Sy) 10–14-inch Precipitation Zone, Northern Plains (R058BY150WY)

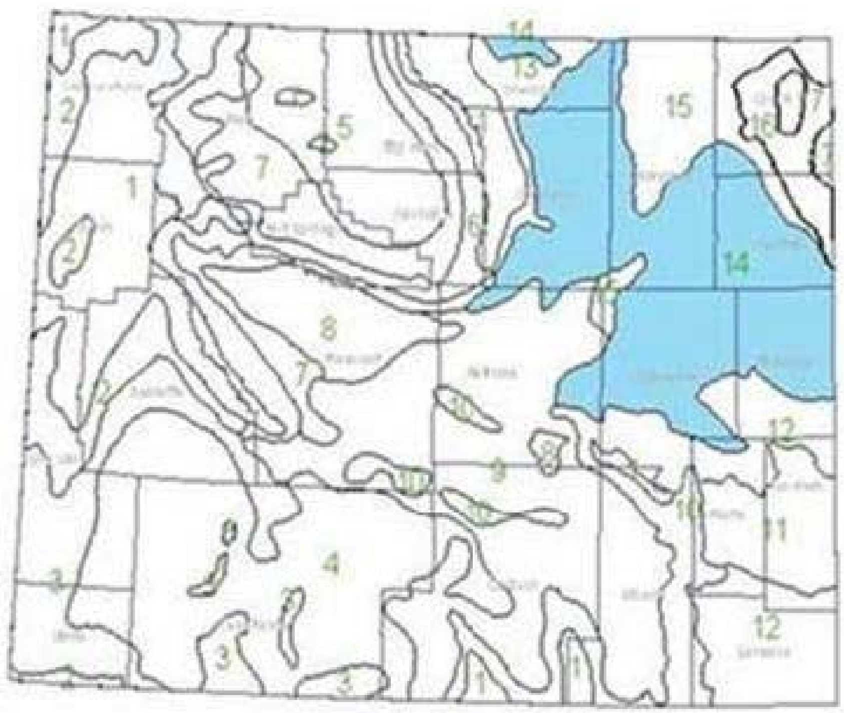
United States Department of Agriculture
Natural Resources Conservation Service
Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site name: **Sandy (Sy) 10-14" Northern Plains Precipitation Zone**
Site type: Rangeland
Site ID: R058BY150WY
Major land resource area (MLRA): 058B-Northern Rolling High Plains, Southern Part

Precipitation Zones for Rangeland Ecological Site Descriptions



Physiographic Features

This site occurs on nearly level to 50% slopes.

Landform: (1) Alluvial fan
(2) Plateau
(3) Ridge

	Minimum	Maximum
Elevation (feet):	3600	5100

Slope (percent):	0	30
Flooding		
Frequency:	None	None
Ponding		
Depth (inches):	0	0
Frequency:	None	Rare
Runoff class:	Negligible	High
Aspect:	No Influence on this site	

Climatic Features

Annual precipitation ranges from 10-14 inches per year. Wide fluctuations may occur in yearly precipitation and result in more drought years than those with more than normal precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring.

Wind speed averages about 8 mph, ranging from 10 mph during the spring to 7 mph during late summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 75 mph.

Growth of native cool season plants begins about April 1 and continues to about July 1. Native warm season plants begin growth about May 15 and continue to about August 15. Green up of cool season plants may occur in September and October of most years.

The following information is from the "Clearmont 5 SW" climate station:

Frost-free period (32 F): 76 - 132 days; (5 yrs. out of 10, these days will occur between May 30 – September 11)
Freeze-free period 28 F): 110 - 145 days; (5 yrs. out of 10, these days will occur between May 16 – September 21)
Mean annual precipitation: 12.4 inches
Mean annual air temperature: 43.2 F (28.4 F Avg. Min. – 57.9 F Avg. Max.)
For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/ website. Other climate station(s) representative of this precipitation zone include: “Dull Center”.

	Minimum	Maximum
Frost-free period (days):	76	132
Freeze-free period (days):	110	145
Mean annual precipitation (inches):	10.00	14.00

Influencing Water Features

Stream Type: None

Representative Soil Features

The soils of this site are moderately deep (greater than 20” to bedrock) to very deep, well-drained soils that formed in alluvium or alluvium over residuum. These soils have moderate, moderately rapid, or rapid permeability. The surface soil will vary from 3 to 6 inches deep and have one of the following textures: fine sandy loam, sandy loam, or loamy very fine sand. Coarser topsoils may be included if underlain by finer textured subsoil. Layers of the soil most influential to the plant community vary from 3 to 8 inches thick.

Major Soil Series correlated to this site include: Bowbac, Decolney, Hargreave, Hiland, Julesburg, Keeline, Moskee, Terro, Turnercrest, Vonalee,

Other Soil Series correlated in MLRA 58B to this site include: Absted, Ascalon, Bankard, Bayard, Cambria, Clarkelen, Draknab, Forkwood, FortCollins, Garrett, Glenberg, Keyner, Jayem, Manter, Maysdorf, Noden, Nuncho, Otero, Pugsley, Satanta, Schooner, Southfork, Terry, and Vona

Surface texture: (1) Fine sandy loam
(2) Sandy loam

Subsurface texture group: Sandy

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	0
Surface fragments >3" (% cover):	0	0
Subsurface fragments <=3" (% volume):	0	0
Subsurface fragments >3" (% volume):	0	0

Drainage class: Well drained to excessively drained

Permeability class: Moderately rapid to rapid

	Minimum	Maximum
Depth (inches):	20	60
Available water capacity (inches):	2.00	5.10
Electrical conductivity (mmhos/cm):	0	4
Sodium adsorption ratio:	0	5
Calcium carbonate equivalent (percent):	0	5
Soil reaction (1:1 water):	6.6	8.4

Plant Communities

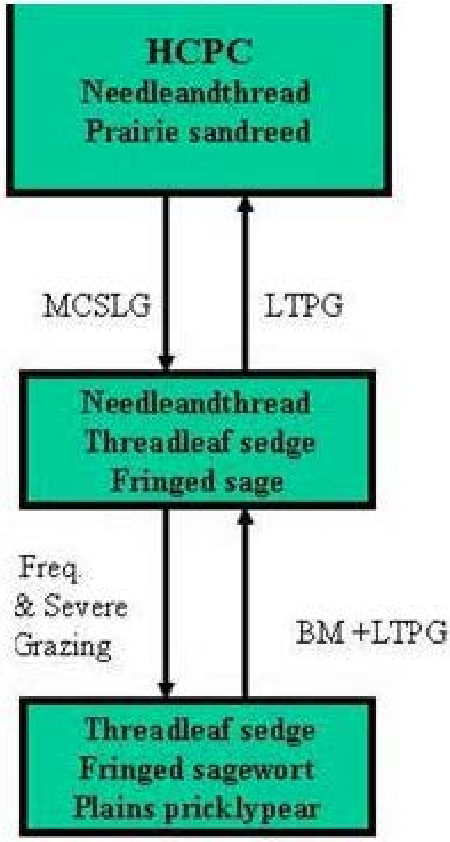
Ecological Dynamics of the Site

As this site deteriorates, species such as threadleaf sedge, needleandthread, fringed sagewort and silver sagebrush will increase. Mid grasses such as prairie sandreed and indian ricegrass will decrease in frequency and production.

The Historic Climax Plant Community (description follows the plant community diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model Diagram that illustrates the common plant communities (states) that can occur on the site and the transitions between these communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

State-and-Transition Diagram



BM - Brush Management (fire, chemical, mechanical)
Freq. & Severe Grazing - Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season
GLMT - Grazing Land Mechanical Treatment
LTPG - Long-tem Prescribed Grazing
MCSLG - Moderate, Continuous Season-long Grazing
NU, NF - No Use and No Fire
PG - Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)
VLTPG - Very Long-term Prescribed Grazing (could possibly take generations)
Na - found adjacent to a saline site

Needleandthread/Prairie Sandreed Plant Community

The interpretive plant community for this site is the Historic Climax Plant Community. This state evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. Potential vegetation is about 75% grasses or grass-like plants, 15% forbs, and 10% woody plants. The state is a mix of warm and cool season midgrasses. The major grasses include needleandthread, prairie sandreed, little bluestem, and Indian ricegrass. Other grasses occurring in the state include rhizomatous wheatgrasses, Sandberg bluegrass, blue grama, and threadleaf sedge. Silver sagebrush and green rabbitbrush are conspicuous components of this state.

The total annual production (air-dry weight) of this state is about 1200 pounds per acre, but it can range from about 750 lbs./acre in unfavorable years to about 1600 lbs./acre in above average years.

The state is stable and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Transitions or pathways leading to other plant communities are as follows:

• Moderate, Continuous Season-Long grazing will convert the plant community to the Needleandthread/ Threadleaf sedge/ Fringed sagewort Vegetation State.

• Frequent and Severe grazing will convert the plant community to the Threadleaf sedge/ Fringed sagewort/ Plains Pricklypear Vegetation State.

Needleandthread/Prairie Sandreed Plant Community Plant Species Composition

	Grass/Grasslike				Annual Production (pounds per acre)	
Group	Group name	Common name	Symbol	Scientific name	Low	High
1					75	160
		streambank wheatgrass, thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	75	160
		western wheatgrass	PASM	*Pascopyrum smithii*	75	160
2					113	240
		Indian ricegrass	ACHY	*Achnatherum hymenoides*	113	240
3					75	160
		little bluestem	SCSC	*Schizachyrium scoparium*	75	160
4					188	400
		needle and thread, needleandthread	HECO26	*Hesperostipa comata*	188	400
5					75	160
		Cusick's bluegrass, Cusick bluegrass	POCU3	*Poa cusickii*	75	160
6					150	320
		prairie sandreed	CALO	*Calamovilfa longifolia*	150	320
7					75	160
		threadleaf sedge	CAFI	*Carex filifolia*	75	160

Group	Group name	Common name	Symbol	Scientific name	Low	High
8					188	400
		blue grama	BOGR2	Bouteloua gracilis	38	80
		hairy grama	BOHI2	Bouteloua hirsuta	38	80
		needleleaf sedge	CADU6	Carex duriuscula	38	80
		prairie Junegrass	KOMA	Koeleria macrantha	38	80
		Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	Poa secunda	38	80

Forb

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	High
9					113	240
		yarrow	ACHIL	Achillea	38	80
		textile onion	ALTE	Allium textile	38	80
		rosy pussytoes, rose pussytoes	ANRO2	Antennaria rosea	38	80
		prairie sagewort, fringed sagewort	ARFR4	Artemisia frigida	38	80
		aster	ASTER	Aster	38	80
		milkvetch	ASTRA	Astragalus	38	80
		tapertip hawksbeard	CRAC2	Crepis acuminata	38	80
		white prairie clover	DACA7	Dalea candida	38	80
		violet prairie clover, purple prairie clover	DAPU5	Dalea purpurea	38	80
		sulphur-flower buckwheat	ERUM	Eriogonum umbellatum	38	80
		scarlet beeblossom, scarlet gaura	GACO5	Gaura coccinea	38	80
		stemless mock goldenweed	HAAC	Haplopappus acaulis(syn)	38	80
		desertparsley, biscuitroot	LOMAT	Lomatium	38	80
		bluebells	MERTE	Mertensia	38	80
		large Indian breadroot, breadroot scurfpea	PEES	Pediomelum esculentum	38	80
		upright prairie coneflower, prairie coneflower	RACO3	Ratibida columnifera	38	80
		American vetch	VIAM	Vicia americana	38	80

Shrub/Vine

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	High
10					38	80
		big sagebrush	ARTR2	Artemisia tridentata	38	80
11					113	240
		silver sagebrush	ARCAC5	Artemisia cana ssp. cana	38	80
		yellow rabbitbrush, green rabbitbrush, low	CHVI8	Chrysothamnus	38	80

rabbitbrush, Douglas rabbitbrush		viscidiflorus		
winterfat	KRLA2	Krascheninnikovia lanata	38	80
western snowberry	SYOC	Symphoricarpos occidentalis	38	80
soapweed yucca, small soapweed	YUGL	Yucca glauca	38	80

Plant Growth Curve

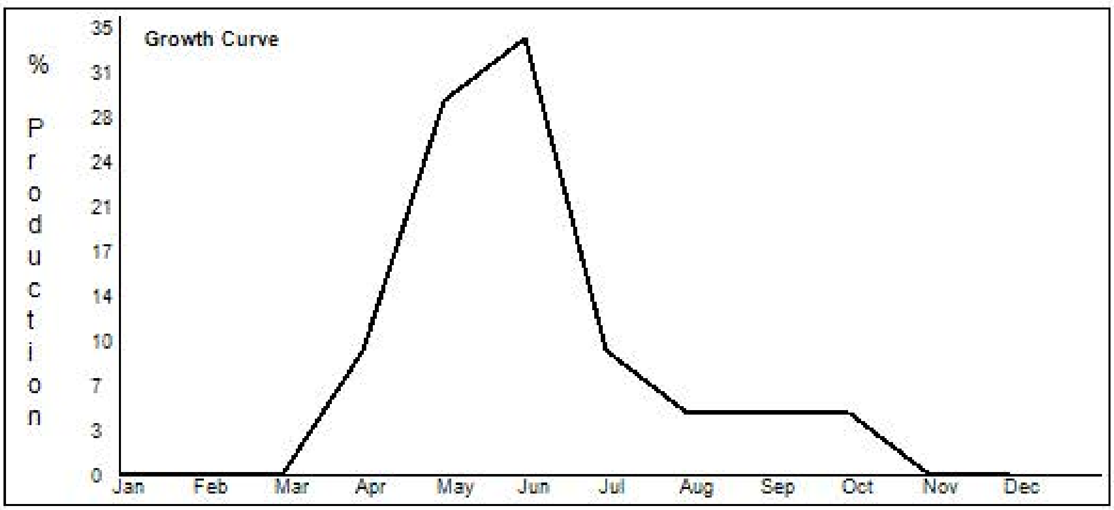
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Needleandthread/Threadleaf Sedge/Fringed Sagewort Plant Community

This plant community is the result of moderate season long grazing. The understory of grass includes needleandthread, threadleaf sedge, and prairie junegrass. Fringed sagewort has increased. When compared to the Historic Climax Plant Community, prairie sandreed and Indian ricegrass have decreased. Threadleaf sedge, needleandthread and fringed sagewort have increased. This community is well suited to grazing by both domestic livestock and wildlife, during the spring, summer and fall.

The total annual production (air-dry weight) of this state is about 800 pounds per acre, but it can range from about 600 lbs./acre in unfavorable years to about 1000 lbs./acre in above average years.

The communities' soil biotic integrity and watershed is intact, although more than normal runoff may occur due to the sod forming vegetation.

Transitional pathways leading to other plant communities are as follows:

• Long-Term Prescribed grazing will return this state to near Historic Climax Plant Community condition. The sod forming nature of threadleaf sedge and needleandthread will make the transition to Historic Climax Plant Community difficult.

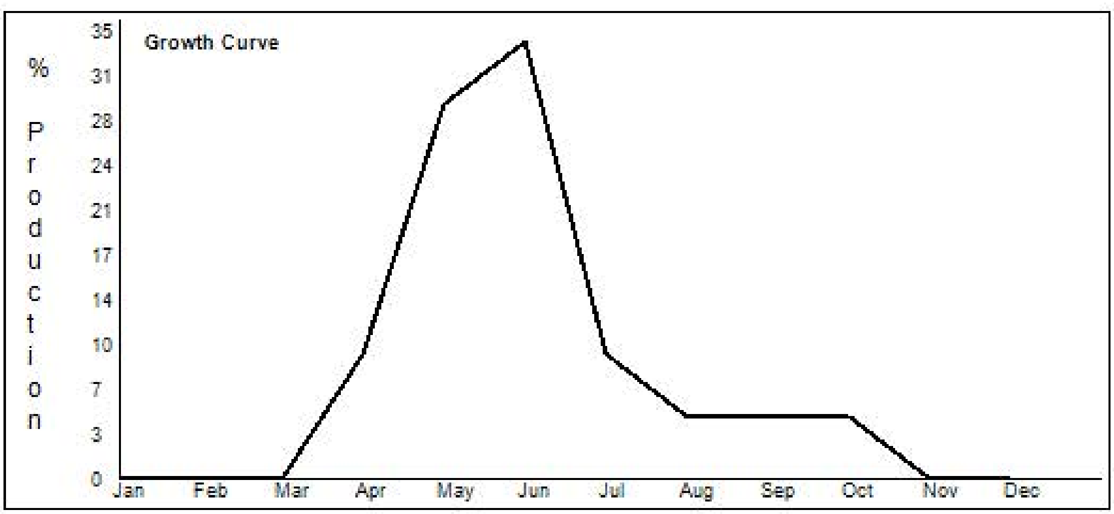
• Frequent and Severe grazing will convert this state to the Threadleaf sedge/ Fringed sagewort/ Plains pricklypear Vegetation State.

Plant Growth Curve

Growth curve number:	WY1401
Growth curve name:	10-14NP upland sites
Growth curve description:	

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Threadleaf Sedge/Fringed Sagewort/Plains Pricklypear Plant Community

This plant community is the result of frequent and severe grazing. A sod of threadleaf sedge and needleandthread dominates it. Pricklypear cactus can become dense enough so that livestock cannot graze forage growing within the cactus clumps. When the historic climax community is replaced by sod forming communities, grass production is reduced.

The total annual production (air-dry weight) of this state is about 650 pounds per acre, but it can range from about 500 lbs./acre in unfavorable years to about 800 lbs./acre in above average years.

The soil is generally well protected in this state. The biotic integrity may be reduced due to low vegetative production. The sod formed by these grasses is resistant to water infiltration. While this sod protects the site, off-site areas are affected by excessive runoff that may cause gully erosion. This sod is resistant to change and may require practices such as long-term prescribed grazing to return to a mid grass community.

Transitional pathways leading to other plant communities are as follows:

• Long-term Prescribed grazing with Brush Management will return this plant community to near Historic Climax Plant Community.

Plant Growth Curve

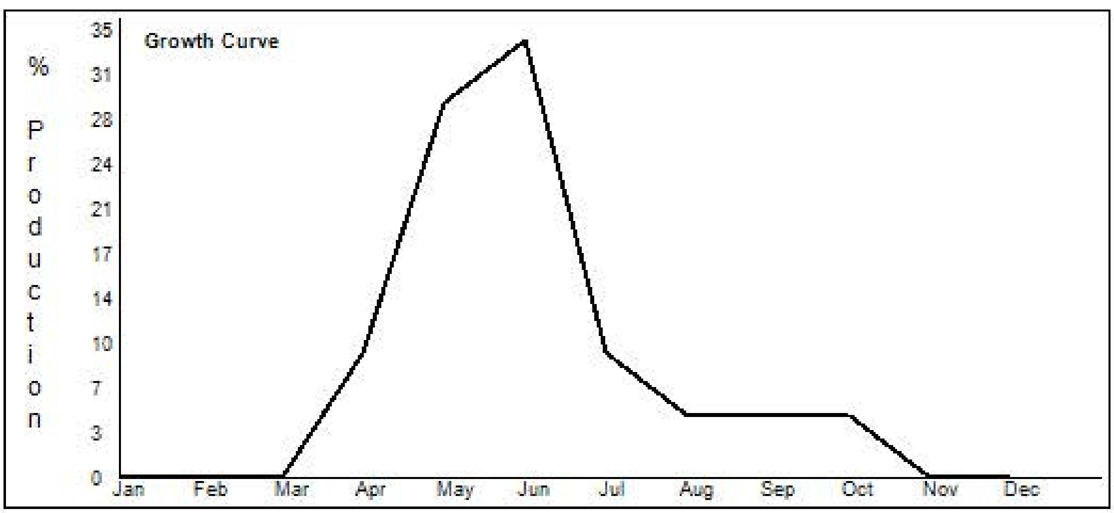
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Section II: Ecological Site Interpretations

Animal Community

Animal Community – Wildlife Interpretations
Historic Climax Plant Community: The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants. However, topographical variations could provide some escape cover. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here.

Needleandthread/Threadleaf sedge/Fringed sagewort: These communities provide foraging for antelope and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover.

Threadleaf sedge/Fringed sagewort/Cactus: These communities provide limited grazing for antelope and other herbivores due to low production. They may be used as a foraging site by sage grouse if proximal to woody cover.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
(lb./ac) (AUM/ac)
Historic Climax Plant Community 750-1600 .4
Threadleaf sedge/Needleandthread/Fringed sagewort 600-1000 .33
Threadleaf sedge/Fringed sagewort/Cactus 500-900 .2

* - Continuous, season-long grazing by cattle under average growing conditions.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Plant Preference by Animal Kind

Animal kind: All antelope

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	*Achillea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	*Achnatherum hymenoides*	Leaves	N	N	N	P	P	P	N	N	N	D	D	D
textile onion	*Allium textile*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	*Andropogon gerardii*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand bluestem	*Andropogon hallii*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rosy pussytoes, rose pussytoes	*Antennaria rosea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	*Artemisia cana*	Leaves	P	P	P	P	P	P	P	P	P	P	P	P
tarragon, green sagewort	*Artemisia dracunculus*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	*Artemisia frigida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	*Artemisia pedatifida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	*Aristida purpurea var. longiseta*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	P	P	P	P	P	P	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue grama	Bouteloua gracilis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Leaves	P	P	P	P	P	P	P	P	P	P	P	P
inland sedge	Carex interior	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sandreed	Calamovilfa longifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
plains reedgrass	Calamagrostis montanensis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Nebraska sedge	Carex nebrascensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand dropseed	Sporobolus cryptandrus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
alkali cordgrass	Spartina gracilis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

western snowberry	*Symphoricarpos occidentalis*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	*Thermopsis rhombifolia var. annulocarpa(syn)*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	*Triglochin*	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	*Typha angustifolia*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	*Typha latifolia*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	*Vicia americana*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	*Yucca glauca*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	*Achillea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Indian ricegrass	*Achnatherum hymenoides*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
textile onion	*Allium textile*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	*Andropogon gerardii*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	*Andropogon hallii*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
rosy pussytoes, rose pussytoes	*Antennaria rosea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
tarragon, green sagewort	*Artemisia dracunculus*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	*Artemisia frigida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	*Artemisia pedatifida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	*Aristida purpurea var. longiseta*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	*Artemisia tridentata*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
aster	*Aster*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	*Astragalus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	*Atriplex canescens*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	*Atriplex gardneri*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	*Bouteloua curtipendula*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	*Bouteloua gracilis*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	*Bouteloua hirsuta*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	*Buchloe dactyloides(syn)*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	*Calamagrostis canadensis*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley,														

biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
alkali sacaton	Sporobolus airoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
alkali cordgrass	Spartina gracilis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var.													

	annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broadleaf cattail	Typha latifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Fruits/Seeds	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All deer

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand bluestem	Andropogon hallii	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Wyoming big sagebrush	Artemisia tridentata ssp. wyomingensis	Entire plant	P	P	P	P	P	P	D	D	D	D	D	D
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sandreed	Calamovilfa longifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Nebraska sedge	Carex nebrascensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T

poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
silverberry	Elaeagnus commutata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
prairie coneflower	Ratibida	Entire plant	D	D	D	P	P	P	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand dropseed	Sporobolus cryptandrus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
alkali cordgrass	Spartina gracilis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	Artemisia cana ssp. cana	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	U	U	U	N	N	N	N	N	N	U	U	U
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	D	D	D	U	U	U	U	U	U	D	D	D
sideoats grama	Bouteloua curtipendula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom,														

scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
willow	Salix	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
greasewood	Sarcobatus vermiculatus	Leaves	U	U	U	U	U	U	U	U	U	U	U	U

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
alkali cordgrass	Spartina gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broadleaf cattail	Typha latifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All sheep

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	Artemisia cana	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Wyoming big sagebrush	Artemisia tridentata ssp. wyomingensis	Entire plant	P	P	P	D	D	D	D	D	D	P	P	P
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	N	N	N	T	T	T	T	T	T	T	T	T

aster	*Aster*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	*Astragalus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	*Atriplex canescens*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	*Atriplex gardneri*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	*Bouteloua gracilis*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	*Bouteloua hirsuta*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	*Buchloe dactyloides(syn)*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	*Calamagrostis canadensis*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
needleleaf sedge	*Carex duriuscula*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	*Carex filifolia*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	*Carex interior*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	*Calamovilfa longifolia*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains reedgrass	*Calamagrostis montanensis*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	*Carex nardina*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	*Carex nebrascensis*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	*Chrysothamnus viscidiflorus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	*Cicuta*	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	*Conium maculatum*	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	*Crepis acuminata*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
white prairie clover	*Dalea candida*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	*Dalea purpurea*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	*Deschampsia caespitosa(syn)*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	*Distichlis spicata*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	*Elymus caninus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	*Elymus canadensis*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	*Elaeagnus commutata*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	*Elymus elymoides ssp. elymoides*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank wheatgrass, thickspike wheatgrass	*Elymus lanceolatus ssp. lanceolatus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	*Elymus trachycaulus*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	*Equisetum*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	*Ericameria nauseosa*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	*Eriogonum umbellatum*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	*Gaura coccinea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	*Glycyrrhiza lepidota*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broom snakeweed	*Gutierrezia sarothrae*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	*Haplopappus acaulis(syn)*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	D	D	D	D	D	D	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue-eyed grass	Sisyrinchium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

broadleaf cattail	*Typha latifolia*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	*Vicia americana*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	*Yucca glauca*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Legend: P=Preferred; D=Desirable; U=Undesirable; N=Not consumed; E=Emergency; T=Toxic; X=Used, but degree of utilization unknown

Hydrology Functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B, with localized areas in hydrologic group C. Infiltration potential for this site varies from moderately rapid to rapid depending on soil hydrologic group and ground cover. Runoff varies from low to moderate. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational Uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an esthetic value that appeals to visitors.

Wood Products

No appreciable wood products are present on the site.

Other Products

None noted.

Supporting Information

Associated Sites

Site name	Site ID	Site narrative
Shallow Sandy (SwSy) 10-14" Northern Plains Precipitation Zone	R058BY166WY	

Similar Sites

Site name	Site ID	Site narrative
Sandy (Sy) 15-17" Northern Plains Precipitation Zone	R058BY250WY	Sandy 15-17" Northern Plains P.Z. has higher production.

State Correlation

This site has been correlated with the following states: **MT**

Inventory Data References

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel was also used. Those involved in developing this site include: Glen Mitchell, Range Management Specialist, NRCS; Chuck Ring, Range Management Specialist, NRCS; and Everet Bainter, Range Management Specialist. Other sources used as references include: USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, and USDA NRCS Soil Surveys from various counties.

Inventory Data References
Data Source Number of Records Sample Period State County
SCS-RANGE-417 12 1971-1994 WY Campbell & others
Ocular estimates 5 1990-1999 WY Campbell & others

Original Site Description Approval

Author	Date	Approval	Date
G. Mitchell	10/31/2002	E. Bainter	3/7/2008

Reference Sheet

Author(s)/participant(s):

Contact for lead author:

Date: 4/1/2005 **MLRA:** 058B **Ecological Site:** Sandy (Sy) 10-14" Northern Plains Precipitation ZoneR058BY150WY This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: XAnnual Production, Foliar Cover, Biomass

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Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural disturbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

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1. **Number and extent of rills:** Rills should not be present.
2. **Presence of water flow patterns:** Barely observable.
3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.
4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** Bare ground is 20-30% occurring in small areas throughout site.
5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present.
6. **Extent of wind scoured, blowouts and/or depositional areas:** None
7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement. Plant litter
remains in place and is not moved by erosional forces.
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and litter is at 70% or greater of soil surface and maintains soil surface integrity. Soil Stability class is anticipated to be 4 or greater.

9. **Soil surface structure and SOM content (Include type and strength of structure, and A-horizon color and thickness):** Use Soil Series description for depth and color of A-horizon.

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10. **Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Grass canopy and basal cover should reduce raindrop impact and slow overland flow providing increased time for infiltration to occur. Healthy deep rooted native grasses enhance infiltration and reduce runoff. Infiltration is Moderately Rapid to Rapid.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer or soil surface crusting should be present.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    Dominant: Mid stature Cool Season Grasses = Mid Stature Warm Season Grasses >
    Short stature Grasses/Grasslike > Shrubs > Forbs
    Sub-dominant:
    Other:
    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very Low.

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14. **Average percent litter cover (%) and depth (inches):** Average litter cover is 25-35% with depths of 0.25 to 1.0 inches

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15. **Expected annual production (this is TOTAL above-ground production, not just forage production):** 1300 lbs/ac

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16. **Potential invasive (including noxious) species (native and non-native). List Species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicator, we are describing what is NOT expected in the reference state for the ecological site**: Threadleaf sedge, Fringed sagewort, Prickly Pear, Broom Snakeweed, Yucca, and Species found on
    Noxious Weed List.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing.

Reference Sheet Approval:

Approval	**Date**
E. Bainter	3/7/2008

APPENDIX G

PREDOMINANT ECOLOGICAL SITE DESCRIPTIONS

ESD3_ Shallow Loamy (SwLy) 10–14-inch Precipitation Zone, Northern Plains (R058BY162WY)

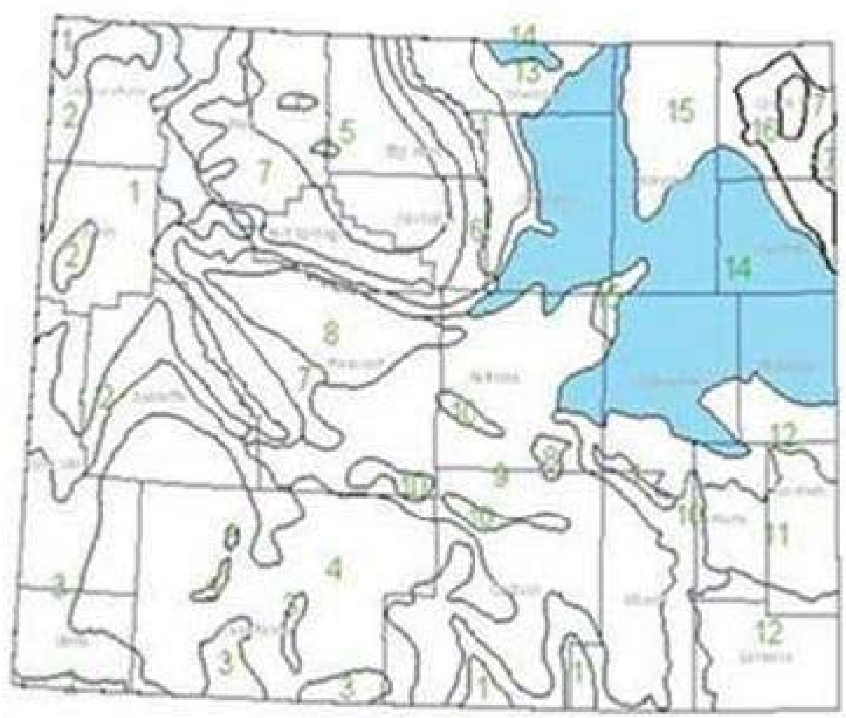
United States Department of Agriculture
Natural Resources Conservation Service
Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

***Site name:* Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone**
Site type: Rangeland
Site ID: R058BY162WY
Major land resource area (MLRA): 058B-Northern Rolling High Plains, Southern Part

Precipitation Zones for Rangeland Ecological Site Descriptions



Physiographic Features

This site occurs on steep slopes and ridge tops, but may occur on all slopes.

Landform: (1) Hill
(2) Ridge
(3) Escarpment

	Minimum	Maximum
Elevation (feet):	3600	5100

Slope (percent):	0	60
Flooding		
Frequency:	None	None
Ponding		
Frequency:	None	None
Runoff class:	Negligible	High
Aspect:	No Influence on this site	

Climatic Features

Annual precipitation ranges from 10-14 inches per year. Wide fluctuations may occur in yearly precipitation and result in more drought years than those with more than normal precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring.

Wind speed averages about 8 mph, ranging from 10 mph during the spring to 7 mph during late summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 75 mph.

Growth of native cool season plants begins about April 1 and continues to about July 1. Native warm season plants begin growth about May 15 and continue to about August 15. Green up of cool season plants may occur in September and October of most years.

The following information is from the "Clearmont 5 SW" climate station:
Frost-free period (32 F): 76 - 132 days; (5 yrs. out of 10, these days will occur between May 30 – September 11)
Freeze-free period 28 F): 110 - 145 days; (5 yrs. out of 10, these days will occur between May 16 – September 21)
Mean annual precipitation: 12.4 inches
Mean annual air temperature: 43.2 F (28.4 F Avg. Min. – 57.9 F Avg. Max.)
For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/ website. Other climate station(s) representative of this precipitation zone include: "Dull Center".

	Minimum	Maximum
Frost-free period (days):	76	132
Freeze-free period (days):	110	145
Mean annual precipitation (inches):	10.00	14.00

Influencing Water Features

Stream Type: None

Representative Soil Features

The soils of this site are shallow (less than 20"to bedrock) well-drained soils formed in alluvium over residuum or residuum. These soils have moderate permeability and may occur on all slopes. The bedrock may be any kind which is virtually impenetrable to plant roots, except igneous. The surface soil will have one or more of the following textures: very fine sandy loam, loam, silt loam, sandy clay loam, silty clay loam, and clay loam. Thin ineffectual layers of other textures are disregarded. Layers of the soil most influential to the plant community vary from 3 to 6 inches thick.

Major Soil Series correlated to this site includes: Shingle, Worf,

Other Soil Series in MLRA 58B correlated to this site include: Cragola, Nihill

Surface texture: (1) Loam
(2) Sandy loam
(3) Clay loam

Subsurface texture group: Loamy

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	10
Surface fragments >3" (% cover):	0	20
Subsurface fragments <=3" (% volume):	0	15
Subsurface fragments >3" (% volume):	0	0

Drainage class: Well drained
Permeability class: Moderate to moderately rapid

	Minimum	Maximum
Depth (inches):	10	20
Available water capacity (inches):	1.10	4.20
Electrical conductivity (mmhos/cm):	0	4
Sodium adsorption ratio:	0	5
Calcium carbonate equivalent (percent):	0	5
Soil reaction (1:1 water):	6.6	8.4

Plant Communities

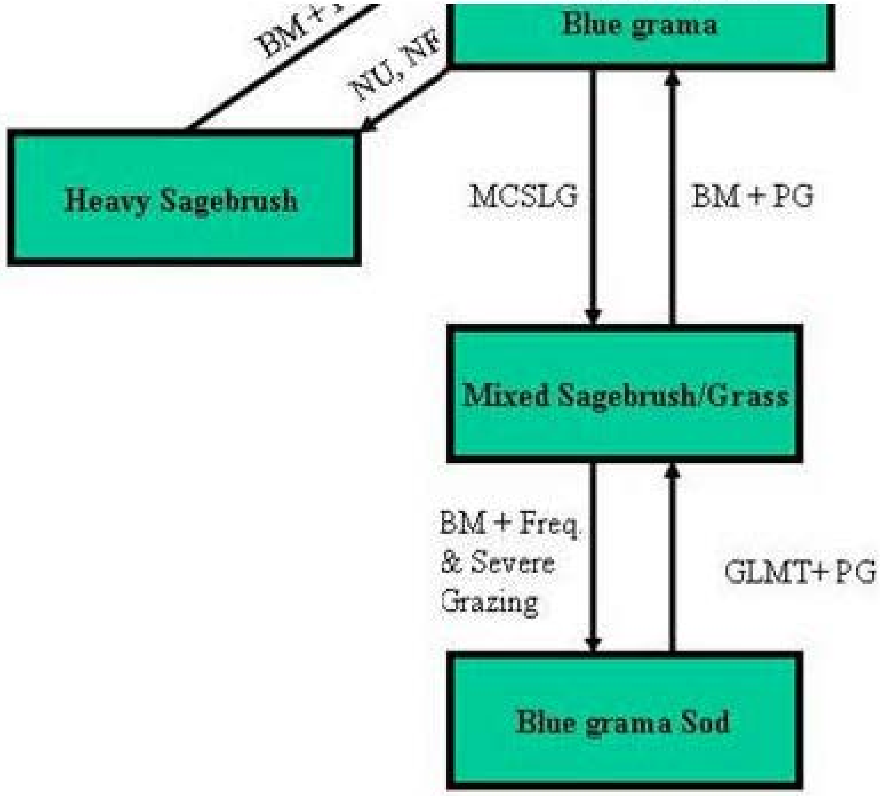
Ecological Dynamics of the Site

As this site deteriorates, species such as blue grama and big sagebrush will increase. Cool season grasses such as bluebunch wheatgrass and rhizomatous wheatgrasses will decrease in frequency and production.

The Historic Climax Plant Community (description follows the plant community diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model Diagram that illustrates the common plant communities (states) that can occur on the site and the transitions between these communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

State-and-Transition Diagram



BM - Brush Management (fire, chemical, mechanical)
Freq. & Severe Grazing - Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season
GLMT - Grazing Land Mechanical Treatment
LTPG - Long-tem Prescribed Grazing
MCSLG - Moderate, Continuous Season-long Grazing
NU, NF - No Use and No Fire
PG - Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)
VLTPG - Very Long-term Prescribed Grazing (could possibly take generations)
Na - found adjacent to a saline site

Rhizomatous wheatgrasses/Needleandthread/Blue Grama Plant Community

The interpretive plant community for this site is the Historic Climax Plant Community. This state evolved with grazing by large herbivores and is well suited for grazing by domestic livestock. Potential vegetation is about 75% grasses or grass-like plants, 15% forbs, and 10% woody plants. The state is dominated by cool season midgrasses. The major grasses include western wheatgrass, bluebunch wheatgrass, needleandthread, and little bluestem. Other grasses occurring on the state include Cusick's and Sandberg bluegrass, blue grama, and prairie junegrass. Big sagebrush is a conspicuous element of this state, occurring in a mosaic pattern, and makes up 5 to 10% of the annual production. Big sagebrush may become dominant on some areas with absence of fire. Natural fire occurred frequently in this community and prevented big sagebrush from being the dominant landscape. Wildfires are actively controlled in recent times so chemical control using herbicides has replaced the historic role of fire on this state. Recently controlled burning has regained some popularity.

The total annual production (air-dry weight) of this state is about 900 pounds per acre, but it can range from about 450 lbs./acre in unfavorable years to about 1200 lbs./acre in above average years.

The state is extremely stable and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Transitions or pathways leading to other plant communities are as follows:

• Protection from grazing and fire will convert this plant community to the Heavy Sagebrush Vegetation State.

• Moderate, continuous season-long grazing will convert the plant community to the Mixed Sagebrush/Grass Vegetation State.

• Frequent and severe grazing and brush management will convert the plant community to the Blue Grama Vegetation State.

Rhizomatous wheatgrasses/Needleandthread/Blue Grama Plant Community Plant Species Composition

	Grass/Grasslike				Annual Production (pounds per acre)	
Group	Group name	Common name	Symbol	Scientific name	Low	High
1					68	180
		streambank wheatgrass, thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	68	180
		western wheatgrass	PASM	*Pascopyrum smithii*	68	180
2					225	600
		bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	225	600
3					23	60
		green needlegrass	NAVI4	*Nassella viridula*	23	60
4					45	120
		needle and thread, needleandthread	HECO26	*Hesperostipa comata*	45	120
5					45	120
		little bluestem	SCSC	*Schizachyrium scoparium*	45	120
6					23	60
		Cusick's bluegrass, Cusick bluegrass	POCU3	*Poa cusickii*	23	60

7					45	120
		blue grama	BOGR2	*Bouteloua gracilis*	45	120
8					45	120
		hairy grama	BOHI2	*Bouteloua hirsuta*	45	120
9					45	120
		threadleaf sedge	CAFI	*Carex filifolia*	45	120
10					113	300
		Indian ricegrass	ACHY	*Achnatherum hymenoides*	23	60
		Fendler threeawn, red threeawn	ARPUL	*Aristida purpurea var. longiseta*	23	60
		sideoats grama	BOCU	*Bouteloua curtipendula*	23	60
		needleleaf sedge	CADU6	*Carex duriuscula*	23	60
		plains reedgrass	CAMO	*Calamagrostis montanensis*	23	60
		prairie Junegrass	KOMA	*Koeleria macrantha*	23	60
		plains muhly, stoneyhills muhly	MUCU3	*Muhlenbergia cuspidata*	23	60
		Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	POSE	*Poa secunda*	23	60

Forb

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	High
11					45	120
		yarrow	ACHIL	*Achillea*	23	60
		textile onion	ALTE	*Allium textile*	23	60
		rosy pussytoes, rose pussytoes	ANRO2	*Antennaria rosea*	23	60
		aster	ASTER	*Aster*	23	60
		milkvetch	ASTRA	*Astragalus*	23	60
		tapertip hawksbeard	CRAC2	*Crepis acuminata*	23	60
		white prairie clover	DACA7	*Dalea candida*	23	60
		violet prairie clover, purple prairie clover	DAPU5	*Dalea purpurea*	23	60
		sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	23	60
		scarlet beeblossom, scarlet gaura	GACO5	*Gaura coccinea*	23	60
		stemless mock goldenweed	HAAC	*Haplopappus acaulis(syn)*	23	60
		desertparsley, biscuitroot	LOMAT	*Lomatium*	23	60
		bluebells	MERTE	*Mertensia*	23	60
		large Indian breadroot, breadroot scurfpea	PEES	*Pediomelum esculentum*	23	60

		upright prairie coneflower, prairie coneflower	RACO3	Ratibida columnifera	23	60
		American vetch	VIAM	Vicia americana	23	60

Shrub/Vine

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	High
12					23	60
		winterfat	KRLA2	Krascheninnikovia lanata	23	60
13					45	120
		silver sagebrush	ARCAC5	Artemisia cana ssp. cana	23	60
		big sagebrush	ARTR2	Artemisia tridentata	23	60
		rubber rabbitbrush	ERNA10	Ericameria nauseosa	23	60
		skunkbush sumac	RHTR	Rhus trilobata	23	60

Plant Growth Curve

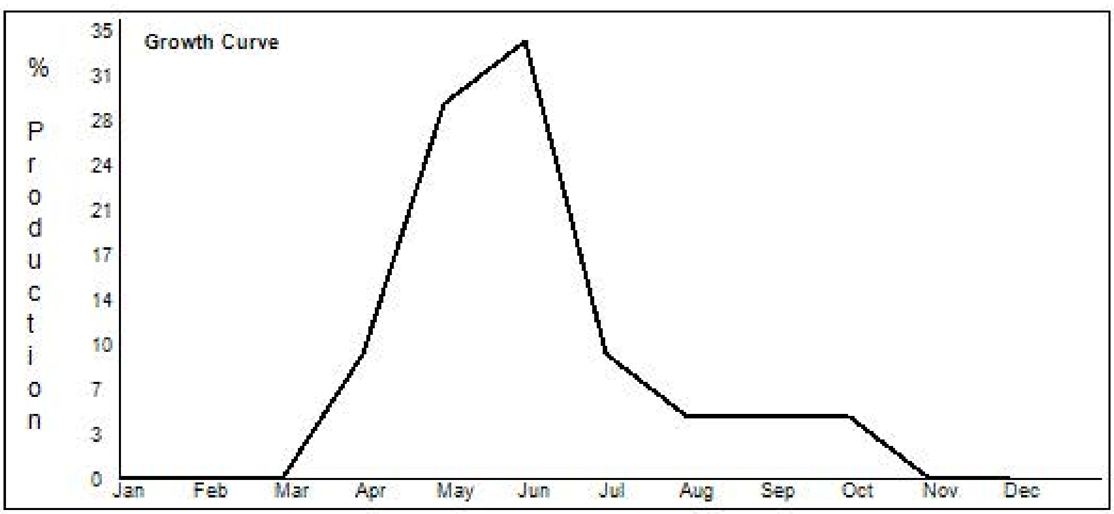
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Heavy Sagebrush Plant Community

This plant community is the result of protection from grazing and fire. Big sagebrush dominates this plant community with canopy cover often exceeding 50%. The understory of grass includes rhizomatous wheatgrasses, bluebunch wheatgrass, Sandberg bluegrass, and prairie junegrass. With complete protection from grazing and fire, the state will become dominated by big sagebrush. The big sagebrush canopy protects the cool season grasses, but this protection makes them unavailable for grazing. Big sagebrush is long-lived and will persist for a long period.

This plant community can provide valuable winter feed for both livestock (especially sheep) and wildlife (such as mule deer and antelope).

The total annual production (air-dry weight) of this state is about 675 pounds per acre, but it can range from about 450 lbs./acre in unfavorable years to about 900 lbs./acre in above average years.

The soil resources of this state are protected from erosion. The watershed is functioning. The biotic community is intact except that grass production is lowered.

Transitional pathways leading to other plant communities are as follows:

• Brush control followed by deferment for 1 to 2 years and prescribed grazing management thereafter will return this state to near Historic Climax Plant Community. Care should be taken when planning brush control to exclude critical winter ranges.

Plant Growth Curve

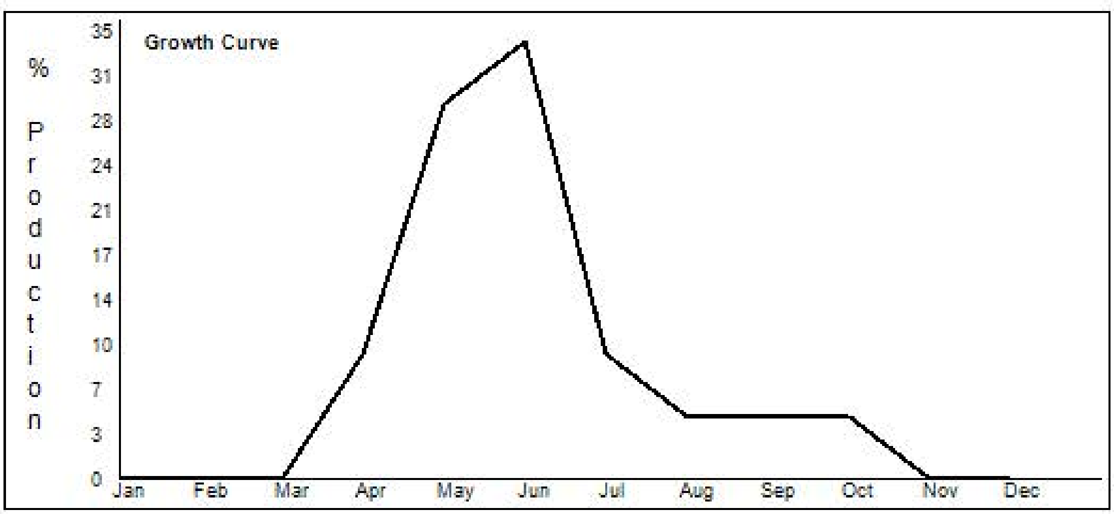
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Mixed Sagebrush/Grass Plant Community

Historically, this plant community evolved under grazing by bison and a low fire frequency. Currently, it is found under moderate, season-long grazing by livestock in the absence of fire or brush control. Wyoming big sagebrush is a significant component of this plant community. Cool-season grasses make up the majority of the understory with the balance made up of short warm-season grasses, annual cool-season grass, and miscellaneous forbs.

Dominant grasses include bluebunch wheatgrass, rhizomatous wheatgrasses, and blue grama. Grasses of secondary importance include little bluestem, prairie junegrass, and Sandberg bluegrass. Forbs, commonly found in this plant community, include Louisiana sagewort (cudweed), plains wallflower, hairy goldaster, slimflower scurfpea, and scarlet globemallow. Big sagebrush canopy ranges from 20% to 30%. Fringed sagewort is commonly found. Plains pricklypear and winterfat can also occur.
When compared to the Historical Climax Plant Community, big sagebrush and blue grama have increased. Bluebunch wheatgrass has decreased, often occurring only where protected from grazing by the sagebrush canopy. Production of cool-season grasses has also been reduced. Cheatgrass (downy brome) has invaded the state. The overstory of big sagebrush and understory of grass and forbs provide a diverse plant community that will support domestic livestock and wildlife such as mule deer and antelope.

The total annual production (air-dry weight) of this state is about 725 pounds per acre, but it can range from about 450 lbs./acre in unfavorable years to about 1000 lbs./acre in above average years.

The state is stable and protected from excessive erosion. The biotic integrity of this plant community is usually intact. However, it can be at risk depending on how far a shift has occurred in plant composition toward blue grama, sagebrush, and/or cheatgrass. The watershed is usually functioning. However, it can become at risk when canopy cover of sagebrush, blue grama sod, and/or bare ground increases.

Transitional pathways leading to other plant communities are as follows:

• Brush management followed by 1 or 2 years deferment and prescribed grazing use will return this state to near Historic Climax Plant Community.

• Frequent and severe grazing and brush management will convert this stat

Plant Growth Curve

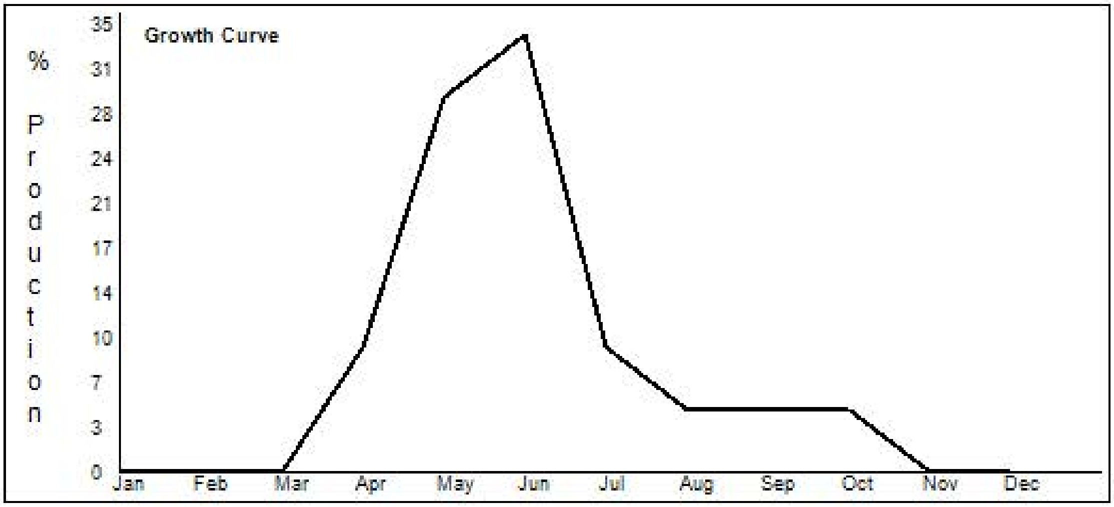
Growth curve number: WY1401

Growth curve name: 10-14NP upland sites

Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Blue Grama Sod Plant Community

This plant community is the result of long-term, heavy, continuous, season-long grazing. A dense sod of blue grama and threadleaf sedge dominates and covers up to 90% of the soil surface. When the historic climax community is replaced by warm season dominated communities, grass production is reduced.

The total annual production (air-dry weight) of this state is about 600 pounds per acre, but it can range from about 400 lbs./acre in unfavorable years to about 800 lbs./acre in above average years.

The sod formed by these grasses is resistant to water infiltration. While this sod protects the state, off-site areas are affected by excessive runoff that may cause gully erosion. This sod is resistant to change and may require practices such as grazing land mechanical treatment to return to a cool season grass community. Transitional pathways leading to other plant communities are as follows:

Transitional pathways leading to other plant communities are as follows:

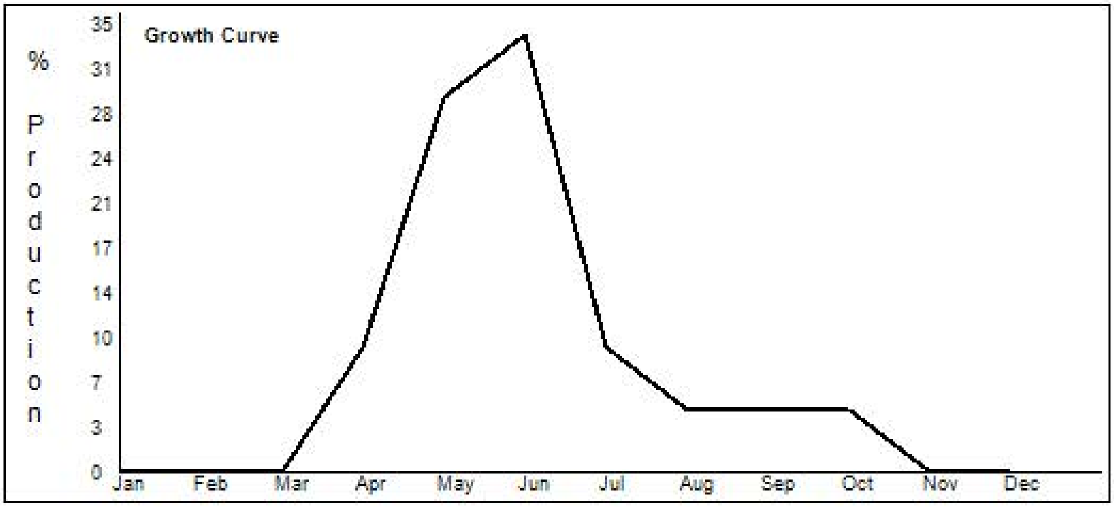
• Grazing Land Mechanical Treatment (chiseling, etc.) followed by prescribed grazing will return this plant community to near Historic Climax Plant Community.

Plant Growth Curve

Growth curve number: WY1401
Growth curve name: 10-14NP upland sites
Growth curve description:

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	30	35	10	5	5	5	0	0



Section II: Ecological Site Interpretations

Animal Community

Animal Community – Wildlife Interpretations
Historic Climax Plant Community: The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants. However, topographical variations could provide some escape cover. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here.

Heavy Sagebrush: This plant community can provide important winter foraging for elk, mule deer and antelope, as sagebrush can approach 15% protein and 40-60% digestibility during that time. This community can provide nesting and brood rearing habitat for sage grouse.

Mixed Sagebrush/Grass: The combination of an overstory of sagebrush and an understory of grasses and forbs provide a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer and antelope may use this state for foraging and cover year-round, as would cottontail and jack rabbits. It provides important winter, nesting, brood-rearing, and foraging habitat for sage grouse. Brewer's sparrows' nest in big sagebrush plants, and hosts of other nesting birds utilize stands in the 20-30% cover range.

Blue Grama Sod: These communities provide limited foraging for antelope and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover and if the Historic Climax Plant Community or the Mixed Sagebrush/Grass Plant Community is limiting. Generally, these are not target plant communities for wildlife habitat management.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
(lb./ac) (AUM/ac)
Historic Climax Plant Community 450-1200 .2
Heavy Sagebrush 450-900 .17
Mixed Sagebrush/Grass 450-1000 .17
Blue Grama Sod 400-800 .1

* - Continuous, season-long grazing by cattle under average growing conditions.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Plant Preference by Animal Kind

Animal kind: All antelope

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	*Achillea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	*Achnatherum hymenoides*	Leaves	N	N	N	P	P	P	N	N	N	D	D	D
textile onion	*Allium textile*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	*Andropogon gerardii*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand bluestem	*Andropogon hallii*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rosy pussytoes, rose pussytoes	*Antennaria rosea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	*Artemisia cana*	Leaves	P	P	P	P	P	P	P	P	P	P	P	P
tarragon, green sagewort	*Artemisia dracunculus*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	*Artemisia frigida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	*Artemisia pedatifida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	*Aristida purpurea var. longiseta*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	*Artemisia tridentata*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
twogrooved milkvetch	*Astragalus bisulcatus*	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
aster	*Aster*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	*Astragalus*	Entire plant	D	D	D	P	P	P	P	P	P	D	D	D
fourwing saltbush	*Atriplex canescens*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	*Atriplex gardneri*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	*Bouteloua curtipendula*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue grama	*Bouteloua gracilis*	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	*Bouteloua hirsuta*	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	*Buchloe dactyloides(syn)*	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	*Calamagrostis canadensis*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needleleaf sedge	*Carex duriuscula*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	*Carex filifolia*	Leaves	P	P	P	P	P	P	P	P	P	P	P	P
inland sedge	*Carex interior*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sandreed	*Calamovilfa longifolia*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
plains reedgrass	*Calamagrostis montanensis*	Leaves	D	D	D	D	D	D	D	D	D	D	D	D

spike sedge	Carex nardina	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Nebraska sedge	Carex nebrascensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Leaves	D	D	D	D	D	D	D	D	D	D	D	D
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand dropseed	Sporobolus cryptandrus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
alkali cordgrass	Spartina gracilis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D

bluebunch wheatgrass	*Pseudoroegneria spicata*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	*Puccinellia nuttalliana*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	*Ratibida columnifera*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
skunkbush sumac	*Rhus trilobata*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	*Rosa woodsii var. woodsii*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	*Salix*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	*Sarcobatus vermiculatus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	*Schizachyrium scoparium*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
alkali sacaton	*Sporobolus airoides*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	*Sporobolus cryptandrus*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
alkali cordgrass	*Spartina gracilis*	Leaves	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All cattle

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Pursh seepweed	*Suaeda calceoliformis*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	*Symphoricarpos occidentalis*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	*Thermopsis rhombifolia var. annulocarpa(syn)*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	*Triglochin*	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	*Typha angustifolia*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broadleaf cattail	*Typha latifolia*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
American vetch	*Vicia americana*	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	*Yucca glauca*	Fruits/Seeds	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All deer

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	*Achillea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
textile onion	*Allium textile*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	*Andropogon gerardii*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand bluestem	*Andropogon hallii*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rosy pussytoes, rose pussytoes	*Antennaria rosea*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
tarragon, green sagewort	*Artemisia dracunculus*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	*Artemisia frigida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	*Artemisia pedatifida*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	*Aristida purpurea var. longiseta*	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	*Artemisia tridentata*	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Wyoming big sagebrush	*Artemisia tridentata ssp. wyomingensis*	Entire plant	P	P	P	P	P	P	D	D	D	D	D	D
twogrooved milkvetch	*Astragalus bisulcatus*	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T

aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sideoats grama	Bouteloua curtipendula	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sandreed	Calamovilfa longifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Nebraska sedge	Carex nebrascensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
silverberry	Elaeagnus commutata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread,														

needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
prairie coneflower	Ratibida	Entire plant	D	D	D	P	P	P	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
sand dropseed	Sporobolus cryptandrus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
alkali cordgrass	Spartina gracilis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	Artemisia cana ssp. cana	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	U	U	U	N	N	N	N	N	N	U	U	U
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	D	D	D	U	U	U	U	U	U	D	D	D
sideoats grama	Bouteloua curtipendula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U

white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bluebells	Mertensia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
willow	Salix	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
greasewood	Sarcobatus vermiculatus	Leaves	U	U	U	U	U	U	U	U	U	U	U	U

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue-eyed grass	Sisyrinchium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
alkali sacaton	Sporobolus airoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: all horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
alkali cordgrass	Spartina gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All horses

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broadleaf cattail	Typha latifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Animal kind: All sheep

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	O	N	D
yarrow	Achillea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
textile onion	Allium textile	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
big bluestem	Andropogon gerardii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand bluestem	Andropogon hallii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
rosy pussytoes, rose pussytoes	Antennaria rosea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
silver sagebrush	Artemisia cana	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
tarragon, green sagewort	Artemisia dracunculus	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie sagewort, fringed sagewort	Artemisia frigida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
birdfoot sagebrush	Artemisia pedatifida	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Fendler threeawn, red threeawn	Aristida purpurea var. longiseta	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
big sagebrush	Artemisia tridentata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Wyoming big sagebrush	Artemisia tridentata ssp. wyomingensis	Entire plant	P	P	P	D	D	D	D	D	D	P	P	P
twogrooved milkvetch	Astragalus bisulcatus	Entire plant	N	N	N	T	T	T	T	T	T	T	T	T
aster	Aster	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
milkvetch	Astragalus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
fourwing saltbush	Atriplex canescens	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Gardner's saltbush	Atriplex gardneri	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue grama	Bouteloua gracilis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
hairy grama	Bouteloua hirsuta	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
buffalograss	Buchloe dactyloides(syn)	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluejoint, bluejoint reedgrass	Calamagrostis canadensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
needleleaf sedge	Carex duriuscula	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
threadleaf sedge	Carex filifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
inland sedge	Carex interior	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
prairie sandreed	Calamovilfa longifolia	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
plains reedgrass	Calamagrostis montanensis	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
spike sedge	Carex nardina	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Nebraska sedge	Carex nebrascensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush, green rabbitbrush, low rabbitbrush, Douglas rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
water hemlock	Cicuta	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
poison hemlock	Conium maculatum	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
tapertip hawksbeard	Crepis acuminata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
white prairie clover	Dalea candida	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
violet prairie clover, purple prairie clover	Dalea purpurea	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
tufted hairgrass	Deschampsia caespitosa(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

inland saltgrass	Distichlis spicata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
bearded wheatgrass	Elymus caninus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Canada wildrye	Elymus canadensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
silverberry	Elaeagnus commutata	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
squirreltail, bottlebrush squirreltail	Elymus elymoides ssp. elymoides	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
streambank wheatgrass, thickspike wheatgrass	Elymus lanceolatus ssp. lanceolatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
slender wheatgrass	Elymus trachycaulus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
horsetail	Equisetum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
rubber rabbitbrush	Ericameria nauseosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
sulphur-flower buckwheat	Eriogonum umbellatum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
scarlet beeblossom, scarlet gaura	Gaura coccinea	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American licorice	Glycyrrhiza lepidota	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broom snakeweed	Gutierrezia sarothrae	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
stemless mock goldenweed	Haplopappus acaulis(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread, needleandthread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
iris	Iris	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Baltic rush	Juncus balticus(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Rocky Mountain juniper	Juniperus scopulorum	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie Junegrass	Koeleria macrantha	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
winterfat	Krascheninnikovia lanata	Entire plant	P	P	P	D	D	D	D	D	D	P	P	P
basin wildrye	Leymus cinereus	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
desertparsley, biscuitroot	Lomatium	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
bluebells	Mertensia	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains muhly, stoneyhills muhly	Muhlenbergia cuspidata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
mat muhly	Muhlenbergia richardsonis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
green needlegrass	Nassella viridula	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
large Indian breadroot, breadroot scurfpea	Pediomelum esculentum	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
ponderosa pine	Pinus ponderosa	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
Sandberg bluegrass	Poa canbyi(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Cusick's bluegrass, Cusick bluegrass	Poa cusickii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
plains cottonwood	Populus deltoides ssp. monilifera	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass, big bluegrass, Canby bluegrass, alkali														

bluegrass	Poa secunda	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Sandberg bluegrass	Poa secunda ssp. juncifolia(syn)	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
bluebunch wheatgrass	Pseudoroegneria spicata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Nuttall's alkaligrass	Puccinellia nuttalliana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
upright prairie coneflower, prairie coneflower	Ratibida columnifera	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
skunkbush sumac	Rhus trilobata	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Woods' rose	Rosa woodsii var. woodsii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
willow	Salix	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
greasewood	Sarcobatus vermiculatus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
little bluestem	Schizachyrium scoparium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
blue-eyed grass	Sisyrinchium	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
sand dropseed	Sporobolus cryptandrus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
Pursh seepweed	Suaeda calceoliformis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
western snowberry	Symphoricarpos occidentalis	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
prairie thermopsis	Thermopsis rhombifolia var. annulocarpa(syn)	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
arrowgrass	Triglochin	Entire plant	T	T	T	T	T	T	T	T	T	T	T	T
narrowleaf cattail	Typha angustifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
broadleaf cattail	Typha latifolia	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
American vetch	Vicia americana	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
soapweed yucca, small soapweed	Yucca glauca	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Legend: P=Preferred; D=Desirable; U=Undesirable; N=Not consumed; E=Emergency; T=Toxic; X=Used, but degree of utilization unknown

Hydrology Functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B and C, with localized areas in hydrologic group D. Infiltration ranges from moderate to moderately rapid. Runoff potential for this site varies from moderate to high depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses such as bluebunch wheatgrass. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational Uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an esthetic value that appeals to visitors.

Wood Products

No appreciable wood products are present on the site.

Other Products

None noted.

Supporting Information

Associated Sites

Site name	Site ID	Site narrative
Shallow Clayey (SwCy) 10-14" Northern Plains Precipitation Zone	R058BY158WY	

Similar Sites

Site name	Site ID	Site narrative
Shallow Loamy (SwLy) 15-17" Northern Plains Precipitation Zone	R058BY262WY	Shallow Loamy 15-17" Northern Plains P.Z. has higher production.

State Correlation

This site has been correlated with the following states: **MT**

Inventory Data References

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel was also used. Those involved in developing this site include: Glen Mitchell, Range Management Specialist, NRCS; Chuck Ring, Range Management Specialist, NRCS; and Everet Bainter, Range Management Specialist. Other sources used as references include: USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, and USDA NRCS Soil Surveys from various counties.

Inventory Data References
Data Source Number of Records Sample Period State County
SCS-RANGE-417 12 1971-1994 WY Campbell & others
Ocular estimates 5 1990-1999 WY Campbell & others

Original Site Description Approval

Author	Date	Approval	Date
G. Mitchell	10/31/2002	E. Bainter	3/7/2008

Reference Sheet

Author(s)/participant(s):

Contact for lead author:

Date: 4/1/2005 **MLRA:** 058B **Ecological Site:** Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation ZoneR058BY162WY This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: XAnnual Production, Foliar Cover, Biomass

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Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural disturbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

1. **Number and extent of rills:** Rills should not be present.

2. **Presence of water flow patterns:** Barely observable.

3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** Bare ground is 40-60% occurring in small areas throughout site.

5. **Number of gullies and erosion associated with gullies:** Active gullies should be restricted to areas of concentrated water flow
patterns on steeper slopes.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Small scoured sites may be observed.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is little to none based on topography and water flow patterns.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and litter is at 50% or greater of soil surface and maintains soil surface
integrity. Soil Stability class is anticipated to be 4 or greater.

9. **Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness):** Use Soil Series description for depth and color of A-horizon.

10. **Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Grass canopy and basal cover should reduce raindrop impact and slow overland flow providing increased time for infiltration to occur. Infiltration is moderate.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer or soil surface crusting should be present.

12. **Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    Dominant: Mid stature Cool Season Grasses > Short Grasses/Grasslikes > Mid
Stature Warm Season Grasses > Shrubs > Forbs
    Sub-dominant:
    Other:
    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very Low

14. **Average percent litter cover (%) and depth (inches):** Average litter cover is 15-25% with depths of 0.25 to 0.5 inches

15. **Expected annual production (this is TOTAL above-ground production, not just forage production):** 900 lbs/ac

16. **Potential invasive (including noxious) species (native and non-native). List Species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicator, we are describing what is NOT expected in the reference state for the ecological site:** Blue grama, Threadleaf sedge, Prickly Pear, Broom Snakeweed, and Species found on Noxious
Weed List.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing.

Reference Sheet Approval:

Approval	Date
E. Bainter	3/7/2008

APPENDIX H

NATURAL RESOURCES CONSERVATION SERVICE NETWORK EFFECTS DIAGRAMS

nrcs_314_brush_management_NED

nrcs_338_prescribed_burning_NED

nrcs_348_diversion_dam_NED

nrcs_378_pond_NED

nrcs_382_fence_NED

nrcs_391_riparian_forest_buffer_NED

nrcs_396_fish_passage_NED

nrcs_430_irrigation_water_conveyance_pipeline_NED

nrcs_449_irrigation_water_management_NED

nrcs_516_livestock_water_pipeline_NED

nrcs_528_prescribed_grazing_NED

nrcs_533_pumping_plant_NED

nrcs_550_range_planting_NED

nrcs_574_spring_development_NED

nrcs_580_streambank_protection_NED

nrcs_587_structure_water_control_NED

nrcs_612_tree_shrub_establishment_NED

nrcs_614_watering_facility_NED

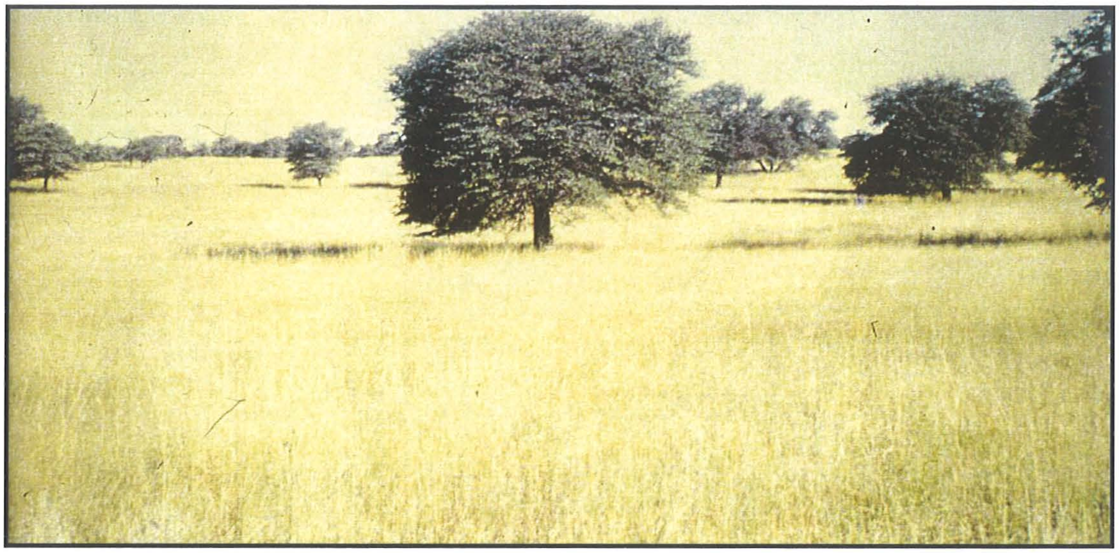
nrcs_642_water_well_NED

nrcs_659_wetland_enhancement_NED

BRUSH MANAGEMENT

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 314



BRUSH MANAGEMENT

Brush management is the removal, reduction, or manipulation of tree and shrub species.

PRACTICE INFORMATION

Brush management is designed to achieve the optimum level of control of the target woody species and protection of the desired species. This is accomplished by mechanical, chemical, biological, or a combination of these techniques. The practice is also planned and applied to meet the habitat requirements of fish and wildlife.

Brush management is applied to accomplish one or more of the following:

- Restore natural plant community balance
- Create the desired plant community
- Reduce competition for space, moisture, and sunlight to favor the desired species
- Manage noxious woody plants
- Restore vegetation to control erosion and sedimentation, improve water quality, and enhance streamflow
- Maintain or enhance wildlife habitat including habitat for threatened and endangered species
- Improve forage accessibility, quality, and quantity for domestic and wild animals
- Protect life and property from wildfire
- Improve visibility and access for handling livestock

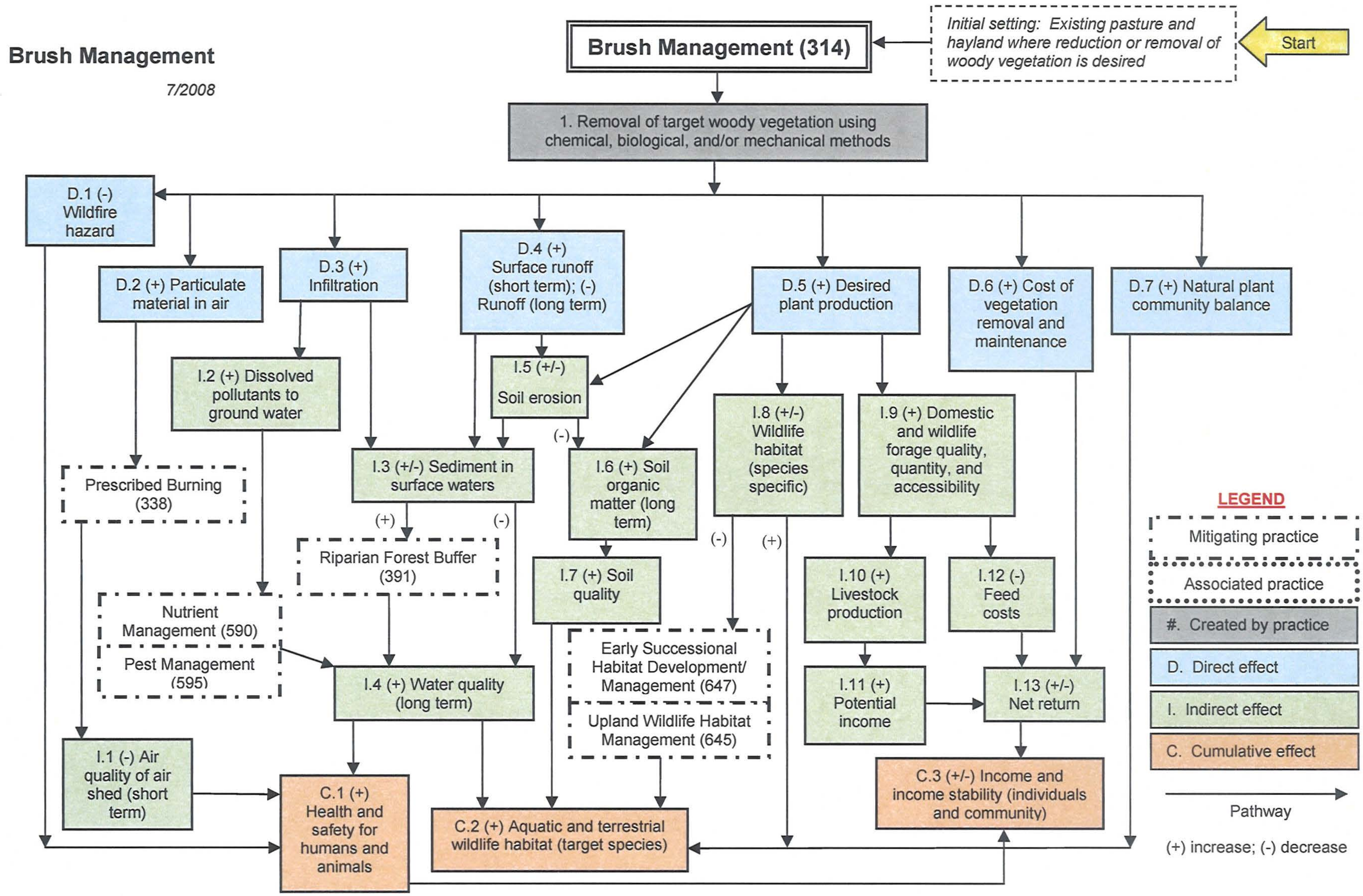
COMMON ASSOCIATED PRACTICES

Brush Management is commonly used in a Conservation Management System with the following practices:

- Pest Management (595)
- Prescribed Grazing (528)

Refer to the practice standard in the local Field Office Technical Guide and associated Job Sheets for further information.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.



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July 2008

PRESCRIBED BURNING

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 338

PRESCRIBED BURNING

Prescribed burning is applying controlled fire to a predetermined area of land.

PRACTICE INFORMATION

This practice applies to all land uses for the following purposes:

- Control undesirable vegetation
- Prepare sites for planting or seeding
- Control plant diseases
- Reduce wildfire hazards
- Improve wildlife habitat
- Improve forage quantity and quality
- Slash and debris removal following forest management activities
- Enhance seed/seedling production
- Facilitate distribution of grazing and browsing animals

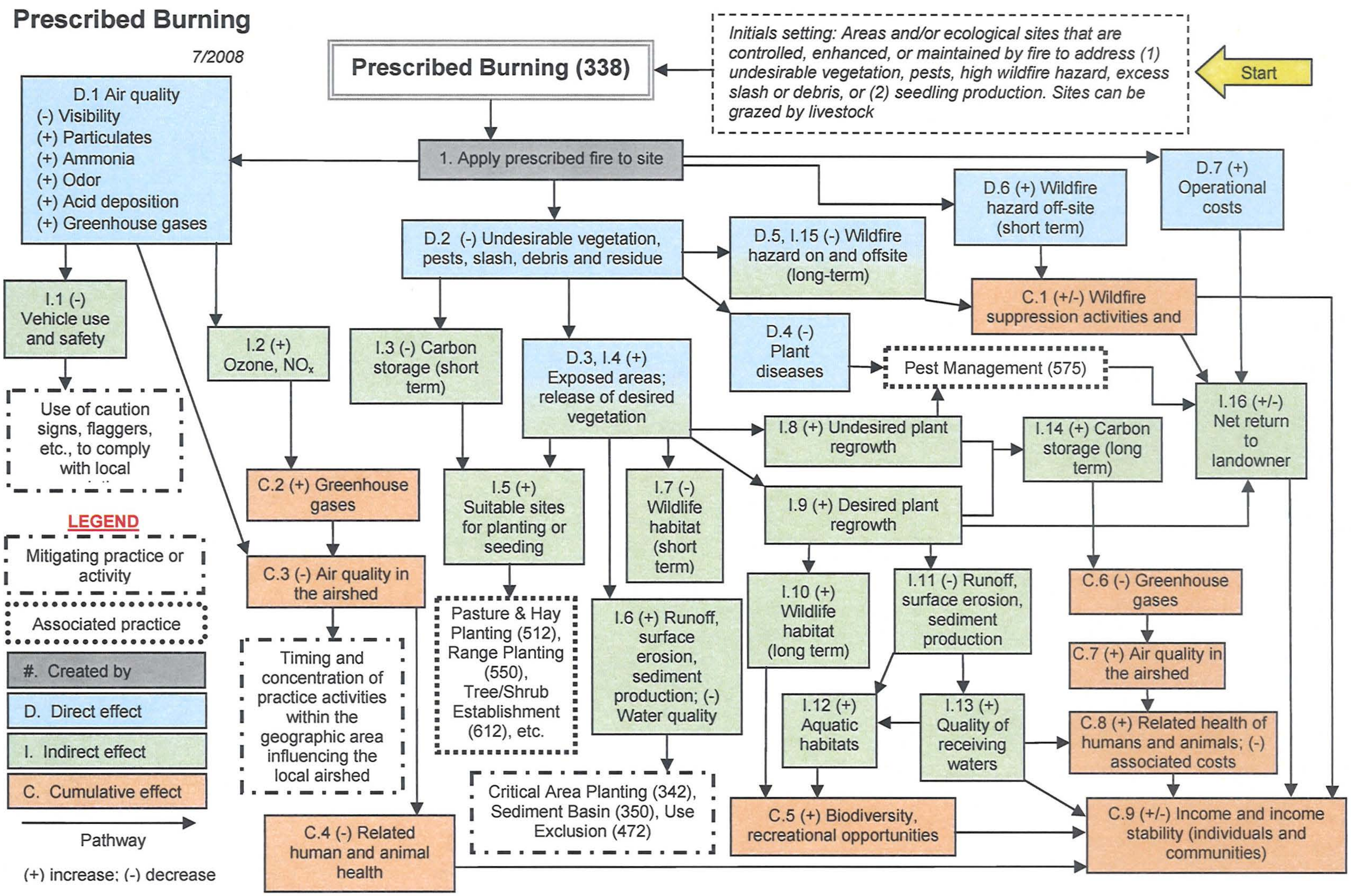
This is a highly specialized practice that requires intensive training and sufficient support personnel and equipment. A safe successful burn must be timed for proper humidity, wind conditions, air temperature, and fuel conditions (ignitable vegetation). Safety precautions are carefully planned before the burn and monitored during the burn. Existing barriers, such as streams, lakes, roads, wetlands, and constructed firebreaks, are important considerations in planning the practice.

COMMON ASSOCIATED PRACTICES

Prescribed Burning is commonly used in a Conservation Management System with practices such as Forest Stand Improvement (666), Forest Trails and Landings (655), Pest Management (595), and other associated harvesting, planting, and seeding practices and activities.

For more information, refer to the practice standard in the NRCS Field Office Technical Guide and associated specifications and design criteria.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.



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Dam, Diversion

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service - practice code 348

DEFINITION

A diversion dam is a structure built to divert all or part of the water from a watercourse into another watercourse for conservation purposes.

PRACTICE INFORMATION

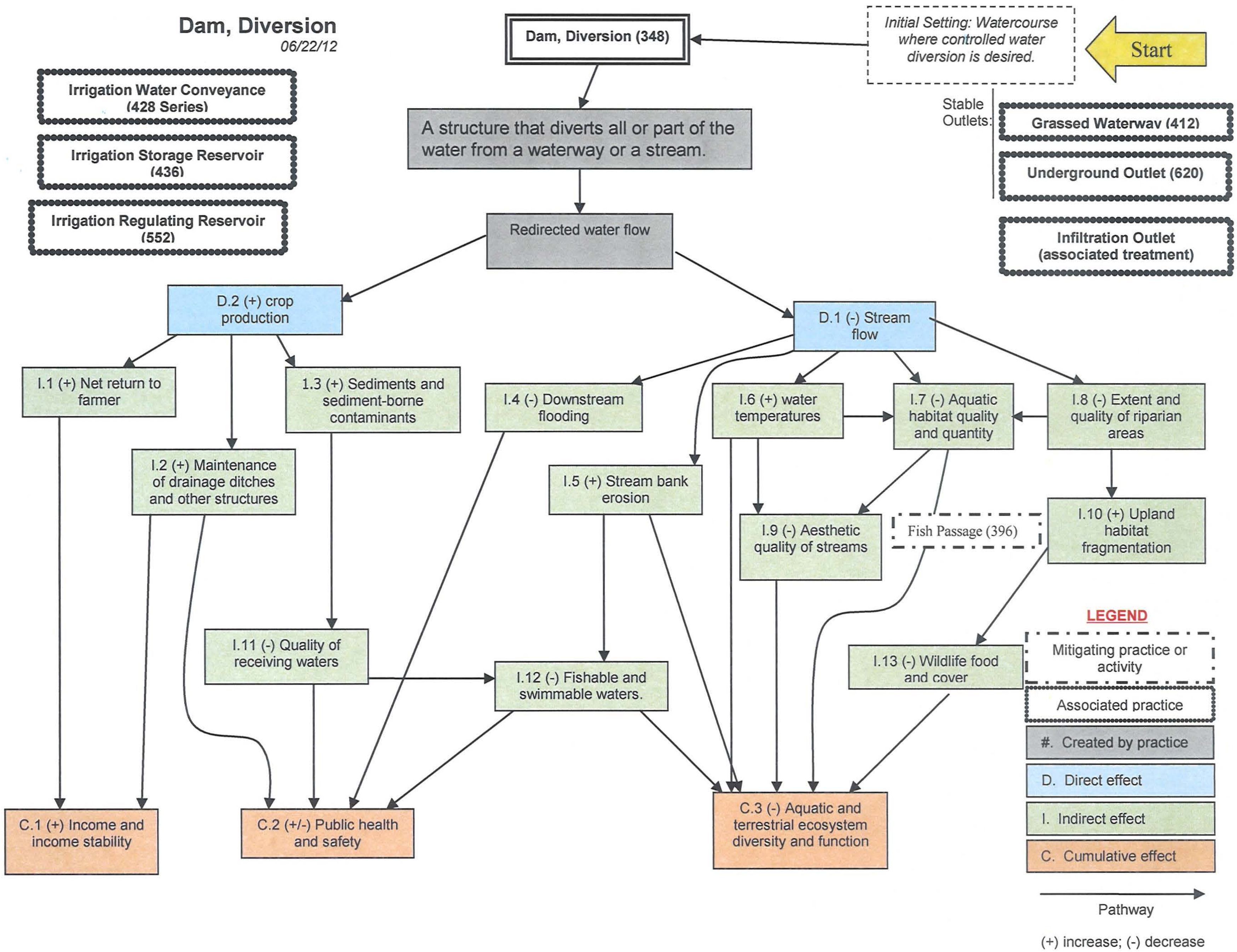
A diversion dam is designed to divert water from a watercourse such as a waterway or stream into another watercourse, irrigation canal, stream, water-spreading system, or another waterway.

The purpose of the practice is to improve the beneficial use of water, or divert damaging flows to another watercourse that is more stable or otherwise more capable of reducing damage. One of the more common uses of this practice is diverting water from a stream or river into a canal used for irrigation purposes.

The impacts of a proposed diversion dam are evaluated to assure water quality, fish and wildlife, aesthetics, and other environmental concerns are considered in the design and layout of the structure (s).

The practice is also carefully evaluated to assure compliance with state and local laws concerning natural watercourses.

Additional information including design criteria and specifications are in the local NRCS Field Office Technical Guide.

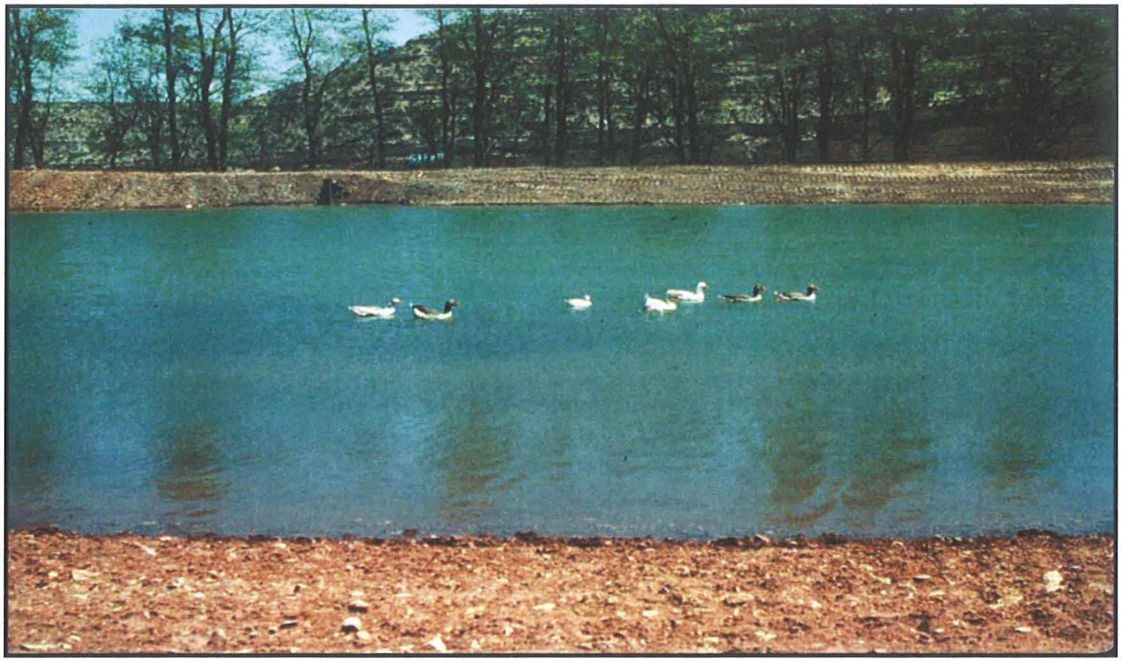

Dam, Diversion
06/22/12
Irrigation Water Conveyance (428 Series)
Irrigation Storage Reservoir (436)
Irrigation Regulating Reservoir (552)
Dam, Diversion (348)
Initial Setting: Watercourse where controlled water diversion is desired.
Start
A structure that diverts all or part of the water from a waterway or a stream.
Stable Outlets:
Grassed Waterway (412)
Underground Outlet (620)
Infiltration Outlet (associated treatment)
Redirected water flow
D.2 (+) crop production
D.1 (-) Stream flow
I.1 (+) Net return to farmer
I.3 (+) Sediments and sediment-borne contaminants
I.4 (-) Downstream flooding
I.6 (+) water temperatures
I.7 (-) Aquatic habitat quality and quantity
I.8 (-) Extent and quality of riparian areas
I.2 (+) Maintenance of drainage ditches and other structures
I.5 (+) Stream bank erosion
I.9 (-) Aesthetic quality of streams
Fish Passage (396)
I.10 (+) Upland habitat fragmentation
I.11 (-) Quality of receiving waters
I.12 (-) Fishable and swimmable waters.
I.13 (-) Wildlife food and cover
C.1 (+) Income and income stability
C.2 (+/-) Public health and safety
C.3 (-) Aquatic and terrestrial ecosystem diversity and function
LEGEND
Mitigating practice or activity
Associated practice
#. Created by practice
D. Direct effect
I. Indirect effect
C. Cumulative effect
Pathway
(+) increase; (-) decrease

August 2008

POND

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 378



POND

A pond is a water impoundment made by constructing a dam or excavating a pit or dugout.

PRACTICE INFORMATION

If a dam is constructed, the pond is referred to as an embankment pond; if the pond storage is achieved solely by excavating material, the pond is referred to as an excavated pond.

The purpose of this type of pond is to provide water for livestock, recreation, and fish and wildlife. Other uses include providing a water supply for things such as fire control and crop or orchard spraying.

The Pond practice standard applies where failure will not result in loss of life, damage to homes, commercial buildings, main highways, railroads, or interruption of public utilities; the product of the storage (acre/feet) times the effective height of the dam is less than 3,000 and the effective height of the dam is 35 feet or less.

The site must be such that runoff from the design storm can pass safely through a natural or constructed spillway. The drainage area must be protected from erosion that would significantly reduce the expected life of the structure and be large enough so that surface runoff and ground water flow will normally maintain an adequate supply of water in the pond. The water quality must be suitable for the intended use of the water.

COMMON ASSOCIATED PRACTICES

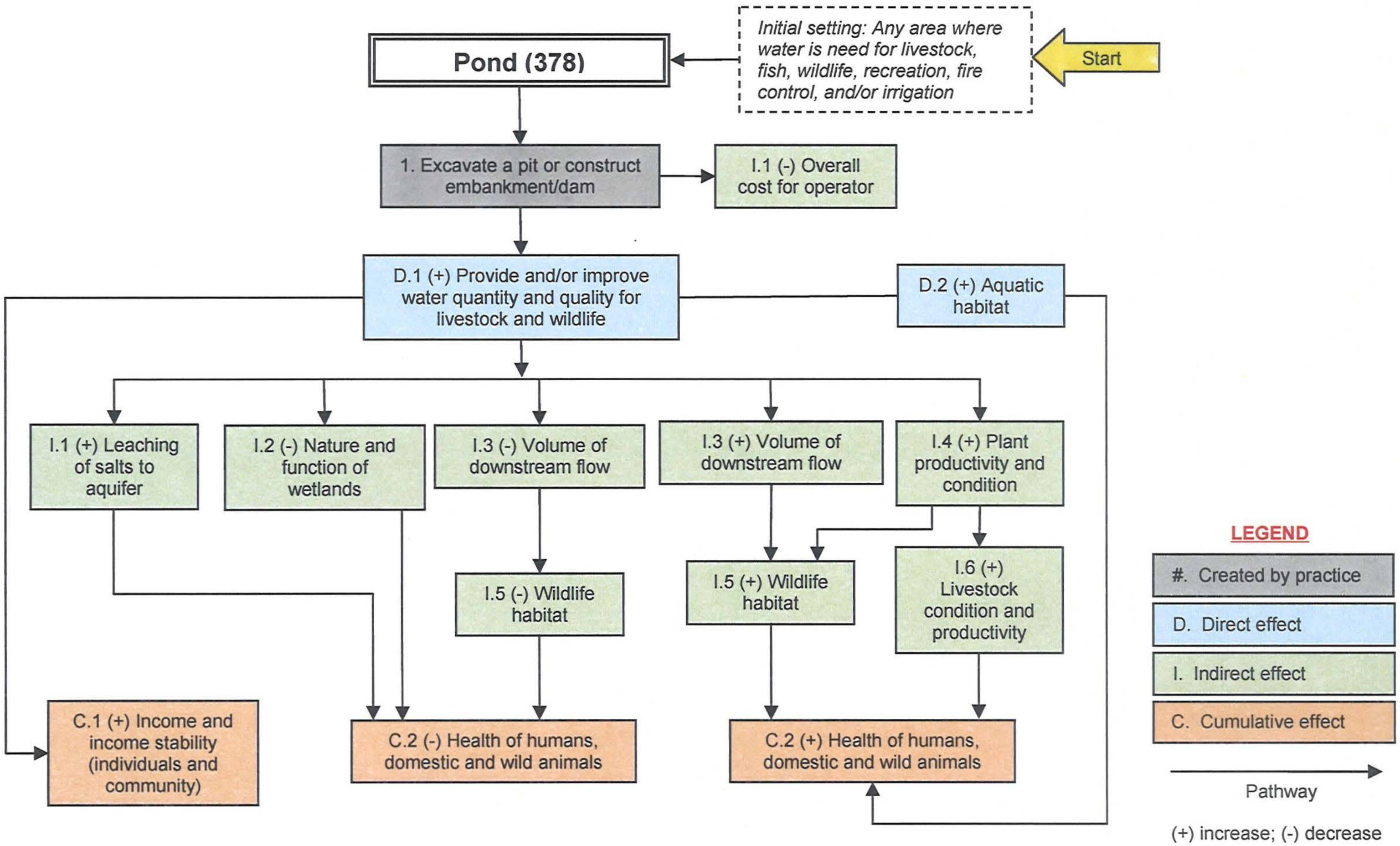
Pond is commonly planned as part of a Conservation Management System with Prescribed Grazing (528), Fence (382), Access Control (472), and Critical Area Planting (342).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated practice specifications and job sheets.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowner and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Pond (378)

5/2002



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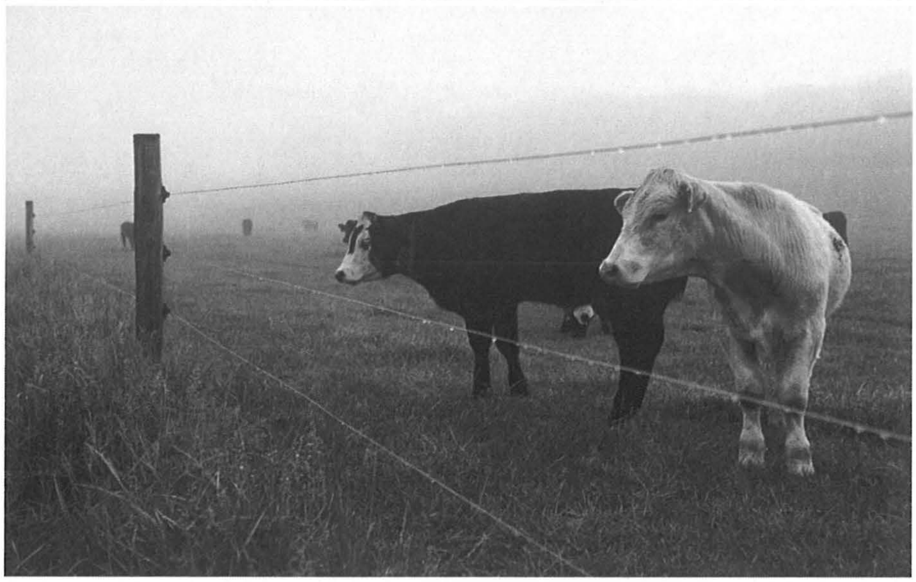
FENCE

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 382



FENCE

A fence is a constructed barrier to animals or people.

PRACTICE INFORMATION

This practice may be applied to any area where management of animal or human movement is needed.

A wide variety of types of fencing has developed. However, fencing type, materials and construction quality is always designed and installed to assure the fence will meet the intended purpose and longevity requirements of the project.

A standard fence is constructed of either barbed or smooth wire suspended by posts with support structures. Other types include woven wire, electric fence, and suspension fences which are designed with heavy, but widely spaced posts and support structures. Designs for many types of fences are available at the local NRCS field office.

Things to consider when planning a fence include:

- Topography. For ease of maintenance, avoid as much irregular terrain as possible
- Animal and human movement needs and safety
- State and local laws that may apply to boundary fences
- Animal handling, watering, and feeding requirements
- Soil erosion potential and feasibility of fence construction when planning fences on steep or irregular terrain

COMMON ASSOCIATED PRACTICES

Fence is commonly used in a Conservation Management System with the following practices:

- Prescribed Grazing (528)
- Access Control (472)

Refer to the practice standard in the local Field Office Technical Guide and associated Job Sheets for further information.

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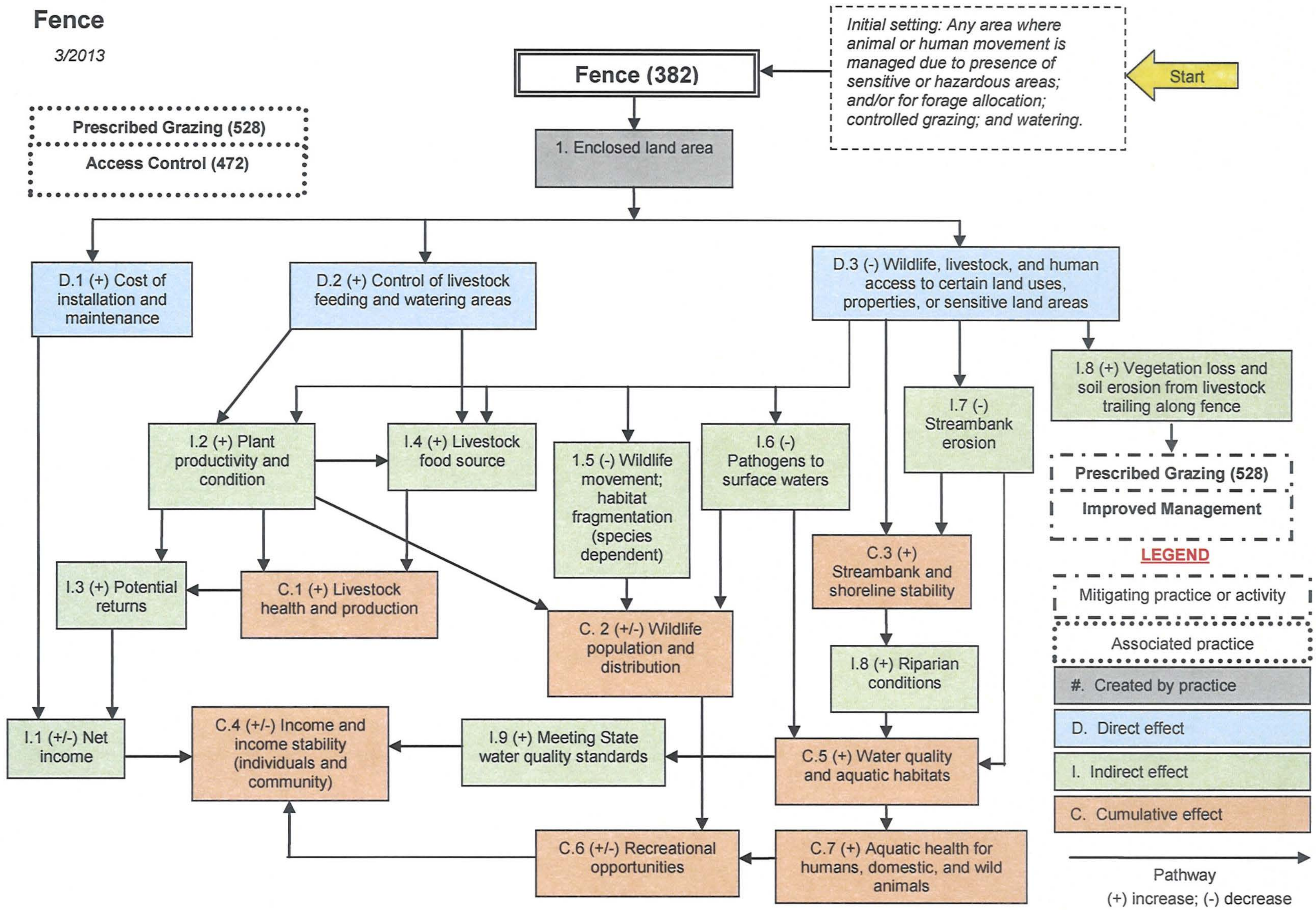

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July 2008

RIPARIAN FOREST BUFFER

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 391

RIPARIAN FOREST BUFFER

A riparian forest buffer is an area of trees and/or shrubs located adjacent to a body of water. The vegetation extends outward from the water body for a specified distance necessary to provide a minimum level of protection and/or enhancement.

PRACTICE INFORMATION

This practice applies to areas adjacent to permanent or intermittent streams, lakes, ponds, wetlands, and areas associated with ground water recharge.

The riparian forest buffer is a multi-purpose practice design to accomplish one or more of the following:

- Create shade to lower water temperatures and improve habitat for aquatic animals
- Provide a source of debris necessary for healthy robust populations of aquatic organisms and wildlife
- Act as a buffer to filter out sediment, organic material, fertilizer, pesticides, and other pollutants that may adversely impact the water body, including shallow ground water

Dominant vegetation consists of existing or planted trees and shrubs suited to the site and purpose(s) of the practice. Grasses and forbs that come in naturally further enhance the wildlife habitat and filtering effect of the practice. Headcuts and streambank erosion should be assessed and treated appropriately before establishing the riparian forest buffer. Specifications for each installation are based on a thorough field investigation of each site.

COMMON ASSOCIATED PRACTICES

Riparian Forest Buffer is commonly used in Conservation Management Systems on a variety of land uses. Associated practices may include Riparian Herbaceous Cover (390), Stream Habitat Improvement and Management (395), Streambank and Shoreline Protection (580), and Tree/Shrub Establishment (612).

Refer to the practice standard in the local Field Office Technical Guide and associated specifications and Job Sheets for further information.

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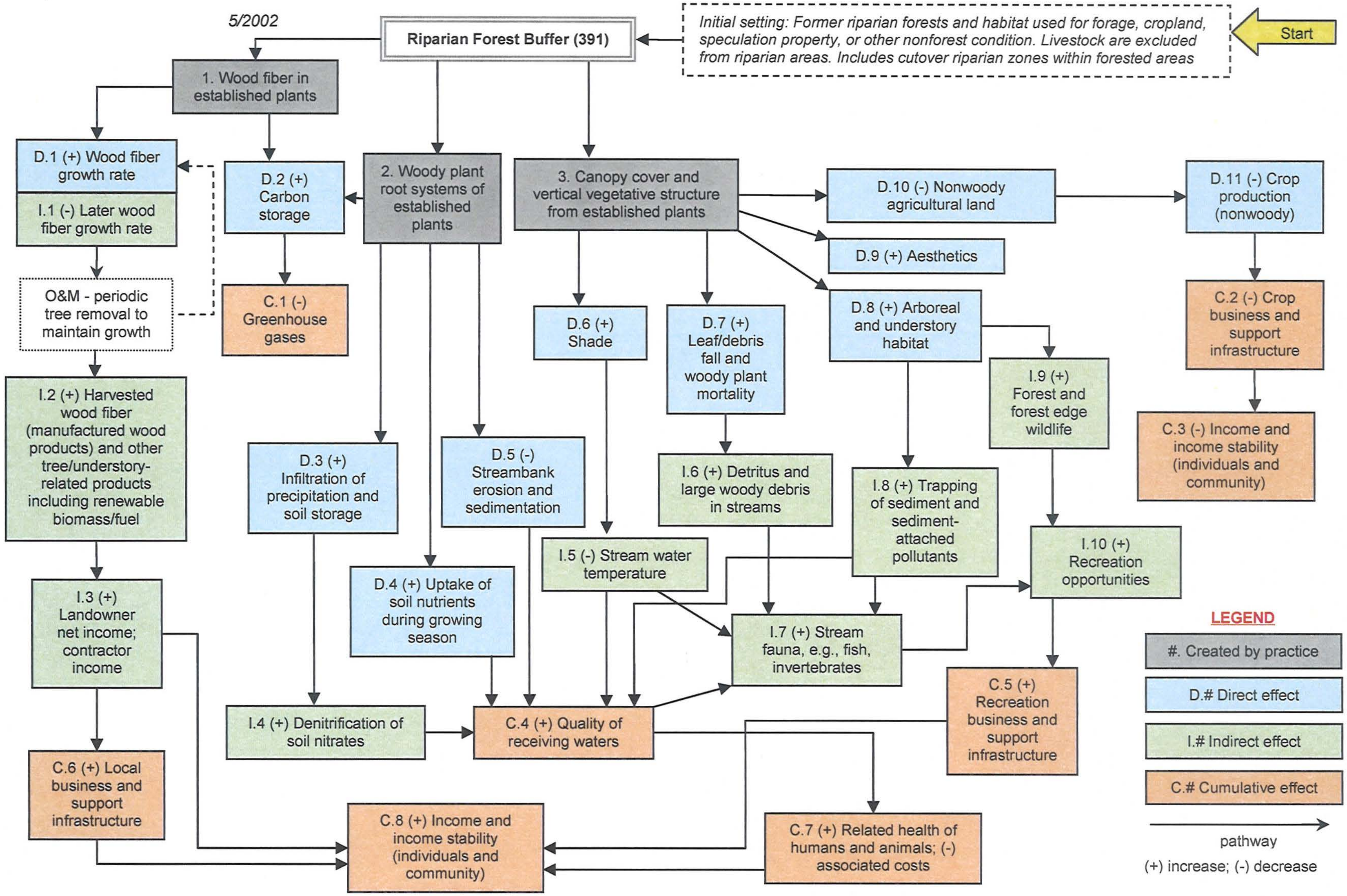
Riparian Forest Buffer



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July 2008

FISH PASSAGE

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 396

FISH PASSAGE

Fish passage is the modification or removal of barriers that restrict or prevent movement or migration of fish. A fish passage allows fish to move upstream and downstream.

PRACTICE INFORMATION

The purpose of this practice is to allow upstream and downstream movement of fish past barriers where feasible or desirable.

This practice applies to all rivers, streams, and outlets of ponds or lakes where barriers impede desired fish passage. Modification or removal of barriers, particularly on large river systems, may significantly affect hydrology, for example, by creating impoundments or increasing seasonal inundation in the flood plain.

The context and intensity of these impacts must be considered when planning any project involving a fish passage.

COMMON ASSOCIATED PRACTICES

Fish Passage is commonly used in a Conservation Management System with the following practices:

- Obstruction Removal (500)
- Riparian Forest Buffer (391)
- Streambank and Shoreline Protection (580)
- Stream Habitat Improvement Management (395)

Refer to the practice standard in the local Field Office Technical Guide and associated Job Sheets for further information.

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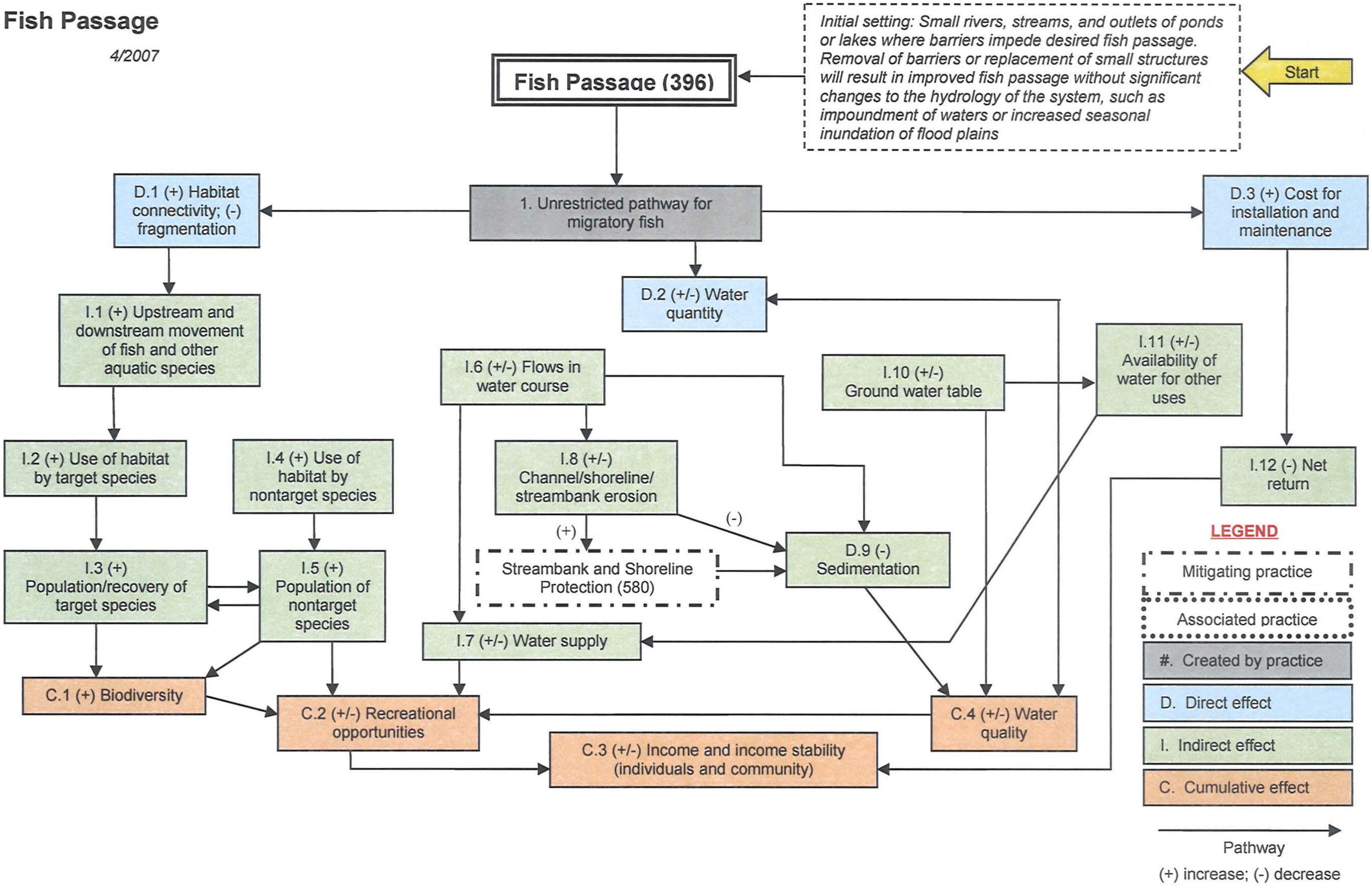
Fish Passage

4/2007



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The scope of the practice implementation and resulting effects are limited to those described in the "initial setting." Projects involving larger river systems, impoundment of waters, increased seasonal inundation of flood plains, or any other changes to the hydrologic system may need to be evaluated in a site-specific EA.

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August 2008

IRRIGATION WATER CONVEYANCE—PIPELINE

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 430 (AA–GG)

IRRIGATION WATER CONVEYANCE—PIPELINE

Irrigation water conveyance includes pipelines and appurtenances installed as an integral part of an irrigation system.

PRACTICE INFORMATION

The purpose of this practice is to efficiently deliver or convey water from a source of supply to points of application or storage to facilitate management of irrigation water. The practice reduces erosion, conserves water, and protects water quality. Underground pipelines serve as an integral part of the irrigation water distribution system and significantly improve the overall efficiency of the system.

The practice standard applies to water conveyance and distribution pipelines installed above or below ground.

This standard does not apply to multiple outlet pipes, except main line pipes that have multiple risers with distant point of discharge.

This practice requires proper design and installation to function properly.

COMMON ASSOCIATED PRACTICES

Irrigation Water Conveyance–Pipeline is commonly used in a Conservation Management System with practices such as Irrigation Water Management (449), Pumping Plant (533), Irrigation System (441, 442, 443, 447), Critical Area Planting (342), and Nutrient Management (590).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

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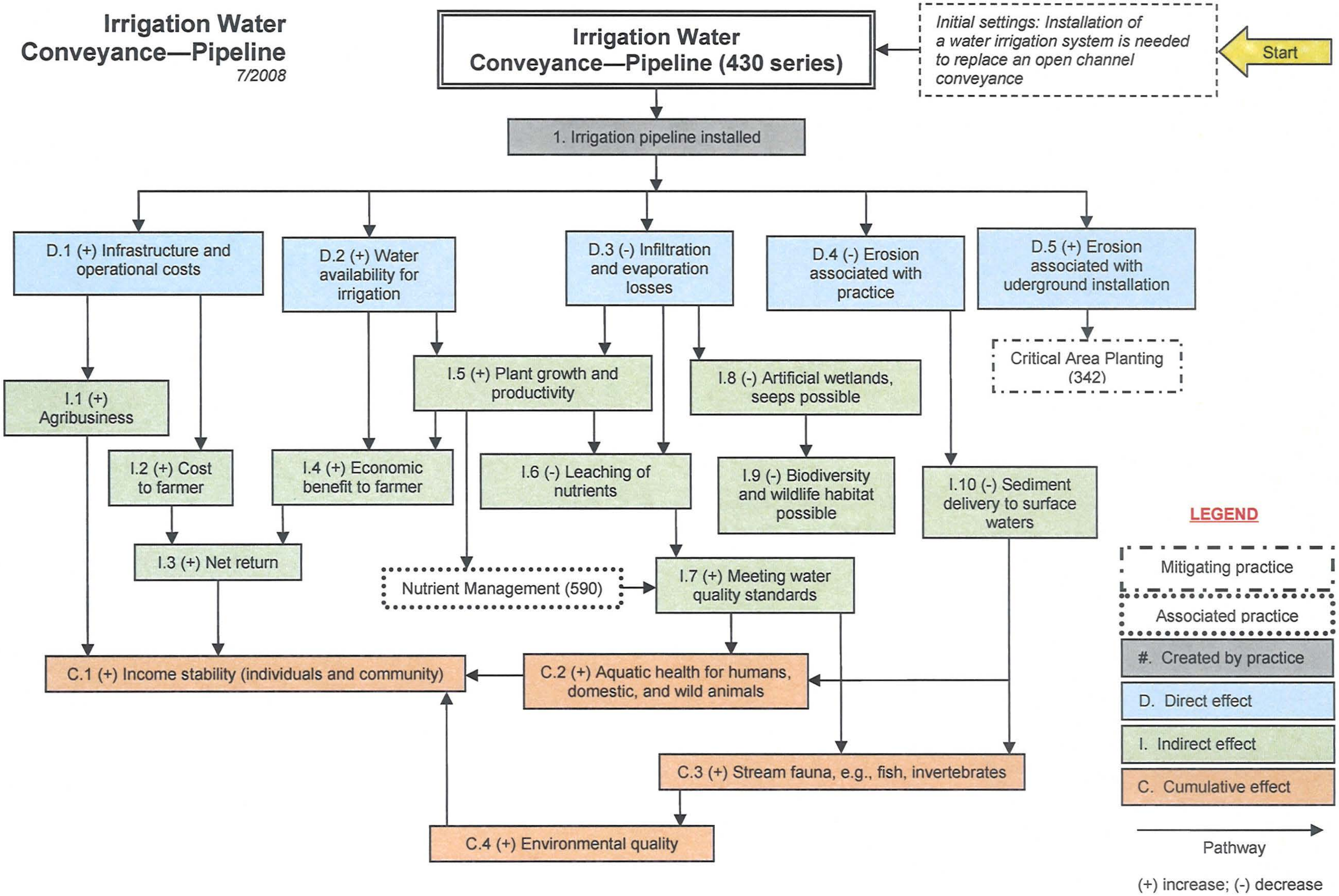
Irrigation Water Conveyance—Pipeline
7/2008



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August 2008

IRRIGATION WATER MANAGEMENT

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 449

IRRIGATION WATER MANAGEMENT

Irrigation and water management is determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner.

PRACTICE INFORMATION

The purpose of this practice is to effectively use available irrigation water in managing and controlling the moisture environment of crops and other vegetation. The objectives are to promote a desired response, minimize soil erosion, minimize loss of plant nutrients, and protect both the quantity and quality of water resources.

This practice is applicable to all areas that are suitable for irrigation and have a water supply of suitable quality and quantity. In addition, a suitable irrigation system must be available and the irrigator needs to have the knowledge and capability to manage irrigation water. The following knowledge is required to properly manage irrigation water:

- How to determine when to apply water based on the rate of use by the crops at various stages of growth
- How to measure or estimate the amount of water required for each irrigation
- The time needed for the soil to absorb the required amount of water
- How to detect changes in intake rate
- How and when to adjust stream size, application rate, and irrigation time to compensate for changes in the soil or topography that effect intake rate
- How to recognize erosion caused by irrigation
- How to evaluate the uniformity of water application

COMMON ASSOCIATED PRACTICES

Irrigation Water Management is commonly used in a Conservation Management System with practices such as Nutrient Management (590), Pest Management (595), Irrigation Water Conveyance practices, and Pumping Plant (533).

For more information, refer to the practice standard in the NRCS Field Office Technical Guide and associated specifications and design criteria.

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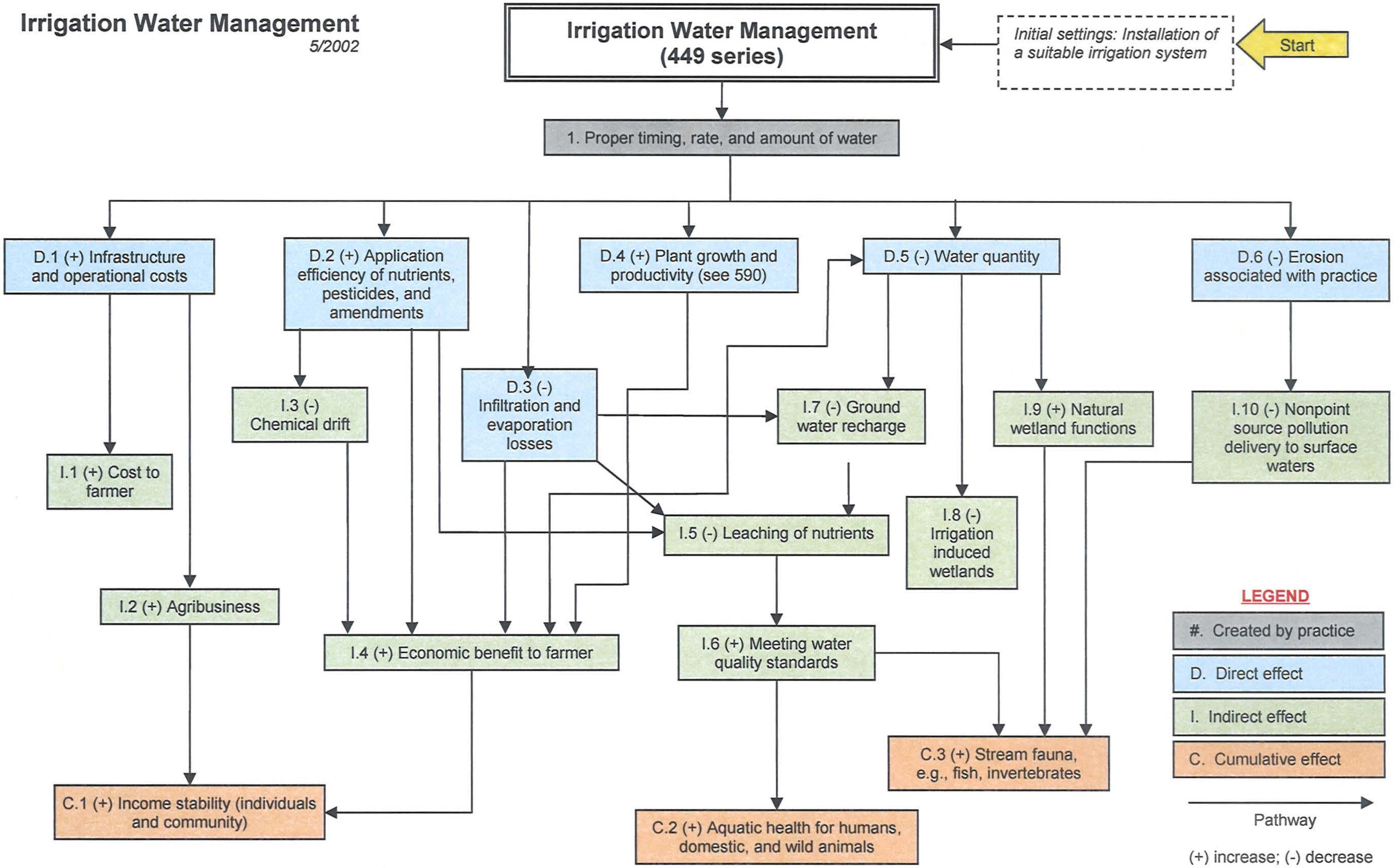
Irrigation Water Management
5/2002



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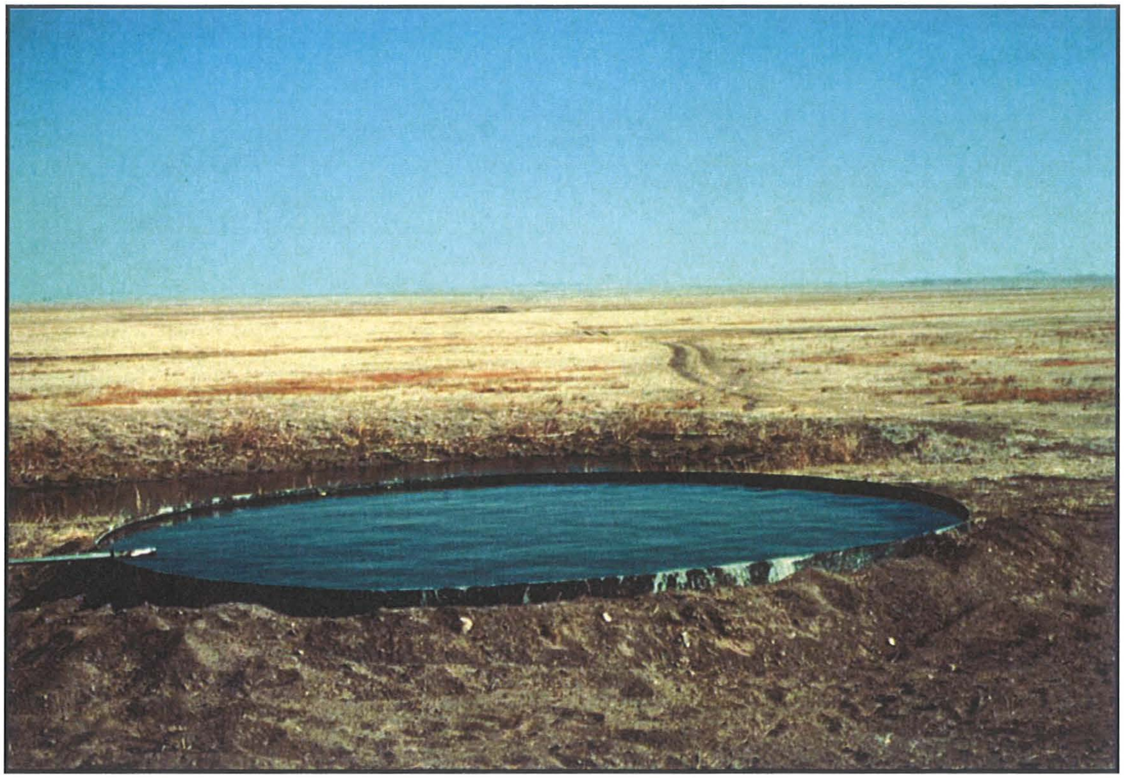
August 2008

PIPELINE

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 516



PIPELINE

The pipeline practice is used when a pipeline is needed to convey water for livestock, recreation or wildlife.

PRACTICE INFORMATION

The purpose of this practice is simply to convey water from the source of supply to the point(s) of use. The objective is usually to decentralize the location of drinking or water storage facilities. The practice is applicable where water needs to be piped to another location(s) for management purposes, to conserve the supply, or for reasons of sanitation.

Pipelines installed under this practice are generally for livestock management purposes. A single water source can provide livestock water to several locations and be very effective in improving management of a grazing unit.

Pipelines are also used on recreation and wildlife lands to provide or distribute drinking water facilities for humans as well as wildlife.

COMMON ASSOCIATED PRACTICES

Pipeline is commonly used as part of a Conservation Management System with watering practices such as Water Well (642), Spring Development (574), Pond (378), and Watering Facility (614).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

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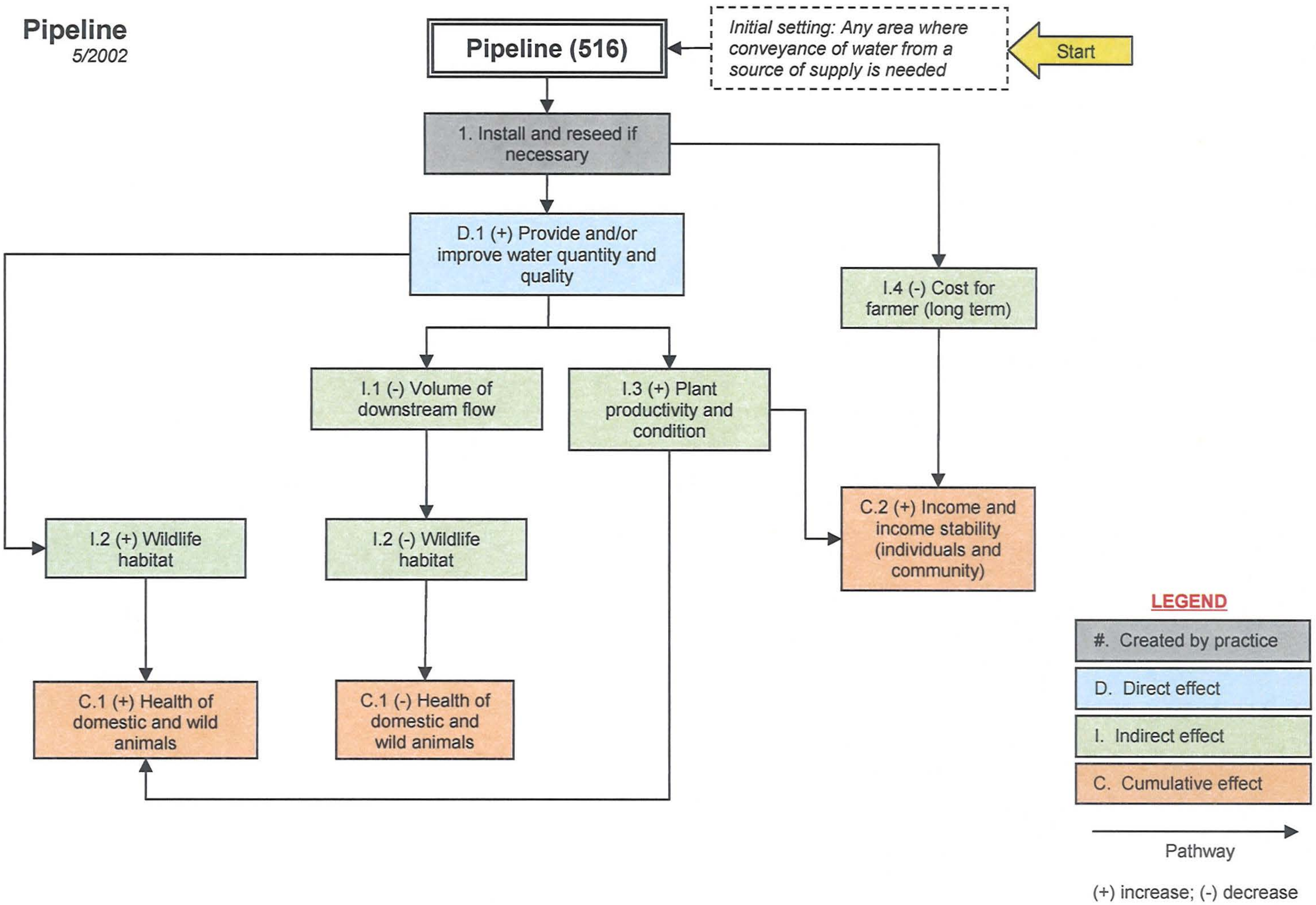

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July 2008

PRESCRIBED GRAZING

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 528

PRESCRIBED GRAZING

Prescribed grazing is the controlled harvest of vegetation with grazing animals managed with the intent to achieve a specific objective.

PRACTICE INFORMATION

Prescribed grazing may be applied on all lands where grazing and/or browsing animals are managed. A prescribed grazing schedule is prepared for all fields and pastures to be grazed. Removal of herbage by the grazing animals is in conformity with realistic yield goals, plant growth needs, and management goals. Duration and intensity of grazing is based on desired plant health and expected productivity of the forage species to meet management objectives. In all cases, enough vegetation is left to prevent accelerated soil erosion.

Application of this practice manipulates the intensity, frequency, duration, distribution, and season of grazing to:

- Improve water infiltration and use
- Maintain or improve riparian and upland area vegetation
- Protect streambanks from erosion
- Manage for uniform deposition of manure away from water bodies
- Promote ecologically and economically stable plant communities which meet landowner objectives

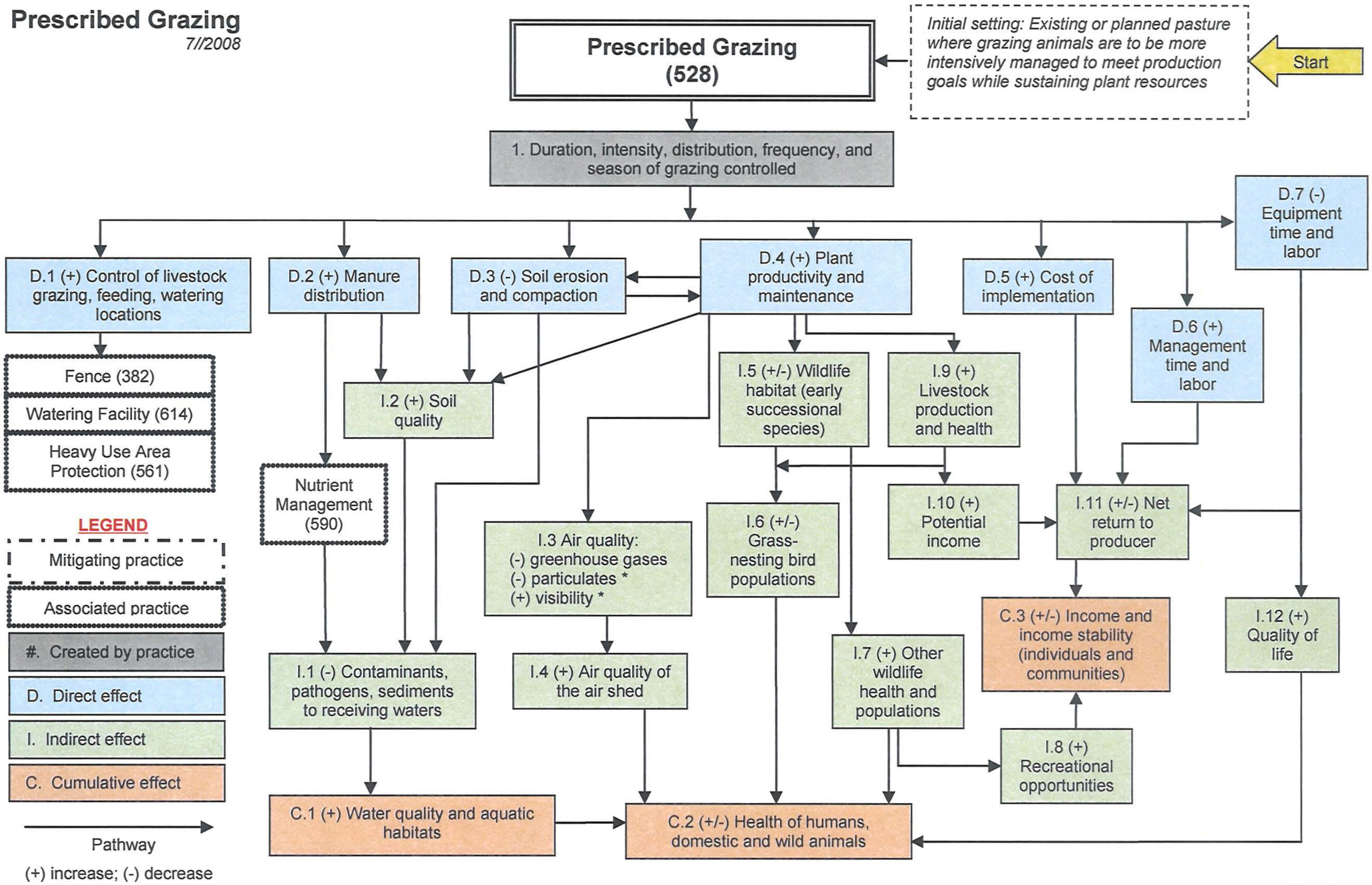
COMMON ASSOCIATED PRACTICES

Prescribed Grazing is commonly used in a Conservation Management System with the following practices: Pasture and Hay Planting (512), Feed Management (592), Fence (382), Watering Facility (614), Heavy Use Area Protection (422), Pipeline (516), Water Well (642), Pond (378), Spring Development (574), Nutrient Management (590), Pest Management (595), Use Exclusion (472), Animal Trails and Walkways (575), and Stream Crossing (589).

Refer to the practice standard in the local Field Office Technical Guide and associated specifications and Job Sheets for further information.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Prescribed Grazing
7//2008



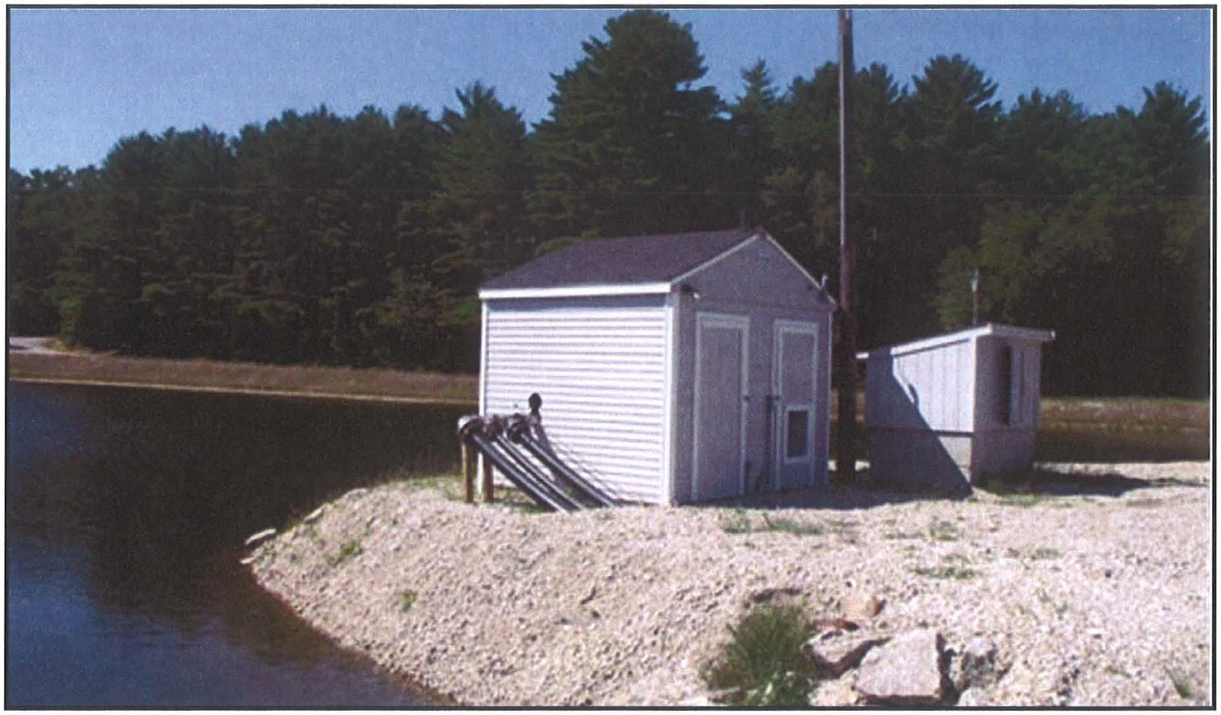
Note: Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

The diagram above identifies the effects expected to occur when this practice is applied according to NRCS practice standards and specifications. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. All income changes are partially dependent upon market fluctuations which are independent of the conservation practices. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

PUMPING PLANT

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service–Practice Code 382



PUMPING PLANT

A Pumping plant is a facility installed to transfer water for a conservation need.

PRACTICE INFORMATION

Pumping plants provide a dependable water source or disposal facility for water management. This practice applies wherever water must be pumped to accomplish a conservation objective, which may include but is not limited to:

- Water supply for irrigation, recreation, livestock, or wildlife
- Maintenance of critical water levels in swamps, marshes, open water, or for newly constructed wetlands and ponds
- Transfer of wastewater for utilization as part of a waste management system
- Facilitation of drainage by the removal of surface runoff or ground water

COMMON ASSOCIATED PRACTICES

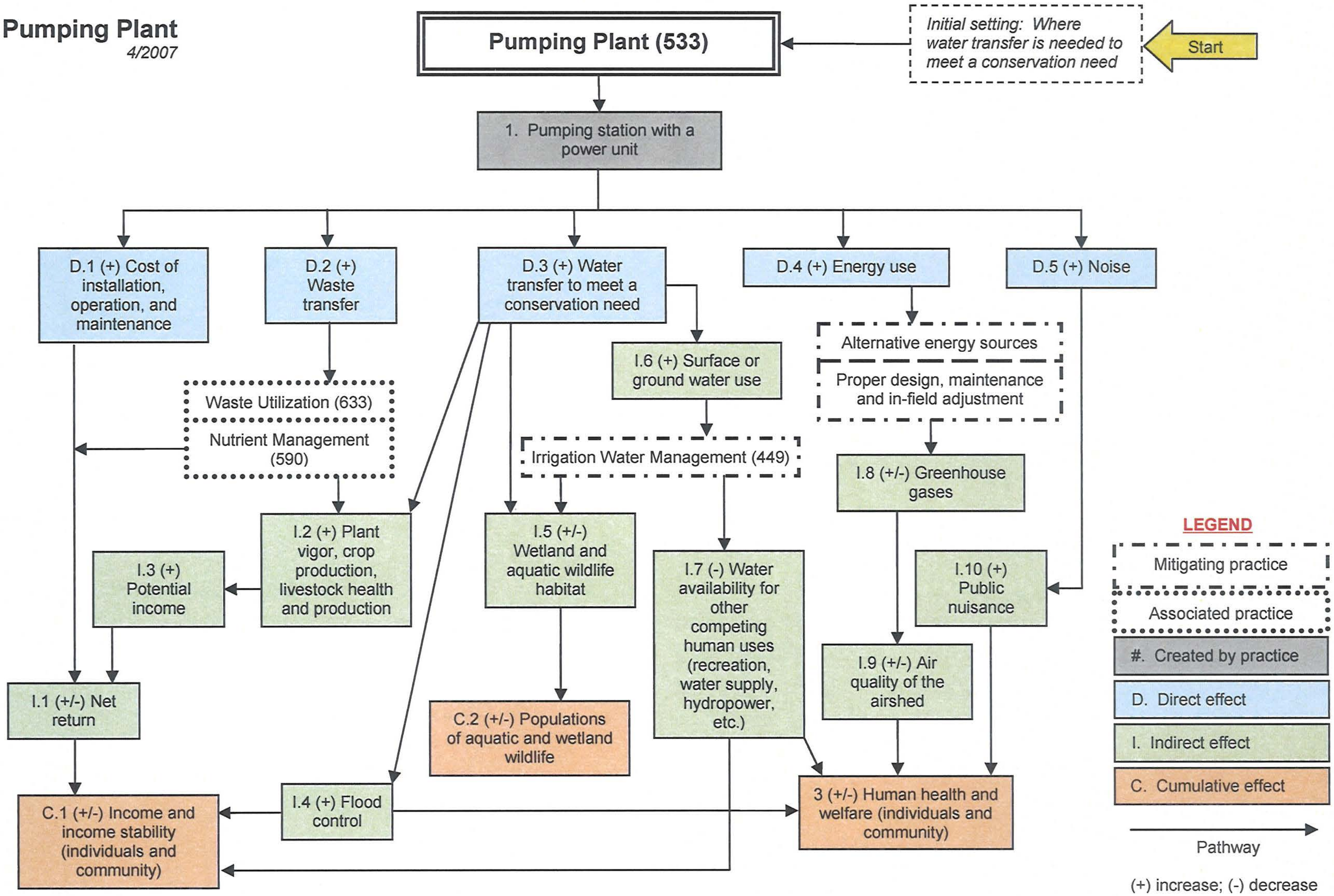
Pumping Plant is commonly used in a Conservation Management System with Irrigation Water Conveyance (428), Irrigation System (441, 442, 443, 447), Pipeline (516), Watering Facility (614), Waste Transfer (634).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Pumping Plant

4/2007



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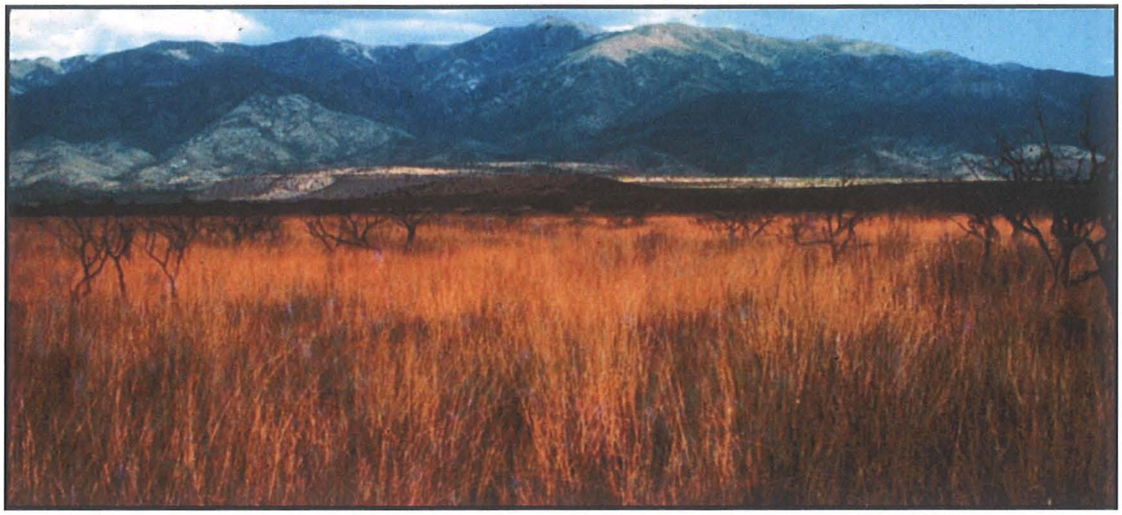
RANGE PLANTING

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 550



RANGE PLANTING

Range planting is establishment of adapted perennial vegetation.

PRACTICE INFORMATION

This practice applies to rangeland, native or naturalized pasture, grazed forest, or other suitable land areas where the principle method of vegetation management is grazing.

Vegetation types might be grasses, legumes, shrubs, forbs, shrubs, and trees.

The practice applies where desirable vegetation is below the acceptable level for natural reseeding to occur or where the potential for enhancement of the vegetation by grazing management is unsatisfactory.

Species, cultivars, or varieties selected must be compatible with management objectives and adapted to climatic conditions, soil, landscape position, and range site. In addition, the selected species for planting must provide adequate cover for erosion control. Plants selected for establishment should also contribute to wildlife and aesthetics when opportunities exist and are in line with planning objectives.

Plant establishment requires the following:

- Proper seedbed preparation
- Observation of recommended planting dates
- Planting at the recommended rate or spacing
- Using quality seed and plant material
- Apply recommended soil amendments and fertilizer
- Control weeds and grazing during establishment period

COMMON ASSOCIATED PRACTICES

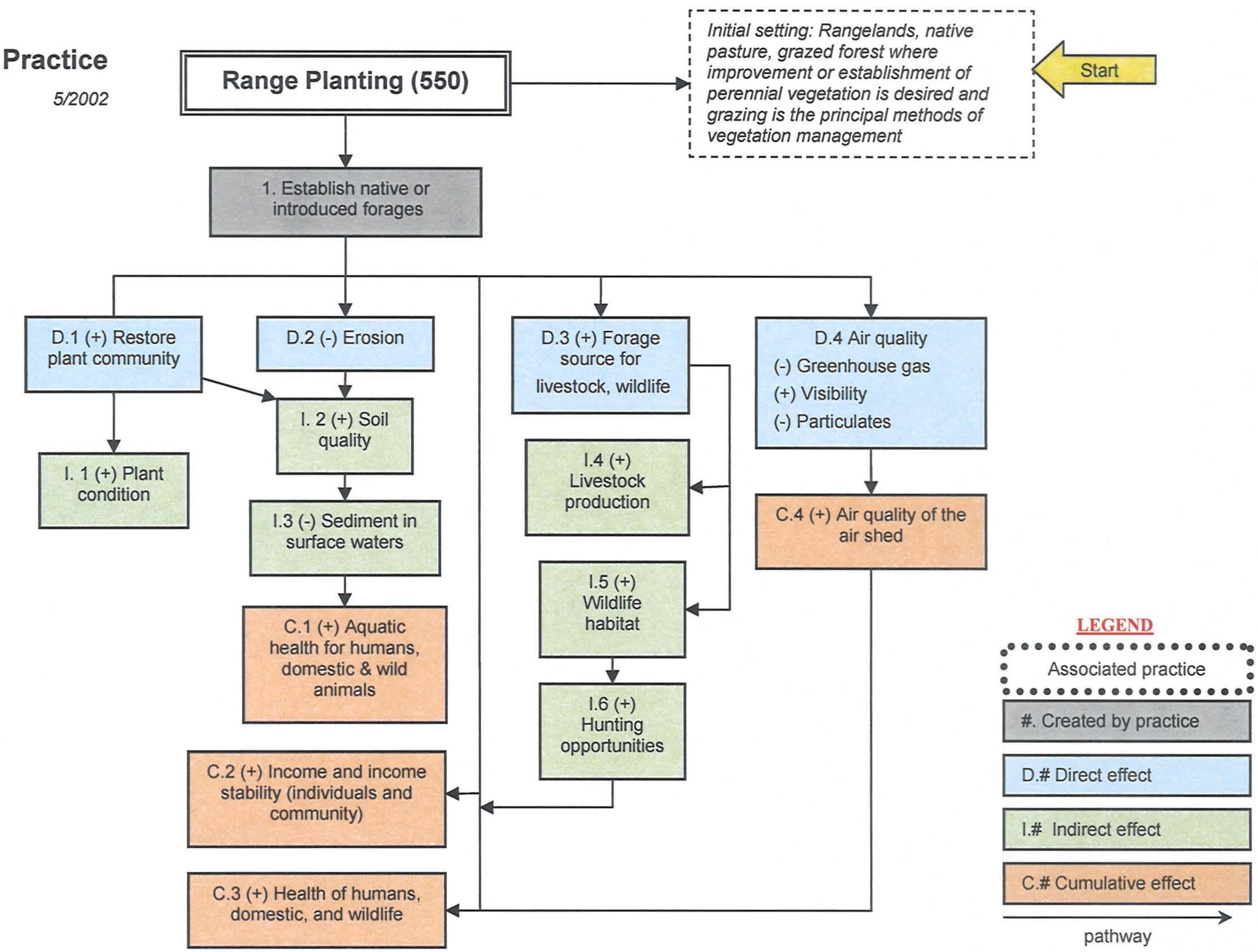
Other conservation practices such as Brush Management (314), Grazing Land Mechanical Treatment (548), Prescribed Burning (338), and livestock watering systems may be needed as part of a Conservation Management System to promote establishment and management of a successful range planting.

Refer to the practice standard in the local Field Office Technical Guide and associated specifications and Job Sheets for further information.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Range Planting Practice

5/2002



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August 2008

SPRING DEVELOPMENT

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 574

SPRING DEVELOPMENT

Spring development is improving springs and/or seeps by excavating, cleaning, capping, or providing collection and storage facilities.

PRACTICE INFORMATION

The purpose of spring development is to improve distribution of water for livestock, recreation, and wildlife. The practice also applies to irrigation when the quantity and quality of water are suitable for irrigating crops. Spring development involves cleaning and/or enlarging the discharge opening of the spring. Other appurtenances might be needed such as a collection device to channel the water and a spring box to provide a small amount of storage, as well as a sediment trap and connection point for an outlet pipe(s). The outlet pipe(s) may then lead to a storage facility such as a trough or tank.

Prior to spring development, an investigation of site conditions must be completed including ecological functions and potential losses to these functions that may occur. Consideration should be given to how diversion of water from the spring may affect streamflow in the watershed and whether the spring can be developed to preserve conditions that support unique habitats in the landscape.

COMMON ASSOCIATED PRACTICES

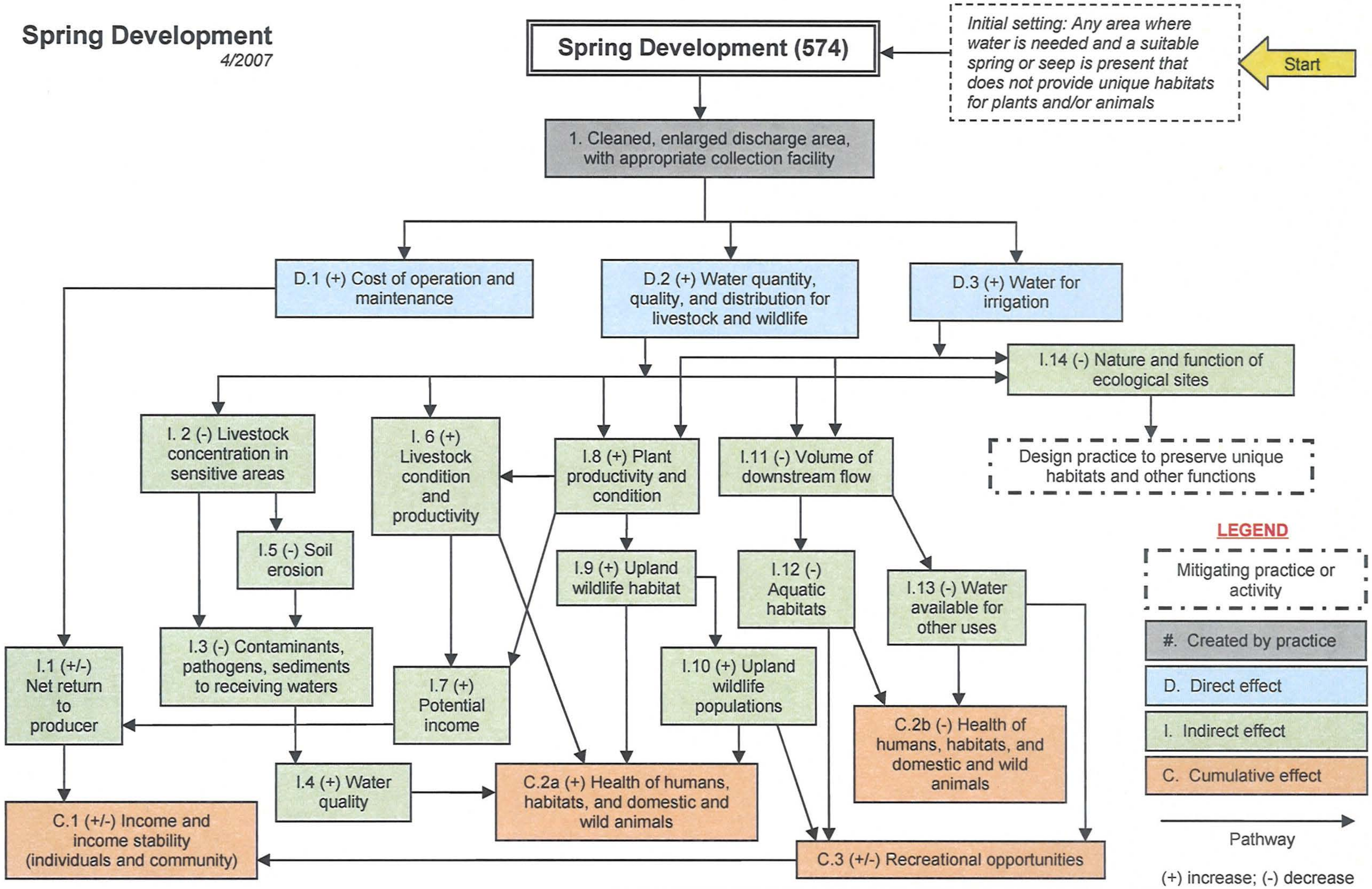
Spring Development is commonly used in a Conservation Management System with practices such as Watering Facility (614), Pipeline (516), Irrigation Water Management (449), and Critical Area Planting (342).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Spring Development

4/2007



Notes:

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The scope of the practice implementation and resulting effects are limited to those described in the "initial setting." If unique habitats supporting plant and animal species exist in a spring to be developed, particularly where there have been numerous disruptions of similar habitats across the landscape, impacts upon the habitat and options for development to preserve unique ecological functions may need to be evaluated in a site-specific EA. Various regulations and policies for the protection of wetlands should also be considered.

The diagram above identifies the effects expected to occur when this practice is applied according to NRCS practice standards and specifications. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowners and are presumed to have been obtained. All income changes are partially dependent upon market fluctuations which are independent of the conservation practices. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

July 2008

STREAMBANK AND SHORELINE PROTECTION

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 580

STREAMBANK AND SHORELINE PROTECTION

Streambank and shoreline protection is the stabilization and protection of streambanks, constructed channels, and shorelines of lakes, reservoirs, or estuaries.

PRACTICE INFORMATION

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion.

The purpose(s) of this practice include:

- Preventing the loss of land or damage to land uses or other facilities adjacent to the banks
- Protecting historical, archeological, and traditional cultural properties, while accommodating the natural fluvial processes within the stream segment and shoreline reach
- Maintaining the flow or storage capacity of the water body
- Reducing the offsite or downstream effects of sediment resulting from bank erosion
- Improving or enhancing the stream corridor for fish and wildlife habitat, aesthetics, and recreation

Various materials may be used for protection of streambanks and shorelines. An extensive site assessment must be conducted to determine, among other factors, if the causes of instability are local or systemic in nature. This information is used in selecting the most appropriate treatment to achieve the desired objectives. Treatments must be functional and stable for the design flow and sustainable for higher flow conditions.

COMMON ASSOCIATED PRACTICES

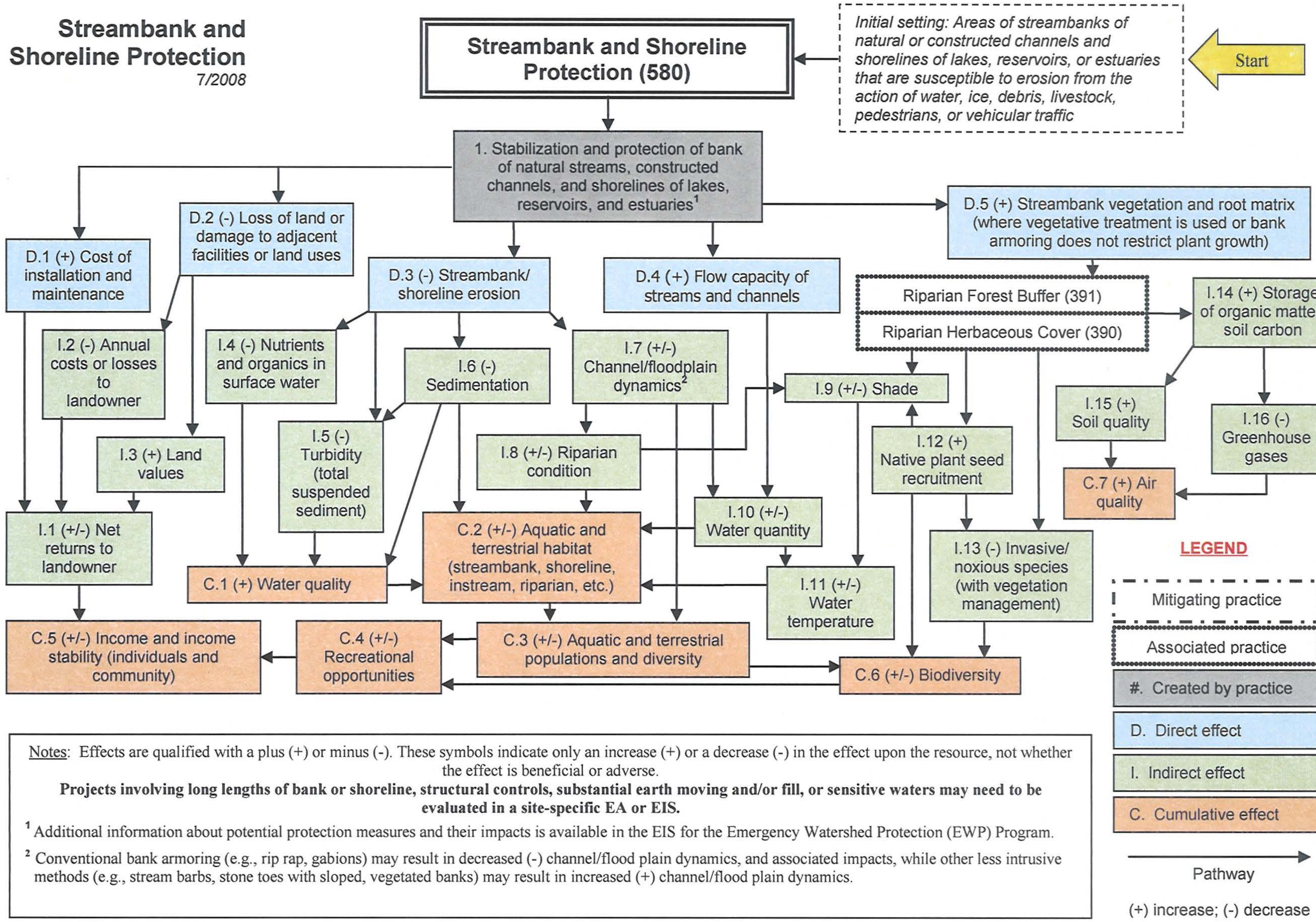
Streambank and Shoreline Protection is commonly used in a Conservation Management System with various conservation practices including Riparian Forest Buffer (391), Riparian Herbaceous Buffer (390), Critical Area Planting (342), Fish Passage (396), Pipeline (516), Fence (382), Use Exclusion (472), and Watering Facility (614).

Refer to the practice standard in the local Field Office Technical Guide and associated Job Sheets for further information.

The following page identifies the effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowner and are presumed to have been obtained. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Streambank and Shoreline Protection

7/2008



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Projects involving long lengths of bank or shoreline, structural controls, substantial earth moving and/or fill, or sensitive waters may need to be evaluated in a site-specific EA or EIS.

[1] Additional information about potential protection measures and their impacts is available in the EIS for the Emergency Watershed Protection (EWP) Program.

[2] Conventional bank armoring (e.g., rip rap, gabions) may result in decreased (-) channel/flood plain dynamics, and associated impacts, while other less intrusive methods (e.g., stream barbs, stone toes with sloped, vegetated banks) may result in increased (+) channel/flood plain dynamics.

The diagram above identifies the effects expected to occur when this practice is applied according to NRCS practice standards and specifications. These effects are subjective and somewhat dependent on variables such as climate, terrain, soil, etc. All appropriate local, State, Tribal, and Federal permits and approvals are the responsibility of the landowner and are presumed to have been obtained. All income changes are partially dependent upon market fluctuations which are independent of the conservation practices. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

August 2008

STRUCTURE FOR WATER CONTROL

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 587

STRUCTURE FOR WATER CONTROL

A structure for water control is placed in irrigation, drainage, or other water management systems to convey water, control the direction or rate of flow, or maintain water surface elevation.

PRACTICE INFORMATION

Structures for water control are used to control the stage, discharge, distribution, delivery, or direction of flow of water in open channels or water use areas. They are also used for water quality control, such as sediment reduction or temperature regulation, or for protection of fish and wildlife and other natural resources.

Water control structures are used as outlets on cranberry bogs and irrigation pits to manage the level of water for harvesting, winter flooding, trash removal, pest control or other purposes. When used to control the division of chemigation water, this practice will reduce the amount of suspended chemicals attached to organic material and soil particles entering surface waters. It allows for the biological treatment of dissolved chemicals when water is detained in the system for the required holding period. Chemicals that remain in the system may be bound up in the soil organic matter; however, soils that are low in organic matter may have a tendency to allow for the leaching of dissolved chemicals into the ground water.

COMMON ASSOCIATED PRACTICES

Structure for Water Control is commonly used in Conservation Management Systems with Dike (356), Open Channel (582), Land Smoothing (466), Shallow Water Development and Management (646), Wetland Wildlife Habitat Management (644), Wetland Enhancement (659), or Wetland Restoration (657).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

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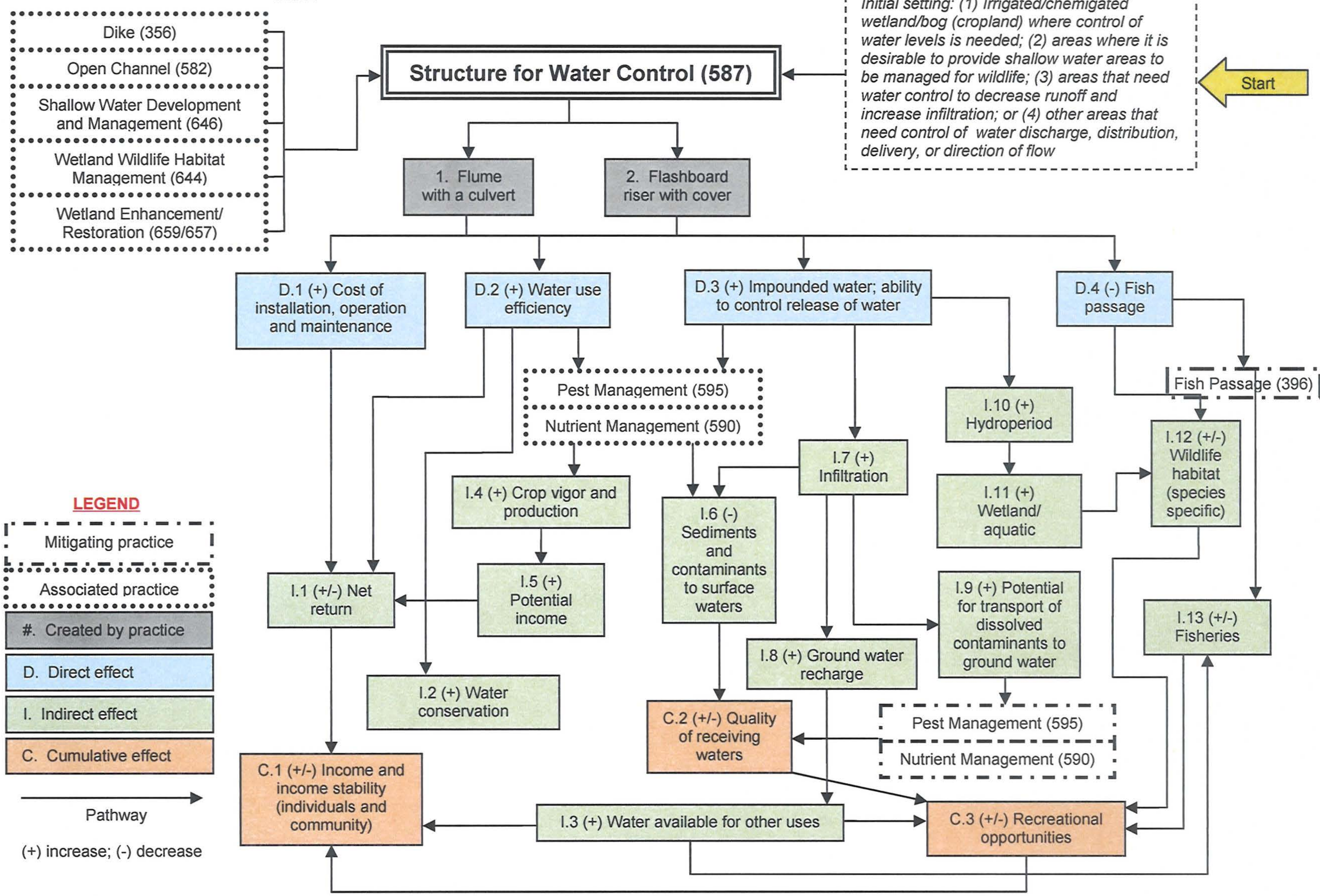
Structure for Water Control

4/2007



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TREE/SHRUB ESTABLISHMENT

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 612

TREE/SHRUB ESTABLISHMENT

Tree and shrub establishment is establishing woody plants by planting seedlings, cuttings, direct seeding or natural regeneration.

PRACTICE INFORMATION

The purposes of the practice include:

- Forest products
- Beautification
- Erosion control
- Energy conservation
- Chemical/nutrient sink for water quality improvement
- Wildlife habitat improvement
- Air quality improvement
- Wetland improvement

This practice is applicable on any site where woody plants are suited. Site adaptation is a major consideration for success in establishing trees and shrubs. Careful consideration should also be given to the suitability of the selected species for the planned purpose and available space for growth.

COMMON ASSOCIATED PRACTICES

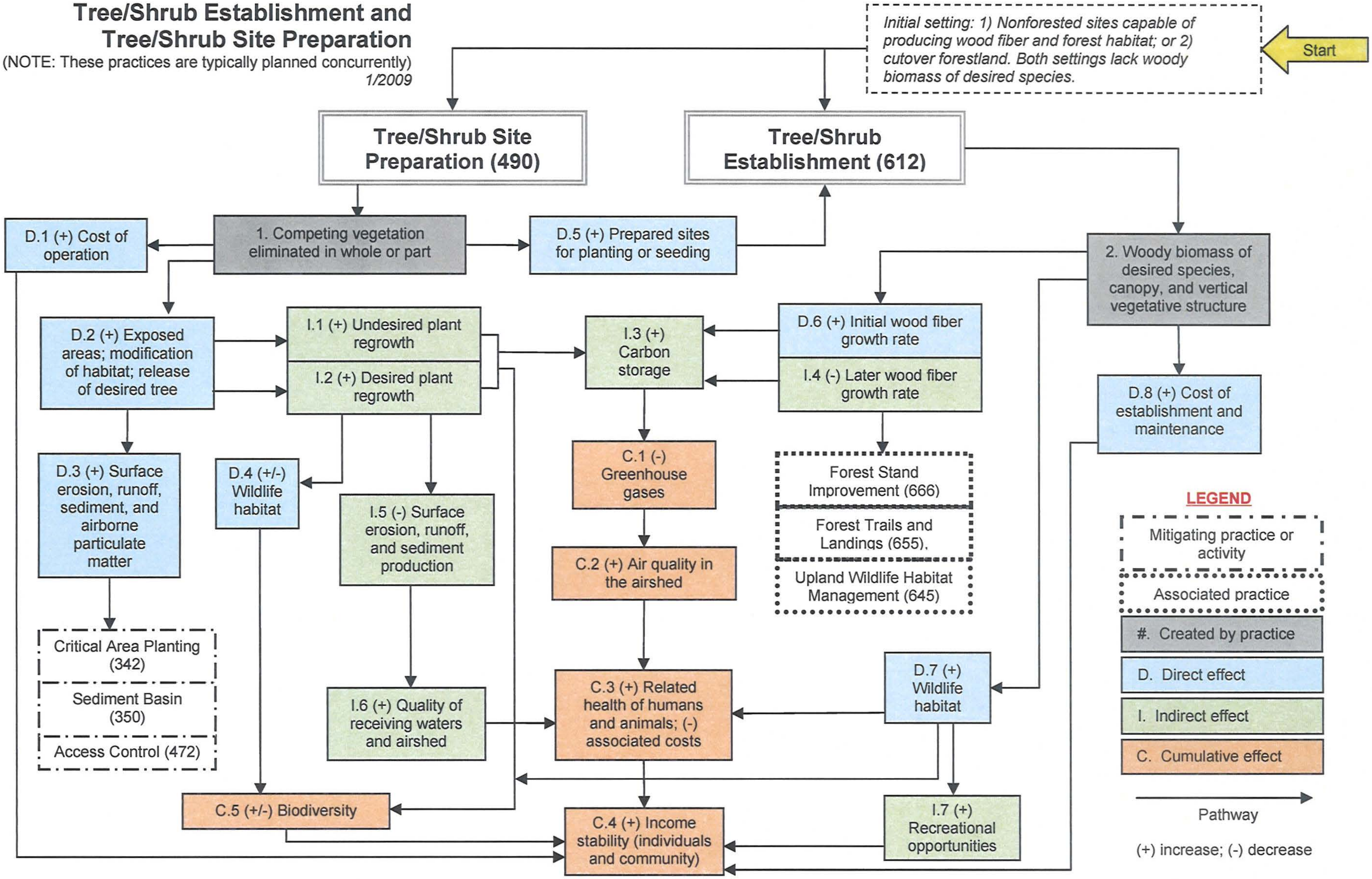
Tree/Shrub Establishment is commonly applied as part of a Conservation Management System and most always with Tree/Shrub Site Preparation (490) preceding it. Other associated practices may include Forest Stand Improvement (666), Forest Trails and Landings (655), Upland Wildlife Habitat (645), Critical Area Planting (342), Sediment Basin (350), Pest Management (595) and Use Exclusion (472).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

The following page identifies the conservation effects expected to occur when this practice is applied. These effects are subjective and somewhat dependent on variables such as climate, terrain, and soil. Users are cautioned that these effects are estimates that may or may not apply to a specific site.

Tree/Shrub Establishment and Tree/Shrub Site Preparation

(NOTE: These practices are typically planned concurrently)
1/2009



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August 2008

WATERING FACILITY

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 614

WATERING FACILITY

A watering facility is a trough or tank installed as a livestock watering facility.

PRACTICE INFORMATION

A watering trough or tank provides livestock with drinking water at planned locations that will protect vegetative cover through proper distribution of grazing or other management techniques. The water source(s) may be a well, spring, stream, pond, or other sources including water hauling, in some situations.

In addition to providing livestock water, troughs are sometimes installed to keep cattle out of streams and other surface water areas where water quality is a concern.

COMMON ASSOCIATED PRACTICES

Watering Facility is commonly used as part of a Conservation Management System with practices such as Water Well (642), Pipeline (516), Spring Development (574), and Prescribed Grazing (528).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated specifications and job sheets.

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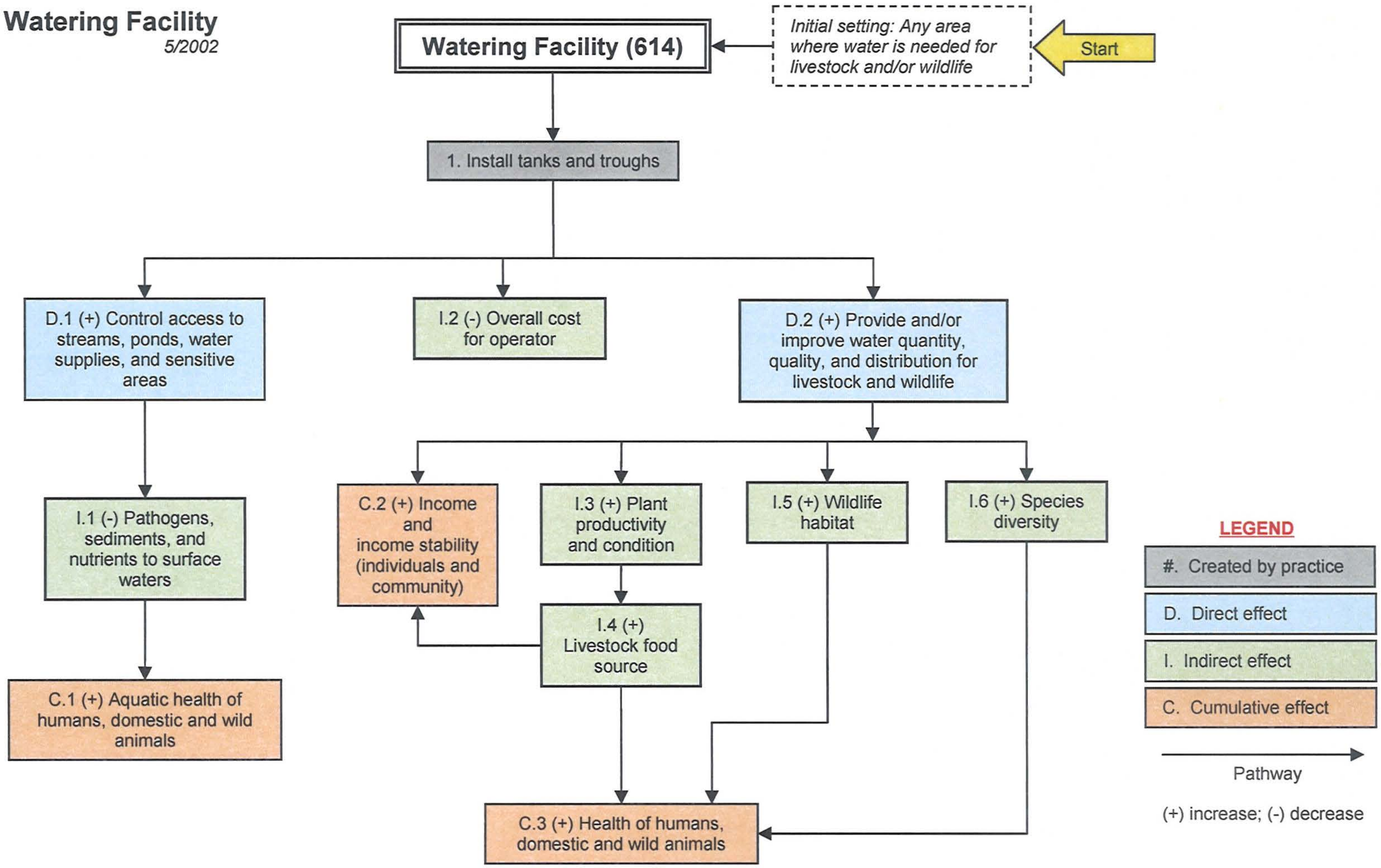
Watering Facility
5/2002



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WATER WELL

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 642

WATER WELL

A water well is a hole drilled, dug, driven, bored, jetted, or otherwise constructed to an aquifer to provide water for livestock, wildlife, irrigation, human, and other uses.

PRACTICE INFORMATION

This practice applies on all sites where the underground supply of water is sufficient in quantity and quality for the intended purpose. Monitoring or observation wells or wells installed for injection purposes are not included.

This practice requires proper design and installation to function properly. If practicable, wells should be located in higher ground and up gradient from sources of contamination or flooding. The potential for adverse interference with existing nearby production wells should be evaluated in planning. Other concerns that should be considered in planning include the potential for ground water overdraft; the long-term safe yield of the aquifer and potential effects of installation; and operation of the well on cultural, historical, archeological, or scientific resources at or near the site.

COMMON ASSOCIATED PRACTICES

Once a well has been installed, a distribution system, watering system, and/or irrigation system are usually needed.

Water Well is commonly used in Conservation Management Systems with practices such as Pumping Plant (533), Pipeline (516), Watering Facility (614), and the Irrigation System practices.

For further information, refer to the practice standard in the local Field Office Technical Guide and associated job sheets.

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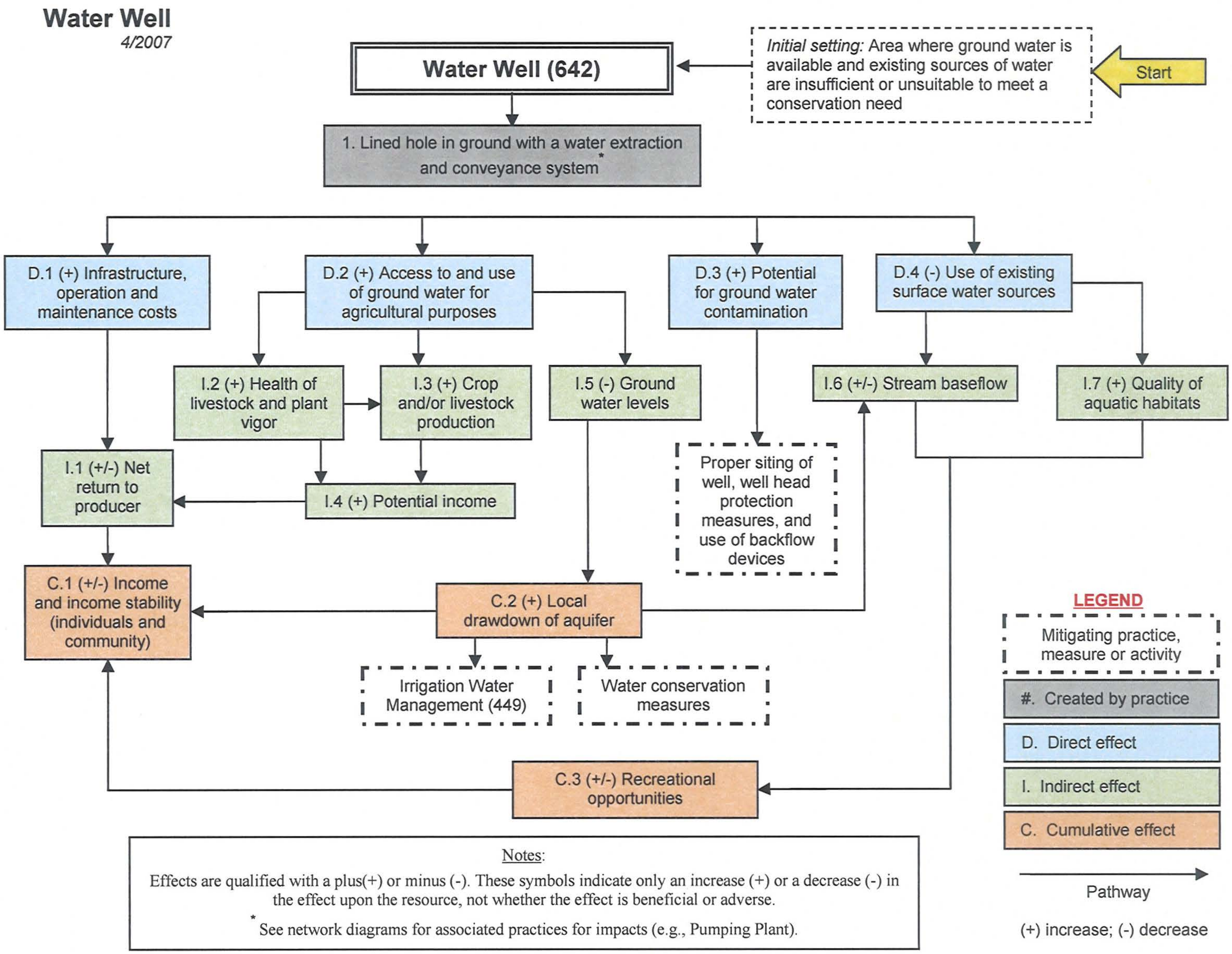

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September 2010

WETLAND ENHANCEMENT

PRACTICE INTRODUCTION

USDA, Natural Resources Conservation Service—Practice Code 659

WETLAND ENHANCEMENT

Wetland Enhancement is the rehabilitation or re-establishment of a degraded wetland, and/or the modification of an existing wetland to favor specific wetland functions.

PRACTICE INFORMATION

This practice applies on any degraded or non-degraded existing wetland where the objective is specifically to enhance selected wetland functions. This practice is not used on degraded wetlands when the soils, hydrology, vegetative community, and biological habitat are returned to original conditions or where a wetland is created on a site that historically was not a wetland.

The purpose of this practice is to provide specific wetland conditions by:

- Hydrologic enhancement (depth duration and season of inundation, and/or duration and season of soil saturation)

  and/or

- Vegetative enhancement (including the removal of undesired species, and/or seeding or planting of desired species).

Native vegetative species should be used in the enhancement whenever possible. Manipulation of water levels can be used to control unwanted vegetation. Haying or grazing can also be used to manage vegetation.

COMMON ASSOCIATED PRACTICES

Wetland Enhancement is commonly used in a Conservation Management System with the following practices: Dike (356), Structure for Water Control (587), Fence (382), Fish Passage (396), Pipeline (516), Pond (378), and Use Exclusion (472).

For further information, refer to the practice standard in the local Field Office Technical Guide and associated job sheets.

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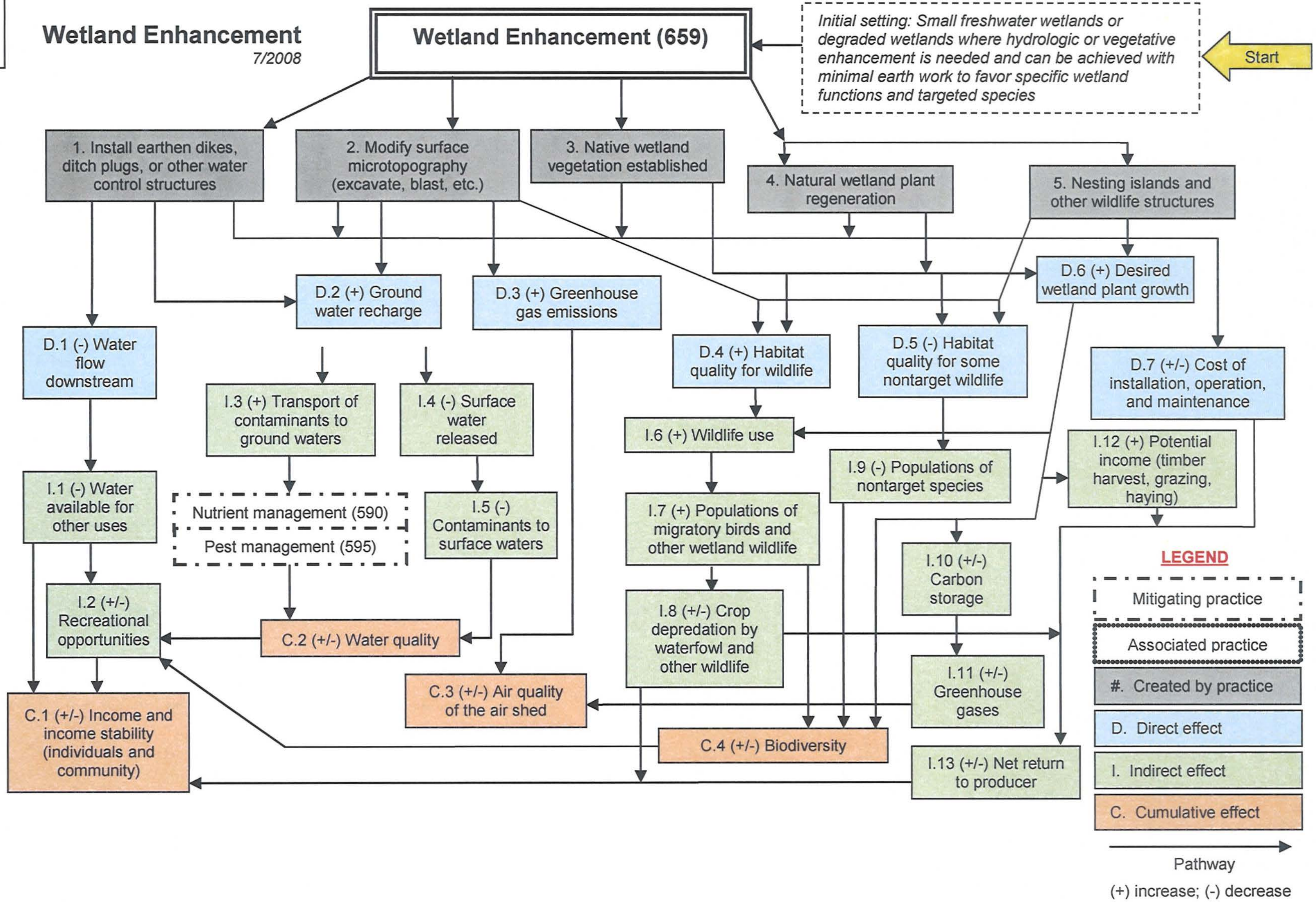
I.5 (-)
Contaminants
to surface
waters

Wetland Enhancement

7/2008



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The scope of the practice implementation and resulting effects are limited to those described in the "initial setting." Larger wetland projects requiring substantial earth work or involving marshes or other brackish waters may need to be evaluated in a site-specific EA.

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